Describing and Remembering Motion Events in British Sign Language

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To the many tailwinds in my life

DECLARATION

This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration. It is not substantially the same as any that I have submitted or is being concurrently submitted for a degree or diploma or other qualification at the University of Cambridge or any other University or similar institution. I further state that no substantial part of my dissertation has already been submitted or is being concurrently submitted for any such degree, diploma or other qualification at the University of Cambridge or any other University or similar institution. In accordance with the Faculty of Modern and Medieval Languages guidelines, this thesis does not exceed 80,000 words.

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Abstract

Motion events are ubiquitous in conversation, from describing a tiresome commute to recounting a burglary. These situations, where an entity changes location, consist of four main semantic components: Motion (the movement), Figure (the entity moving), Ground (the object or objects with respect to which the Figure carries out the Motion) and Path (the route taken). Two additional semantic components can occur simultaneously: Manner (the way the Motion occurs) and Cause (the source of/reason for the Motion). Languages differ in preferences for provision and packaging of semantic components in descriptions. It has been suggested, in the thinking-for-speaking hypothesis, that these preferences influence the conceptualisation of events (such as their memorisation). This thesis addresses questions relating to the description and memory of Motion events in British Sign Language (BSL) and English. It compares early BSL (acquired before age seven) and late BSL (acquired after age 16) descriptions of Motion events and investigates whether linguistic preferences influence memory. Comparing descriptions by early signers and late signers indicates where their linguistic preferences differ, providing valuable knowledge for interpreters wishing to match early signers. Understanding how linguistic preferences might influence memory contributes to debates around the connection between language and thought.

The experimental groups for this study were: deaf early BSL signers, hearing early BSL signers, deaf late BSL signers, hearing late BSL signers and hearing English monolinguals. Participants watched target Motion event video clips before completing a memory and attention task battery. Subsequently, they performed a forced-choice recognition task where they saw each target Motion event clip again alongside a distractor clip that differed in one semantic component. They selected which of the two clips they had seen in the first presentation. Finally, participants were filmed describing all of the target and

distractor video clips (in English for English monolinguals and BSL for all other groups). The Motion event descriptions were coded for the inclusion and packaging of components. Linguistic descriptions were compared between languages (English and BSL) and BSL group. Statistical models were created to investigate variation on the memory and attention task battery and the recognition task.

Results from linguistic analysis reveal that English and BSL are similar in the components included in descriptions. However, packaging differs between languages. English descriptions show preferences for Manner verbs and spatial particles to express Path ('run out'). BSL descriptions show preferences for serial verb constructions (using Manner and Path verbs in the same clause). The BSL groups are also similar in the components they include in descriptions. However, the packaging differs, with hearing late signers showing some English-like preferences and deaf early signers showing stronger serial verb preferences. Results from the behavioural experiments show no overall relationship between language group and memory. I suggest that the similarity of information provided in English and BSL descriptions undermines the ability of the task to reveal memory differences. However, results suggest a link between individual linguistic description and memory; marking a difference between components in linguistic description is correlated with correctly selecting that component clip in the recognition task. I argue that this indicates a relationship between linguistic encoding and memory within each individual, where their personal preference for including certain semantic components in their utterances is connected to their memory for those components. I also propose that if the languages were more distinct in their inclusion of information then there may have been differences in recognition task scores. I note that further research is needed across modalities to create a fuller picture of how information is included and packaged cross-modally and how this might affect individual Motion event memory.

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List of Abbreviations and Acronyms

ASL – American Sign Language

Auslan – Australian Sign Language

BSL – British Sign Language

DGS – Deutsche Gebärdensprache (German Sign Language)

EEG – Electroencephalogram

ERPs - Event-related Brain Potentials

GLM – Generalised Linear Model

HKSL – Hong Kong Sign Language

IPSL – Indo-Pakistani Sign Language

KSL – Korean Sign Language

LSF – Langue des Signes Française (French Sign Language)

fMRI - Functional magnetic resonance imaging

L1 – First language

L2 – Second language

NGT – Nederlandse Gebarentaal (Dutch Sign Language)

NS – Nihon Shuwa (Japanese Sign Language)

NSL – Nicaraguan Sign Language

NZSL – New Zealand Sign Language

S-language – Satellite-framed language

TİD - Türk İşaret Dili (Turkish Sign Language)

TSL – Taiwan Sign Language

V-language – Verb-framed language

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1 INTRODUCTION

1.1 Background to Research

The conceptualisation of events provided through language is heavily influenced by the vocabulary and grammar used. For example, Loftus & Palmer (1974) found that simply changing one verb in a question about witnessing a car crash influenced the perceived severity and speed of the crash. Participants who were asked how fast they thought a car had been driving when it ‘crashed’ estimated an average of around 40 miles per hour, while those asked how fast the car had been going when it ‘collided’ estimated an average of around 30 miles per hour. Burt & Popple (1996) also found that time estimates could be altered through vocabulary choice. They report that participants estimated shorter time durations of a staged event that they had witnessed when the verb ‘running’ was used as opposed to ‘walking’. Similarly, Burt (1999) was able to manipulate participants’ perceived length of a described robbery by varying eight action descriptors in a witness statement (for example, by changing ‘march’ to ‘jog’ and ‘climbed’ to ‘leapt’). More recently, Fausey & Boroditsky (2010) report that switching intransitive for transitive verbs in accident descriptions raises the perceived blame of the agent and also increases the suggested financial penalties. These effects were found even when participants were shown videos of events prior to reading the written descriptions.

Motion events, situations where an entity moves location, are frequently used in forensic settings (such as in witness testimonies) and in medical circumstances (like describing how an injury occurred). If grammatical structure and vocabulary choice can influence important judgments, such as blame or financial liability, then it is vital to understand how languages differ in their descriptions of Motion events. Understanding this difference is especially vital in the area of language interpretation. Interpreters are supposed to be an unobtrusive means of delivering narrative. However, if grammatical structures or linguistic preferences differ in the two languages that they are interpreting between, they may inadvertently misrepresent or contort the original meaning by using the preferred structure of one language in the other. Filipović (2007) reports on the interpretation of Motion events from Spanish into English during police interviews by court interpreters. She provides examples of misleading translations by interpreters based on differences in the typical structure of Motion event descriptions in Spanish and English. For example, a Spanish speaker was describing being pursued by a group and used phrases such as 'se metió' ('he put himself') and 'salió' ('he exited'). When the interpreter rendered the narrative into English, he used the verb 'to run' with various spatial particles (like 'ran into' and 'ran up') to translate the description, based on the linguistic preferences of English and the assumption that a chase would involve running. Later in the police interview it transpired that some of the pursuers had actually been on bicycles, making the use of 'ran' inaccurate and misleading. Translating Motion events between a spoken and a signed language could be seen as particularly problematic as interpreters must move information between a primarily linear spoken modality (there may also be optional simultaneous gesture in the visual modality) and a three-dimensional spatial modality.

1.2 Justification of Research

This study aims to address questions relating to the description and conceptualisation of Motion events in British Sign Language (BSL) and English. It will unveil the differences between early (BSL acquired before age seven) and late (BSL acquired after age 16) descriptions of Motion events in BSL. It will also investigate whether having a sign language may influence the way one views and remembers components of Motion events.

Investigating the description of Motion events by early BSL signers and late BSL signers will reveal where late BSL users commonly differ from early signers. This will be a valuable source of learning for interpreters in forensic and medical settings where differences could have significant and serious repercussions. Sign languages have the potential to provide more detailed spatial information than is possible in a spoken language due to the difference in modalities. Therefore, understanding how knowledge of a sign language might influence memory for Motion events will contribute to debates around Linguistic Relativity (the suggestion that language influences a person's perception of the world). Discovering that Motion event memory is enhanced through knowledge of a sign language could also provide an encouragement for more bimodal bilingualism. This study is essential for understanding more about how different groups use BSL and how use of a sign language may influence memory for Motion events.

1.3 Outline of Research

This study will create a better understanding of how late BSL signers differ from early BSL signers in their description of Motion events. Five groups of participants (deaf early BSL signers, hearing early BSL signers, deaf late BSL signers, hearing late BSL signers and monolingual English-speaking non-signers) will take part in this study. These participants will be asked to describe a set of Motion event video clips in either English (for English monolinguals) or

BSL (for all other groups). Their Motion event descriptions will be analysed for which components of the Motion events are included and how the information is packaged in the utterances. Descriptions will be compared across groups to see if BSL groups differ, including investigating whether acquiring BSL early/late affects BSL signing and whether, for hearing participants, English influences their BSL signing. Filipović (2007, p.254) notes of Spanish-English interpreters and native Spanish speakers providing witness statements that 'it would be interesting to see whether the interpreters, when they add the Manner component, and the witnesses, when they omit it, actually share the same mental imagery of the situation.' By asking monolingual English speakers, early BSL signers and late BSL signers to describe the same scenes in this study, some of the ambiguity of the mental image is removed. The descriptions will reveal what the preferred structures are for describing the same event and allow comparison of like for like.

This study will also investigate whether knowledge of BSL is linked to improved memory for components of Motion events. Participants (the same groups as described previously) will take part in a recognition memory task. Having seen a set of Motion event video clips they will be asked, after twenty minutes, to watch a second set of Motion event video clips and to select which video clips they have seen previously. Accuracy scores for this task will be compared across groups to give an insight into whether knowledge of BSL influences memory for Motion events.

1.4 Potential Limitations

Difficulties arise in BSL research in the area of recruitment. BSL users make up a small proportion of the UK population. An estimate derived from the 2011 Scottish Census suggests that there are 151,000 individuals in the UK who use BSL in the home, regardless of age of acquisition or hearing status (British Deaf Association, 2018). Therefore, due to the smaller population of language users, the number of participants in BSL studies is often lower than in spoken language counterparts. A second related issue is how inclusion criteria for recruitment may differ when investigating sign languages. Deaf children frequently have hearing non-signing parents and BSL is often acquired later than spoken languages because of this. Therefore inclusion criteria (such as age of acquisition) can be less restricted in sign language research than in spoken language research (for example, studies may include signers who learned the language in early childhood, not just signers who were exposed to the language from birth and have parents who were exposed to the language from birth). Finally, one way that sign languages differ significantly from spoken languages is that the majority of sign language users are deaf. It is important, therefore, to separate which abilities are a result of a person's deafness and which are due to their language. In this particular study, participants include deaf early signers (learned BSL in the home before age seven) and deaf late signers (learned BSL after age 16) as well as hearing early signers (learned BSL in the home before age seven) and hearing late signers (learned BSL after age 16) to ensure that the results reported can be accurately attributed. These issues will be considered in detail in Chapter 5. However, it is important to keep these limitations in mind throughout the study.

1.5 Key Conventions & Considerations

In order to understand research relating to sign languages, one must be familiar with some basic sign language conventions and this will be addressed in the following section.

When referring to signs within the text, the closest English translation will be shown capitalised (for example, BOY or TREE). Some signs may require more than one English word for translation and these will be capitalised with hyphens between the words (for example, JUMP-UP). Many signs have multiple possible English translations and, in these cases, translations have been agreed with a native BSL signer. These in-text references can only provide translations of signs and do not contain any information about the sign's motion, location or handshape. There are numerous systems for coding the latter information (such as the Hamburg Notation System, Hanke, 2004; SignFont, Newkirk, 1987; Stokoe Notation, Stokoe, Casterline & Croneberg, 1965 and SignWriting, Sutton, 2010) but, as Morgan (2005) notes, these systems are by no means universal. They are also difficult to immediately interpret, requiring some knowledge and a great deal of attention from the reader. Therefore this study will use illustrations of signs in the form of photographs with annotation (see Appendix 1).

As well as conventions for terminology, there are other considerations related to studying a sign language. Some misconceptions related to sign languages must be addressed before a fuller understanding of sign language research can be reached. A common misconception among those unfamiliar with the deaf community is that sign languages are mutually intelligible or that there is just one sign language that acts as a global language. It is difficult to estimate the number of sign languages globally because many have not received language status in their various countries. However, Ethnologue, an ongoing project that aims to catalogue all the world's languages, lists 140 different sign languages recorded so far (Simons & Fennig, 2017). As with spoken languages, there may be more than one sign language used in a country so, for example, both Spanish Sign Language and Catalan Sign Language are used in Spain. However, countries that share a spoken language may not share a sign language. For example, the USA, the UK and the Republic of Ireland share English as their main spoken language but have different sign languages (American Sign Language, BSL and Irish Sign Language, respectively). Although this study concentrates on BSL, my review of previous literature will include studies that have investigated other sign languages besides BSL. This is not intended to imply that certain features of one sign language (lexis, grammar or particular handshapes, for example) can be assumed to hold true for all sign languages. Instead it is intended to show how previous studies have adapted methodologies to investigate sign languages or to compare signed and spoken modalities.

Although this study will be investigating differences between modalities, it is important to remember that sign languages and spoken languages are similar in many ways. For example, sign languages have a tip-of-the-finger phenomenon much like the spoken tip-of-the-tongue phenomenon (Thompson, Emmorey & Gollan, 2005). There are dialects and regional varieties within sign languages (Quinn, 2010). Factors such as age, gender and living in an urban setting also influence the way signs are produced, much like the sociolinguistics of spoken languages (Lucas, Bayley, Rose & Wulf, 2002; Schembri et al, 2009). Morgan (2006) also notes that early child signing broadly follows universal tendencies in language acquisition, exhibiting sign reduplication and cluster reduction. It should be evident from the findings above then that, despite a difference in modality, sign languages are natural languages that are equal and comparable to spoken languages and exhibit many similar features.

One way that spoken languages and sign languages are comparable, which will be important to understanding the current study, is their phonology. Phonology in spoken language focuses on contrastive units of sound (phonemes) and leads to the formulation of rules for how these are used. Phonemes in spoken languages can contrast in various ways, such as place of articulation or voicing. Contrasts are considered meaningful in a particular language if minimal pairs are found, where two words differ in only one phonemic feature. Phonemic contrasts create different morphemes that can be used for grammatical means, such as adding past tense endings ([t], [d] or [ɪd]) or plural markers ([s], [z] or [ɪz]) in English. The same concepts apply to sign languages, where phonemes may be contrastive in various ways and these contrasts can be used to form different morphemes for grammatical means. Analysis by various researchers (Brentari, 1998; Stokoe, Casterline & Groneberg, 1965; Sutton-Spence & Woll, 1999) suggests that signs have five parameters:

1. Location: The location parameter is equivalent to spoken place of articulation but, instead of positions along the vocal tract, locations are the body parts (or position in the space around a signer) where a sign may take place. The same sign produced in two different locations can yield two different meanings (see Image 1, below).
2. Handshape: Handshape is the second parameter. There are numerous possible handshapes and each sign language uses a sub-set of these as meaningful components. When all other parameters are kept the same and just handshape is changed, two different signs can be produced (see Image 2, below).
3. Orientation: The orientation parameter concerns the exact direction in which the palm faces (upwards/downwards, leftwards/rightwards and frontwards/backwards) and a change in orientation again can produce contrastive signs (see Image 3, below).
4. Movement: How the hands move in a sign is also contrastive and this is reflected in the movement parameter (see an example, below, in Image 4). The movement parameter will be of particular relevance to the current study as changes in movement can change the inflection of a sign (for example, fast repeated movements can indicate durative aspect in BSL).
5. Non Manual Features (NMFs): The final parameter is NMFs, which include facial expressions, mouth gestures and lip patterns.

> By adding mouthing of English words a signer can help clarify whether the same sign means GOVERNMENT or GARAGE (see Image 5, below). Facial expressions can also help distinguish between signs, such as DEPRESSED and RELIEVED (see Image 6, below). However, unlike for the four previous suggested parameters (where using the correct location, handshape, orientation and movement is essential to producing a lexical sign), BSL signs can be produced without NMFs and be distinguished through context alone. It would be clear, for example, whether an individual was signing about a garage or a government from the surrounding context.

In this study I will compare how early signers and late signers differ in these parameters during their descriptions of Motion events (for example, which handshapes they select or the movements they use in verbs).

SEE is signed from the eye

TELL is signed from the mouth

Image 1 BSL signs SEE and TELL form a minimal pair for location

PRAISE is signed with thumbs up

CRITICISE is signed with little fingers up

Image 2 BSL signs PRAISE and CRITICISE form a minimal pair for handshape

HEAVY is signed with palms up

BRITAIN is signed with palms down

Image 3 BSL signs HEAVY and BRITAIN form a minimal pair for orientation

PERSON has one downward movement

ITALY moves side-to-side as it moves down

Image 4 BSL signs PERSON and ITALY form a minimal pair for movement

BSL sign for GOVERNMENT and GARAGE

Image 5 BSL signs for GOVERNMENT and GARAGE are only distinguished by English mouthing

DEPRESSED has a sad expression

RELIEVED has a relieved expression

Image 6 BSL signs DEPRESSED and RELIEVED are only distinguished by facial expression

Although spoken languages primarily operate in the auditory modality, speakers can also exploit the visual modality by producing gesture simultaneously (co-speech gesture). It has been argued that much of BSL has origins in gesture (see, for example, Cormier, Quinto-Pozos, Sevcikova & Schembri, 2012). However, gesture and sign languages are not synonymous; gesture is a form of non-verbal communication that can convey simple ideas and may accompany speech while sign languages are full languages capable of expressing complicated concepts. Although gesture is not language in itself, studies into co-speech gesturing have shown different preferences for speakers of different languages. For example, Kita & Özyürek (2003) and Kita et al (2007) conducted cross-linguistic studies on speech and gesture in Turkish, Japanese and English. They report that co-speech gestures followed the language patterns of the speech. Speakers used gestures to include the same elements as in speech and timed the gesture to match what was being spoken about (so a gesture about an object would be made at the same time as the word for that object was spoken, for example). In the current study, co-speech gesture by English speakers is considered part of the overall language and, if produced, will be seen as part of Motion event descriptions.

1.6 Structure of Thesis

This thesis consists of six chapters, including this introduction. The second chapter is a review of the literature focussing on the research most relevant to the current study. It will cover key general theories relating to Motion events, studies of how different sign languages structure Motion event descriptions, research on second language acquisition of Motion event descriptions and studies on how Motion event research contributes to debates around Linguistic Relativity. The third chapter will fully explain the methodology used during this study, including a justification of the research design. Chapter four will outline the results of the current study and chapter five will provide a discussion of these results. The final chapter will conclude what has been discovered through this study and suggest some possible areas of future research.

2 Review of the Literature

2.1 Introduction

This chapter will review key literature in the fields of Motion event research and sign language research. Firstly, I will set out the theories regarding the depiction of Motion events in spoken languages, including: proposed categorisation for language-specific preferences for Motion event descriptions, the early and late acquisition of these preferences and how they may influence conceptualisation, attention and memory. I will then address how existing research has explored various sign languages through these theories.

2.2 Overview of Motion Events

2.2.1 Components of Motion Events

Talmy (2000a, 2000b) suggests that an event is a portion of reality delimited in the human mind from the continuum of space and time. He defines a Motion event as one consisting of four basic semantic components:

1. Motion: the movement of an entity in place or from one location to another

2. Figure: the entity engaged in the Motion
3. Ground: the object(s) with respect to which the Figure carries out the Motion
4. Path: the route followed by the Figure with respect to the Ground

It is possible to identify these semantic components in an utterance referring to a Motion event (see example 1, below, for an utterance in English divided into the four basic semantic components). Utterances can include additional information about an event occurring simultaneously or relating to the focal Motion event, called the Co-event. Co-events can consist of two additional semantic components:

5. Manner: the way in which the Motion occurs
6. Cause: the source of, or reason for, the Motion occurring

Again, it is possible to identify these additional semantic components in Motion event utterances (see example 2, below, for an utterance in English divided into the four basic semantic components and two Co-event semantic components).

(1) The woman goes into the room.
[Figure] [Motion] [Path] [Ground]

(2) The man comes running down the hill, chased by dogs.
[Figure] [Motion] [Manner] [Path] [Ground] [Cause]

Below I give more detailed explanations of the four basic semantic components (Motion, Figure, Ground and Path) and additional Co-event semantic components (Manner and Cause).

2.2.1.1 Motion

Motion is defined as the movement of an entity in place or the movement of an entity from one location to another. Talmy (2000b) calls the first 'self-contained Motion' and the second 'translational Motion'. For a demonstration of the difference between a self-contained Motion event and a translational Motion event in English, see examples 3 and 4, below.

(3) Self-Contained: The bird hovered over the woods.

(4) Translational: The bird flew through the woods.

Pourcel & Kopecka (2005) describe this difference in the terms Motion activity and Motion event. They state that Motion activities have locational semantics (they identify where a movement is taking place) whereas Motion events have directional semantics (they identify where a movement is going). Mani & Pustejovsky (2012) make further distinctions in Motion, dividing Motion four ways:

1. Translation: movement along a path (for example 'the girl walks across the floor')
2. Rotation: movement of a Figure around an axis (for example, 'the girl spins on the floor')
3. Oscillation: periodic movement of the Figure back and forth (for example, 'the girl paces on the floor')
4. Deformation: bending, stretching, and twisting of a Figure (for example, 'the girl twists on the floor')

For Talmy (2000b) the first type of Motion here (translation) is equivalent to his translational Motion event, while the three other types fall under self-contained Motion. Similarly, for Pourcel & Kopecka (2005), the first type is equivalent to their definition of a Motion event and the other three types are kinds of Motion activity. This current study will only investigate the description of translational Motion events.

2.2.1.2 Figure

Figure refers to the entity carrying out the Motion. Talmy (2000a) divides translational Motion events based on the Figure's agentivity:

1. Agentive Motion: The Figure is not the agent of its movement but is instead moved by an external cause. For example in 'the boy rolls the ball down the hill' the ball is both Figure and patient while the boy is the agent of the Motion.
2. Non-agentive Motion: The Figure is not in charge of the Motion and there is no clear cause for the Motion. For example in 'the ball rolls down the hill' the ball is both Figure and patient while there is no clear agent.
3. Self-agentive Motion: The Figure moves voluntarily. For example in 'the boy runs down the hill' the boy is the Figure and the agent.

It is important not to conflate the agent and the Figure. In the utterance 'the man rolled the barrel across the road' it is the barrel, not the man, which is the Figure because it is undergoing the Motion being described. Agentive Motion events and Non-agentive Motion events both involve Cause, whether explicit or not. Although many studies have investigated the different means languages have for expressing both self-agentive and agentive events (Hendriks, Hickmann & Demagny, 2008; Ji, Hendriks & Hickmann, 2011; Tang & Yang, 2007), this study will only address Self-agentive Motion.

2.2.1.3 Ground

Ground is the object (or objects) with respect to which the Figure carries out the Motion. Objects can act as three different types of Ground:

1. Source: The location from which the Figure moves (for example, 'away from the house')
2. Via: The location the Figure moves through to get elsewhere (for example, 'over the fence')
3. Goal: The location towards which the Figure moves (for example, 'towards the tree')

These three types of Ground are associated with different Path predicates, which will be discussed in the next section.

2.2.1.4 Path

Path and Ground are tightly connected as Path may only operate in relation to Ground; Path is the route followed by the Figure with respect to the Ground. However, Talmy (2000b) suggests subdividing Path into three parts, only one of which (Conformation) involves direct contact with Ground:

1. Vector: The main Path element (for example, 'from' or 'along')
2. Deixis: The movement with respect to the speaker (for example, 'towards' or 'away')
3. Conformation: The main geometric schema indicating the relation of Path to Ground (for example, 'into', 'out of' or 'through')

Talmy (2003), when taking into account sign languages, adds two further parts for Path:

4. Direction: The specific movement within three axes of Motion: sagittal (forwards/backwards), lateral (sidewards) and vertical (upwards/downwards). Movement can also be described through more than one axis (for example, describing a Figure going diagonally up and forwards).
5. Contour: The information about the shape of the Path, broadly: straight, arced, circular and meandering. Talmy suggests English prepositions sometimes require specifying a Contour element. For example, in certain contexts 'across' indicates a straight Contour while 'over' indicates an arced Contour. For English speakers 'I walked across the railway tracks' would be preferable for describing a Figure walking across a level crossing (straight Contour), but 'I walked over the railway tracks' would be

preferable for English speakers describing a Figure walking over a railway bridge (arced Contour).

Aske (1989) suggests another way that all Paths can be divided: telicity. He divides Paths into two types:

1. Telic paths: Paths with a specific endpoint.
2. Atelic Paths: Paths that do not include the endpoint of the event, instead focussing on the location in which the event is occurring.

See examples 5 and 6, below, for a comparison of a telic and an atelic Path in English.

(5) Telic Path: The ball fell to the floor.

(6) Atelic Path: The ball fell towards the floor.

The five parts of Path suggested by Talmy will be explored in the current study. Telicity will be considered in relation to the boundary-crossing constraint, discussed in section 2.2.2.1.

2.2.1.5 Manner

Talmy (2000a) proposes that linguistic structures indicate Manner is conceptualised as separate to the main Motion event (see section 2.2.2.1.1, below, for more information). Therefore, along with Cause, Talmy considers Manner as part of the Co-event. The Co-event is an event related to, or occurring simultaneously to, the main Motion event. Pourcel (2004) suggests dividing expression of Manner into three different groups, which reflect the different choices of Manner verbs languages have:

1. Default Manner (for example, ‘walk’, ‘fly’ and deictic verbs like ‘come’)
2. Forced Manner (for example, ‘skip’ or ‘limp’)
3. Instrumental Manner (for example, ‘cycle’ or ‘drive’)

Slobin (2004), meanwhile, suggests that Manner verbs can be divided into just two groups. The first group are general Manner verbs that describe everyday movement (such as 'walk', 'cycle' or 'jump') and map onto Pourcel's Default Manner and Instrumental Manner. The second group of more elaborate Manner verbs (such as 'creep' or 'gambol') map onto Pourcel's Forced Manner. The current study will use Pourcel's terminology as it accounts for the semantic differences between Motion events that do and do not involve a vehicle.

2.2.1.6 Cause

The Co-event, as defined by Talmy (2000a) comprises Manner, discussed above, and Cause. As discussed in 2.2.1.2, Motion events can be agentive, non-agentive or self-agentive. Talmy (1991, 2000a) makes a distinction between 'spontaneous motion' and 'caused motion' in Motion events. The former is akin to the self-agentive Motion events described earlier, where the Figure moves of its own accord. The latter encompasses both agentive and non-agentive motion and is movement resulting from some external force (whether known or not). See examples 7, 8 and 9, below, for examples of spontaneous and caused motion. Although the current study will not be investigating Cause, it is important to be aware of its role as part of the Co-event because it relates to the theories about how different languages describe Motion events that will be discussed in 2.2.2.1.

(7)	Self-Agentive (Spontaneous):	The cat jumped off the table.
(8)	Non-Agentive (Caused):	The cat fell off the table.
(9)	Agentive (Caused):	He pushed the cat off the table.

2.2.1.7 Summary

Languages are able to represent these six Motion components in different ways. I will now move on to discuss the classification of languages based on the preferences for inclusion and packaging (where the information is contained) of Motion event components.

2.2.2 Classification of Motion Event Preferences

Languages show different preferences for how they express the Motion event information described above. The organisation of languages into types, or along a continuum, can be based on a number of different preferences. In this section I will firstly discuss classifications based on the packaging of the Motion event components outlined above. Secondly, I will discuss classifications based on spatial reference frames.

2.2.2.1 Motion Event Semantics

2.2.2.1.1 Talmy's Typology

Talmy (2000a, 2000b) suggests a classification where languages are divided based on which component of a Motion event is most frequently bound with Motion in the verb root. He argues that languages fall into three categories based on the component that is most likely to be found in the verb root. The first group of languages (like Navajo) is very unusual and preferentially combines verb root and Figure. The second group of languages (such as Spanish) tends to combine Path with the verb root. Finally there are languages (including English) that usually combine the verb root and a Co-event (either Manner or Cause). See examples 10, 11 and 12, below, for a demonstration of the three possible combinations in English.

(10)	Figure + Verb:	It rained in through the window.
(11)	Path + Verb:	He exited the room.
(12)	Co-event + Verb:	He ran out of the room. [Manner]
		She shoved him out of the room. [Cause]

Talmy (and others such as Ibarretxe-Antuñano, 2003, 2004; Pourcel, 2004) considers Path to be the 'core schema' of Motion events and therefore suggests a typology based on how Path information is expressed in different languages. Those languages that show a preference for binding Path information with Motion in the verb, like the second group above, are called verb-framed languages (V-languages). Those languages that do not show a preference for including Path information in the verb, typically encoding Path information in other elements (known as satellites) instead, are called satellite-framed languages (S-languages). Although many languages are able to include Path information within the verb or as a satellite (as shown in the English sentences in example 10, 11 and 12, above), the designation of V-language or S-language is based on how Motion event utterances are typically formed. Talmy (2000a, 2000b) suggests that to decide which is the characteristic way a language expresses Motion events, one must identify:

1. The strategy found most in colloquial utterances
2. The strategy seen most frequently
3. The strategy that is most pervasive in use

The linguistic preference for how Path information is encoded also influences how Co-event information is packaged. While S-languages frequently encode Manner in the verb, V-languages typically include it as a subordinate element, such as a gerundive or adverbial constituent. For instance, one can compare typical encodings of the same Motion event in English (an S-language) and French (a V-language) in examples 13 and 14, below.

(13)	The girls	run	out of the church.	
	[Figure]	[Motion+Manner]	[Path] [Ground]	
(14)	Les filles	sortent	de l'église	en courant.
	The girls	exit	the church	running
	[Figure]	[Motion+Path]	[Ground]	[Manner]

In English, Manner is bound with the verb and Path is a satellite in the intransitive expression 'run out of'. In French, Manner is found in a participle ('en courant') and Path is bound with the verb ('sortent'). Both convey the same semantic content, but the lexicalisation patterns differ. Talmy (2000a, 2000b) notes that in V-languages gerundive or adverbial constituents can be stylistically awkward and therefore, to avoid this, Co-event information is often established elsewhere in the discourse or is completely omitted.

Although Talmy's typology is the most widely used framework in Motion event literature, there are competing theories. In the next section, I will briefly describe a different framework proposed by Slobin that uses the packaging of Manner, rather than Path, to organise language preferences.

2.2.2.1.2 Slobin's Cline of Manner

Slobin (2004, 2006) suggests that not all languages easily fit into the categories of either S-language or V-language. Issues with the typology become clear when studying languages like Mandarin. Mandarin speakers can use two or three verbs in a single clause (serial verb constructions) and express Path in one verb and Manner in the other (see example 15, below, showing a serial verb construction in Mandarin from Chen & Guo, 2009). Talmy (2000a, 2000b) suggests that Mandarin is an S-language because he does not categorise the verb containing Path information as a full verb but instead as a directional complement to the Manner verb. However, Tai (2003) rejects this analysis and suggests that although Mandarin can use directional complement constructions, it often uses full Path verbs to express spatial motion, making it a V-language.

(15)	Wo	pao	chu	le chufang
	I	run	exit	kitchen
	[Figure]	[Motion + Manner]	[Motion + Path]	[Ground]
	'I ran out of the kitchen'			

The issue of categorisation outlined above indicates that the binary distinction between S-language and V-language is problematic. Ameka & Essegbey (2001), Slobin (2004), Zlatev & Yangklang (2004) have suggested that Talmy's typology is reductive and does not account for all languages. Slobin (2004) proposes that some languages, like Mandarin, give Path and Co-Event (Manner/Cause) almost equal morphosyntactic status. He calls these languages equipollently-framed languages and describes three subtypes:

1. Serial verb languages: These languages include two or more verbs in Motion event utterances and it is difficult to resolve which is the main verb. Chinese (as discussed above and in Chen & Guo, 2009) and Thai (Zlatev & Yangklang, 2004) have been reported to show no preference for either Path or Manner in their serial verb constructions.
2. Bipartite verb languages: These are languages where the Motion verb included a Path morpheme and a Manner morpheme of equal status. DeLancey (1989, 2000) describes this construction in Hokan and Penutian languages.
3. Generic verb languages: These languages have a small set of verbs used in Motion events expressing deictic or aspectual function (such as 'come' and 'do'). These verbs are then combined with other elements that encode both Path and Manner. Schultze-Berndt (2000) reports on Jaminjung (an Australian language) that uses only five verbs to express Motion events. Jaminjung combines these verbs with satellite-like elements or co-verbs (elements that work alongside a main verb to include prepositional/positional information) to encode Path and Manner with equal status.

In response to Slobin's theories, Talmy (in Ibarretxe-Antuñano, 2005) agrees that the term equipollently-framed languages might be a useful way to view linguistic variation. However, he suggests that when researchers use an expanded set of criteria to discover which constituent has main verb status, it greatly reduces the number of languages that can be considered equipollently-framed. Brown & Chen (2013) report evidence for the three-way division of V-language, S-language and equipollently-framed language in Motion event descriptions by Japanese, English and Mandarin speakers. They note that Manner information was provided in speech far more frequently in English and Mandarin than in Japanese (typically considered a V-language). Additionally, gesturing differed, with Japanese and Mandarin speakers preferring to gesture Path information and English speakers preferring to gesture Manner information. The authors suggest this indicates that Mandarin is not a V-language (because of the tendency to encode Manner in speech) but does not behave entirely like an S-language either (as speakers prefer to gesture Path information). Therefore Mandarin acts like an equipollently-framed language, as Slobin predicts.

Slobin's categorisation diverges from Talmy's in two further ways. Firstly, while Talmy distinguishes languages based on how they encode Path information, Slobin focuses on the inclusion of Manner, suggesting that it is the most salient component of Motion events. Secondly, Slobin (2004, 2006) argues that languages are not easily divided into typological groups but instead exist on a scale related to how much Manner information is typically included. Slobin (2004) suggests that languages are on a continuum from high-Manner-salient languages to low-Manner-salient languages. He dubs this the 'cline of Manner salience'.

Slobin (2004) suggests that languages may be placed along this cline depending on how easily and regularly Manner information is provided. As discussed in 2.2.1.5, Slobin (1997) proposes that all Manner verbs may be divided into two groups: general Manner verbs representing everyday movement (such as 'walk', 'jump' and 'fly') and more elaborate Manner verbs (such as 'shuffle', 'meander' or 'careen'). He concludes, from research on elicited narratives and analysis of novels, that while English (an S-language in Talmy's typology) possesses Manner verbs in both the first group and the second group, Manner verbs in Spanish (a V-language in Talmy's typology) mainly fall within the first group (Slobin, 1997). Slobin (2004) suggests that high-Manner-salient languages may be identified by the numerous Manner verbs able to encode fine-grained distinctions (as found in English), whereas low-Manner-salient languages have a much smaller set of Manner verbs that are more general (as found in Spanish). By identifying the distribution of Manner verbs, languages may be placed on the cline of Manner salience. This issue of how to categorise languages based on Motion event preferences has ignited further debate, which will be addressed in the following section.

2.2.2.1.3 Further Perspectives

Slobin's suggestion that Motion events should be placed on a continuum, rather than divided into typological groups, is supported by other researchers. Ibarretxe-Antuñano (2004) agrees with Slobin that typologies like Talmy's are too simplistic but rejects the preference for ordering languages based on Manner. Instead she accepts Talmy's suggestion that Path is the core schema of a Motion event. She proposes a cline of Path salience from high-Path-salient languages to low-Path-salient languages. Bohnemeyer, Eisenbeiss & Narasimhan (2006) present evidence that supports the suggestions of Slobin (2004) and Ibarretxe-Antuñano (2004). These researchers compared speakers of seventeen different languages (12 typically considered V-languages, four usually considered S-languages and one serial verb language). Instead of finding that languages fell into distinct categories, where all V-languages behaved the same and all S-languages behaved the same, they report that the languages formed a continuum.

Supporters of the typological approach suggest that, although there may be variation within categories, dividing languages typologically is a useful means of describing Motion events. Beavers, Levin & Tham (2010) acknowledge that languages may have multiple means of expressing Motion events but support

Talmy's perspective that there is always a preferred option for expressing Motion events in a language and therefore the language can be placed in a typological group based on this preference. Papafragou & Selimis (2010) also accept that languages may vary in how strong their preference is for a particular Motion event strategy but reiterate that every language has a more characteristic means of expressing Motion events. They suggest that Talmy's typology must be used as an indicator of preference instead of a definitive divide. Indeed, Talmy (2009) acknowledges that not all languages in one type behave exactly alike. He notes, for example, that there are cross-linguistic differences in the distribution of the three types of Path information (Vector, Deixis and Conformation, as mentioned in 2.2.1.4). He suggests that languages may not include all Path information in a Motion event utterance. For example, Japanese and Korean often include Deixis in the main verb accompanied with a verb root in gerundive or bound form to express Conformation. See examples 16 and 17, below, for English utterances including different Path information in separate constituents.

(16)	The man	crossed	the street	towards me.
	[Figure]	[Motion+{Conformation}]	[Ground]	[{Deixis}]
(17)	The man	approached me across	the dance floor.	
	[Figure]	[Motion+{Deixis}][{Conformation}]	[Ground]	

As has been shown above, the event type being described may also have an influence on the packaging of Motion event information. In an attempt to reconcile the variation within Talmy's typological groups, some researchers suggest a construction-based approach where different Motion events are typologised within a language instead of attempting to impose one overall typology for each language. Croft, Barðdal, Hollman, Sotirova & Taoka (2010) suggest that using Talmy's typology to divide languages would result in all languages being seen as mixed type because they possess features of both V-languages and S-languages. To combat this issue they examine the different strategies individual languages have for encoding Motion events and typologise by event rather than language overall. See examples 18 and 19, below, for two preferred sentence framings used in Bulgarian depending on event type.

Bulgarian most frequently uses satellite framing in telic causative Motion events like 'I rolled the barrel into the basement':

(18)	Iz-	tŭrkaljax	varela	v	mazeto
	I	rolled	the barrel	into	the basement
	[Motion+Manner+Cause]		[Figure]	[Path]	[Ground]

However, it most frequently uses verb framing in telic non-causative Motion events like 'I ran across the street':

(19)	presjakox	ulitsata	na	begom
	I crossed	the street	on	running
	[Motion+Path+Figure]	[Ground]		[Manner]

Example 18, above, is not usually considered permissible in a V-language as it involves the use of a Manner verb in a boundary-crossing event. Aske (1989), in his comparison of telicity in English (an S-language) and Spanish (a V-language), discusses the way these two languages can express Motion event information in boundary-crossing events. As mentioned in 2.2.1.4, telicity denotes whether an action has a definitive endpoint; a telic event has a clear endpoint whereas an atelic event does not, as shown in examples 20 and 21 in English, below.

(20) She ran to him [and hugged him tightly].

(21) She ran towards him [and struggled to catch up].

In example 20, above, the reader understands that the Figure has arrived at her goal, while in example 21 one does not know if the Figure ever reached her goal. Aske notes that English, unlike Spanish, has a number of different ways of describing Path/Ground interactions that are telic when using Manner verbs. English is able to use a verb expressing Manner with telic or atelic Motion events. However, Aske suggests that in Spanish Manner verbs cannot be used in telic events, especially when a Figure moves across a boundary. See examples 22 and 23, below, which show how Spanish is able to use Manner verbs for atelic events but not telic events where a Figure crosses a boundary (from Aske, 1989).

(22) Nadaron dentro de la cueva.
'They swam inside the cave'

(23) *Nadaron adentro de la cueva.
*'They swam into the cave'

Other V-languages, such as French, Japanese and Arabic, also show this avoidance of Manner verbs when Motion events involve boundary crossing (Hendriks & Hickmann, 2015; Kita, 1999; Özçalışkan, 2015). Slobin & Hoiting (1994) dub this phenomenon the 'boundary-crossing constraint'. They explain that V-languages are restricted in how they can use Manner verbs and, because the typological preference is to use a Path verb when describing a change of state, they do not use Manner verbs in boundary-crossing scenarios. Talmy (2000a) also notes that S-languages are able to conflate Manner, Cause and Motion together in a telic boundary-crossing event such as 'I rolled the barrel into the basement.' This sort of construction would not be expected to occur in a V-language and yet, as seen in example 18, above, it is used felicitously in Bulgarian despite V-language preferences in other utterances.

Despite the objections outlined in this section, Talmy's typology continues to be the most widely used framework for investigating Motion events. Even Slobin (2004, p.24) acknowledges that Talmy's typology has been 'useful in systematically sorting the world's languages as well as providing a framework for discourse analysis.' This study will, therefore, also use Talmy's typology as a framework for discussion.

2.2.2.2 Reference Frames

As well as the inclusion of semantic components, the description of Motion events often involves an individual relating the layout of space (including Ground) and where a Figure moves with respect to this space (Path). The ways in which languages divide space are varied but may be seen to fall into two main categories. Firstly, there are absolute referencing systems, as found in Tzeltal (Brown & Levinson, 1993) or GuuGu Yimithirr (Haviland, 1998), where directions relate to set parts of the environment (such as geographical features, like 'uphill/downhill' or cardinal directions, like 'northwards'). Secondly there are relative referencing systems, like English, where directions relate to the speaker (such as 'left/right'). These absolute and relative referencing systems will be discussed in more detail relating to sign languages in 2.3.1.2 and in the next section I will discuss how reference systems and Motion event preferences are acquired by early and late speakers.

2.2.3 Acquisition of Motion Event Preferences

2.2.3.1 Early Language Acquisition

As described in 2.2.2.2, above, different reference frames are used in different languages. An area of interest has been age of acquisition for these reference frames and whether one reference system might develop in children earlier than the other. Brown & Levinson (2000) report a difference in the age of acquisition for absolute and relative referencing systems. They state that in the Mayan language Tzeltal children are able to extend their absolute system very productively from around six years old, long before English-speaking children are able to use their relative system. Marquesan, similarly, uses an absolute referencing system and children speaking Marquesan display the same early ability to extend their referencing system (Cablitz, 2002). Children acquiring relative referencing systems, meanwhile, overall show a slower and more gradual development. Johnston & Slobin (1979) studied the acquisition of prepositions in English, Turkish, Italian and Serbo-Croatian (all languages with relative reference systems) in children aged 2;0 to 4;8 and suggest that for relative referencing systems there is a cross-linguistic order for acquisition, with children learning 'in'/'on' and 'under'/'beside' first (those prepositions that do not require an understanding of a relative reference system) and acquiring the terms for 'back'/'front' much later (prepositions that require a complete understanding of the relative reference system). They report that children make many errors relating to the prepositions 'back' and 'front', even at 4;8. Acquisition of locative constructions also appears to be very difficult for children and comprehending the exact way their first language divides space can lead to prepositions being acquired much later than other parts of speech.

Relative reference systems and locative constructions are not the only way of dividing space which children find difficult to acquire. For example, Gullberg & Narasimhan (2010) note that Dutch children struggle to accurately use the posture verbs 'leggen' ('to lay') and 'zetten' ('to stand'). Children aged 3;1 to 6;0 overuse 'leggen' by producing it in instances where 'zetten' would be appropriate. Some research suggests that gesturing can act as pre-cursor to the acquisition of words and features (see Capirci, Iverson, Pizzuto & Volterra, 2008; Iverson & Goldin-Meadow, 2005; Johnston & Slobin, 1979; Özçalışkan & Goldin-Meadow, 2005) and that gesturing can reveal what is understood conceptually. With this in mind, Gullberg & Narasimhan (2010) also looked at the gesture patterns of the children to see if they understood the difference between 'leggen' and 'zetten' conceptually, even if they were not producing it linguistically. They report, however, that the gesture patterns of the children reflected their delayed understanding of this linguistic difference; those children who overextended 'leggen' gestured Path of the motion but not the horizontal/vertical orientation of the object, while those children who accurately used 'leggen' and 'zetten' gestured like adults and included both the Path of the motion and the orientation of the object. Both their speech and gestures reflected their understanding of the verb semantics.

Attention has also been used as a predictor for later acquisition of Motion event preferences. Konishi, Stahl, Golinkoff & Hirsh-Pasek (2016) report on a study of children acquiring English. They showed children aged 1;1–1;3 a series of three Motion event video clips, all with either the same Path or the same Manner. They then showed the children two video clips simultaneously: one with a familiar Path/Manner and one with a novel Path/Manner. They measured how long the children attended to the novel clips. The same children were then tested on their verb comprehension aged 2;3–2;9 by being asked to point at a video clip showing the sentence being described (such as 'where is she kicking the balloon?'). They report that children who spent longer looking at the novel Path/Manner clips aged 1;1–1;33 also had better verb comprehension aged 2;3–2;9. They argue that early semantic categorisation in non-linguistic events (exhibited through longer looks at novel Paths/Manners) is predictive of later vocabulary acquisition.

Researchers have also investigated the age of acquisition for Motion event preferences in children. For example, Hohenstein (2005) showed English-speaking and Spanish-speaking children video clips accompanied with a novel verb in different sentence frames. Children were then instructed to choose a video clip where the Figure was carrying out the novel verb. The choices were either a Figure doing the same Path or doing the same Manner. Younger children (3;6) selected based on syntactic means (relying only on the sentence frames to decide if it was a Path/Manner verb), but older children (7;0) appeared to be influenced by the Motion event preferences of their language; English children had a stronger preference for selecting Manner while Spanish participants had a stronger preference for Path. These results imply that preferences are acquired slowly through familiarity with one's first language preferences. Further evidence for this gradual development of Motion event preferences is provided by Brown (2000) who reports that in Tzeltal the preference is for Path to be represented in one clause with Manner detail provided by optional positionals (a group of verb roots that give detailed information about Figure position). Brown compared adult Motion event descriptions with those of children aged 3;0–5;0, 6;0–7;0 and 8;0–13;0. She analysed which information was found in the main clause of a Motion event description (Motion, Path and/or position). Adults preferred clauses including Motion or Path alone (52% of clauses) followed by clauses with position alone (39%) and rarely position with either Motion or Path (9%). Children's descriptions showed a slow developmental trend towards adult-like description. Children aged 3;0–5;0, unlike adults, preferred clauses expressing position alone (52%). Children aged 6;0–7;0 showed a strong preference for including only Motion or Path in a clause (71%), indicating heightened sensitivity to this structure and going beyond adult preferences. At age 8;0–13;0 children's preferences fell in line with adult preferences, with 52% of clauses including Motion or Path alone. These results imply that acquisition of linguistic preferences for Motion event typology is a long developmental process. However, evidence that language preferences begin to develop early in childhood is provided by Hickmann & Hendriks (2010) who compared children acquiring either English or French. They report that the density of information in Motion event utterances in both languages increased with age. However, from age 3;0 English-speaking children had more semantic density in their utterances than French-speaking children, who distributed Motion event information in more varied ways. Berman & Slobin (1994) also found language-specific differences at a young age, with children aged 3;0 acquiring an S-language already showing a greater preference for expressing Manner than children of the same age acquiring a V-language. Similarly Özyürek et al, (2008) studied Turkish-speaking and English-speaking participants from infancy to adulthood and found that English-speaking children preferred using one clause to express Motion events (typically with a Manner verb and Path satellite) and Turkish children preferred using two clauses (one to express Manner, the other for Path). They suggest that children begin to acquire language-specific divisions of Motion events from age three. However, they found that adult-like co-speech gesturing did not emerge until after the age of nine. Under the age of nine, Turkish and English children preferred co-speech gesture that showed separate Path and Manner. However, after the age of nine English children changed to using conflated Manner-Path gestures. They suggest this shows a gradual developmental shift towards language-specific preferences and that gesture could indicate children take longer to acquire the particular preferences of a language than their speech might suggest. This finding is of particular interest as previous research (as discussed elsewhere in this section) suggests that gestures could act as pre-cursor to the acquisition of words and features and therefore one might expect that Motion event gesturing would emerge before Motion event utterances. However, gestures that come before speech are often simple mimes (such as miming drinking to mean 'milk') or pointing as a form of deixis. Co-speech gestures occur alongside spoken descriptions and, as will be discussed later, usually reflect the linguistic patterns found in Motion event descriptions. This reflection of spoken language patterns is found both in the information included in the gesture (for example, Manner or Path) and the timing of the gesture (usually simultaneous with the information being included in speech). Therefore, co-speech gesture may be seen as a different phenomenon as a child must have complete knowledge of the underlying syntactic and semantic structures of Motion events in their language to be able to use co-speech gesture appropriately.

Although child language will not be investigated in the current study, the early childhood acquisition of Motion event preferences will be contrasted with the preferences acquired later in life in Chapter 5.

2.2.3.2 Late Language Acquisition

As has been shown above, children appear to display at least some of the preferences of their first language from as early as 3;0, even if speech completely following adult patterns does not develop until around ten years of age. These preferences, which develop early, are thought to become entrenched over time. Researchers have therefore been interested in how late learners are able to learn new strategies for describing Motion events later in life. Late acquisition is of particular interest for the current study because I will be comparing the Motion event preferences of early and late BSL signers. Some studies have investigated whether there is a conceptual transfer of Motion event preferences from a native language (or language acquired early) to a language acquired later. Other studies have looked at whether the reverse can also occur, where the Motion event strategies of a language acquired late may influence the Motion event descriptions of a native language (or language acquired early). As all my signing participants also have some knowledge of English, such studies are again of relevance for the current study. Below I will describe some of the research into the Motion event descriptions of a language acquired late.

Evidence for conceptual transfer comes from Alonso (2011), who asked native Spanish-speaking students specialising in English translation to translate Spanish Motion event sentences into English. It was found that the students preferred to retain their native Spanish strategy of using a Path verb and Manner satellite, as opposed to the English strategy of a Manner verb and Path satellite, despite their high proficiency in English. Sharpen (2016) also reports similar conceptual transfer in English speakers learning Spanish as well as

Spanish speakers learning English. Relatedly, Hendriks & Hickmann (2015) report that the caused Motion event descriptions of advanced late French speakers showed patterns similar to their native English (for example, including Cause information in the verb). Hijazo-Gascón (2015) found evidence of conceptual transfer even between languages within the same family and Motion event language type; he reports that native Italian speakers exhibited transfer when describing Motion events in their late Spanish, expressing Path components more frequently than native Spanish speakers.

Another means of investigating conceptual transfer is to look at co-speech gesture. Studies into co-speech gesturing have shown different preferences for native speakers of different languages. For example, Kita & Özyürek (2003) and Kita et al (2007) conducted cross-linguistic studies on speech and gesture in Turkish, Japanese and English. They report that co-speech gestures followed the language patterns of the speech. Preferences for Manner-only gestures, Path-only gestures and conflated gestures (those showing both and Path and Manner) reflected the linguistic preferences for including Path and Manner in the same or separate clauses. For example, Japanese speakers preferred to include Path and Manner information in separate clauses and their co-speech gestures reflected this; speakers used Path-only gesturing in 80% of instances. Meanwhile, English speakers preferred to include Path and Manner in the same clause in speech and their gesture reflected this; speakers preferred conflated gestures and used Path-only gesturing in just 40% of instances. Similarly, Gullberg, Hendriks & Hickmann (2008) investigated the co-speech gesturing of speakers of French and report that children and adults preferred to co-express Motion event information in gesture (that is, to gesture not only the same semantic content as in speech but produce it at the exact same time as it is being produced in speech).

Choi & Lantolf (2008) investigated whether co-speech gesture in late speakers reflects first language preferences. They compared the gestures of native Korean speakers, native English speakers, late Korean speakers and late English speakers. They report the speech patterns of late speakers showed the Motion event preferences of the target language. These late speakers also synchronised their gesture in the typical locations for the language and did not transfer gesture patterns from their first language. If the assumption is taken that gestures reflect the speaker's conceptualisation of the event, then this is evidence that new Motion event preferences can be learned and internalised.

Another avenue of research related to late acquisition is whether backwards transfer of Motion event preferences can occur. Bylund & Athanasopoulos (2015) report on a study of Swedish speakers learning English as adults. English can include progressive aspect (information about whether an event is/was ongoing) in the verb through the use of the morpheme -ing (for example, progressive 'he is driving' compared to non-progressive 'he drives'). Swedish cannot mark progressive aspect in the verb. Typically, languages that do not include progressive aspect information in verbs have a greater tendency to encode endpoints in Motion event utterances, preferring the equivalent of 'he walks to the house' to 'he is walking' when describing a man walking towards a house. Languages that can mark progressive aspect in verbs have the opposite preference, preferring to focus on whether the action is concluded or ongoing. In Bylund & Athanasopoulos (2015)'s study, Swedish speakers and monolingual English speakers were shown video clips of Figures moving without an endpoint and Figures reaching an endpoint. They were then shown video clips where Figures were moving towards an endpoint (but not reaching it). Participants were asked to select which of the first two clips they found more similar to the third. English speakers chose the clip without an endpoint more frequently overall than Swedish speakers. However, Swedish speakers with higher exposure to English (specifically watching English-language television) showed a stronger preference for choosing clips without endpoints than Swedish speakers with lower English exposure. The authors suggest this could indicate a restructuring of cognitive preferences due to exposure to another language that regularly includes progressive aspectual information. Furthermore, Daller (2011) reports that native Turkish speakers resident in Germany with late German showed characteristically German constructions for Motion events in both their German and their Turkish (indicating backwards transfer), while those who returned to Turkey after having lived in Germany showed Turkish constructions in both languages (showing a return to a less fluent language stage in their late German). Similarly, Brown & Gullberg (2010) report that even an intermediate ability in an language acquired late can change the lexicalisation patterns of Motion events in a language acquired early. They found that Japanese learners of English included far more Path information per clause in Japanese than their monolingual Japanese counterparts. They suggest this is because Path is included more frequently in English Motion event descriptions and this pattern leaked across into Japanese. Moreover, the number of Path expressions produced by the Japanese learners of English while speaking Japanese far exceeded the number produced by native English speakers in English, indicating this feature was being over-extended by learners. Similarly, Aveledo & Athanasopoulos (2015) report findings of backwards transfer in Spanish speaking children (aged 5;0–9;0) learning English as a second language, with these children using more Manner verbs and fewer Path verbs in their Spanish due to influence from English.

Having discussed how the preferences for describing Motion events are acquired, both in early and late language, I will now move on to examine a further area of interest for the current study; whether these preferences may influence the conceptualisation of events.

2.2.4 Linguistic Relativity

Linguistic Relativity is the hypothesis that the structure and preferences of a language can influence certain cognitive processes, such as memory, attention, perception or categorisation. In this hypothesis each individual language is assumed to influence these processes in slightly different ways because of their unique linguistic structures. A related theory is Linguistic Determinism, which argues that a person's language creates the limits of their perception and an individual cannot conceive notions that cannot be expressed in their language. Linguistic Relativity rather than Linguistic Determinism will be considered in this study.

Motion events are an excellent locus for research on Linguistic Relativity because studies can investigate whether the way people encode Motion events influences how people attend to, remember and categorise them. Boroditsky (2003) argues that Linguistic Relativity may be seen in every area of Motion event description, from the depiction of space and time to details about the shapes and objects involved. Below I will discuss research into Motion events, looking at how it is proposed that language might influence the conceptualisation of Motion event components. I will then move on to discuss the theory of thinking-for-speaking and how this will relate to my research questions.

2.2.4.1 Conceptualisation

There are a number of studies looking at how Motion event preferences might influence cognitive processes. One of the most common areas of research is how language might alter the perceived saliency of Motion event components. Studies on perceived saliency look at how prominent different components of Motion events appear to speakers of different languages. Soroli & Hickmann (2010) investigated the perceived saliency of Motion event components for French (a V-language) and English (an S-language) speakers. These participants took part in a forced-choice similarity judgment task where they watched an initial target Motion event video clip before being shown two other clips (one with the same Path and one with the same Manner as the target clip). They were then asked to indicate (by pressing a key) which of the two clips was more similar to the target clip. French participants showed a preference for same-Path clips but English participants showed no clear preference. However, when participants described the Motion events before conducting the same task (with an accompanying spoken description played in their language), French participants showed a preference for same-Path clips again and English participants showed a preference for same-Manner clips. These results indicate that the influence of linguistic preference is stronger when language is explicitly engaged (explanations for this finding will be discussed in 2.2.4.3).

Similar results to those discussed above were found by Papafragou & Selimis (2010) who investigated the perceived saliency of Manner/Path in Motion events in English-speaking and Greek-speaking children and adults. Participants were told that they would be asked to describe some video clips. They then took part in a forced-choice judgment task where they watched clips before indicating which of the two clips represented the same event as the original clip. English adults chose same-Manner clips most frequently, while all other groups chose same-Path clips most, with English children choosing same-Manner clips slightly more frequently than either Greek group. When describing the clips afterwards, the preference for including Path and Manner followed similar patterns. However, when other participants were tested and were not told that they would be describing the clips after the judgment task, the effects of language were eliminated and all groups behaved similarly.

Other researchers have likewise found no difference between speakers of V-languages and S-languages when engaging in a forced-choice judgment test. Cardini (2010) found that English (an S-language) and Italian (a V-language) speakers were nearly equal in their choices on a forced-choice judgment task, with both equally likely to select same-Manner or same-Path clips. There is further evidence that perceived salience may be similar across languages. Pourcel (2004) investigated the effect of the different types of Manner on how people view Motion events (see 2.2.1.5 for explanations of Pourcel's categorisation of different types of Manner). She conducted a rating task with French and English speakers. Pourcel reports that when participants were shown a Motion event with Default Manner (for example, walking or running), they were more likely to rate video clips with the same Path as more similar. However, when participants were shown a Motion event with Forced Manner (for example, hopping or limping), they rated same-Manner and same-Path video clips about equal. She concludes that salience of Path/Manner is not related to language preferences but that Path is cross-linguistically more salient unless Manner is particularly unusual or striking.

Vastenius, van de Weijer & Zlatev (2016) report on differences in the conceptualisation of Motion events in Swedish and Kurdish. These two languages differ in their word orders for describing events; Swedish expresses Ground after the verb while Kurdish can express it before or after. When participants were asked to arrange cards to describe a Motion event (such as a duck moving to a wheelbarrow), Swedish speakers placed the Ground card after the Motion card significantly more often than Kurdish participants, who instead preferred to place the Ground card before the Motion card. These language-specific preferences were present regardless of whether participants described the Motion event before sorting the cards (verbalisation) or if they did not (no verbalisation). However, on a similar task where English, Turkish, Spanish and Chinese speakers were asked to stack transparencies of Motion events one on top of the other, Goldin-Meadow, So, Özyürek & Mylander (2008) found that, regardless of language, participants preferred to place the transparency showing the Ground down first. Vastenius et al (2016) suggest that this is because transparencies were used instead of solid cards and therefore it biased participants into placing the Ground down first because they did not view it as a sequential scene; the same picture would be formed regardless of the order in which the transparencies were stacked.

Spatial referencing is another area where the influence of language on conceptualisation has been tested. Levinson, Kita, Haun & Rasch (2002) and Levinson (2003) suggest that frames of spatial reference in languages influence spatial judgments. They conducted a series of experiments, such as asking participants to view items on a table and then replicate the layout with items on a second table after they had been turned 180 degrees (the animals-in-a-row test). They report that these non-linguistic tasks were influenced by participants' linguistic frames of reference (absolute or relative). Li & Gleitman (2002) criticised these findings after running a simplified animals-in-a-row test and finding that participants could be influenced into either absolute or relative frames of references based on surroundings (such as indoors/outdoors or landmarks/no landmarks). Levinson et al (2002) suggest that the simplified task may have removed the challenge for the participants, possibly preventing them from being distracted from what was being studied, therefore allowing them to think more about the options for arranging the items and thus undermining the aim of the task. Gentner, Özyürek, Gürcanli & Goldin-Meadow (2013) investigated the spatial reference abilities of hearing Turkish-speaking children and deaf children growing up without sign language (instead relying on improvised gesture systems called 'homesign'). They report that hearing children were able to describe spatial relations (for example, in, on and under) at 4;0 in Turkish but deaf children were unable to describe these relations in homesign even by age 5;0. They also report that hearing Turkish-speaking children outperformed the deaf children on a spatial mapping task where children had to abstract the location of an object in one set of boxes from being shown where the equivalent card was in another set of boxes. They suggest that the lack of language for spatial relations potentially delayed deaf children in their ability to fully understand such relations. Although there is debate surrounding whether there is robust proof of Linguistic Relativity in frames of spatial reference, Majid, Bowerman, Kita, Haun & Levinson (2004) consider that the body of evidence indicates that languages play a key role in structuring individuals' spatial cognition. This will be of particular interest when comparing BSL and English as the former is a spatial language and the latter is a primarily linear spoken language (there may also be optional simultaneous gesture in the visual modality).

2.2.4.2 Memory & Attention

As well as research into perceived saliency of Motion event components, there has also been investigation into whether linguistic preferences can influence the distribution of attention and memory for Motion events. Research in this area is of particular interest for the current study, which focuses on memory for Motion events.

Von Stutterheim, Andermann, Carroll, Flecken & Schmiedtová (2012) studied speakers of Arabic, Czech, Dutch, English, German, Russian and Spanish. These languages differ in whether they regularly encode Motion events with an imperfective/progressive aspect (such as 'he was running' or 'he was running continuously') or a perfective aspect (such as 'he had run'). It was predicted that those languages that do not mark imperfective/progressive aspect (Czech, Dutch and German) would pay more attention to Goal even in cases where a Motion event does not reach a set endpoint compared with those languages that prefer imperfective/progressive aspects (Arabic, English, Russian and Spanish). It was shown that, indeed, speakers of Czech, Dutch and German focused on the endpoints more in conditions where the endpoint was not reached than speakers of the other languages. They were also better at remembering Goals in a recognition task. Relatedly, Flecken, Athanasopoulos, Kuipers & Thierry (2015) showed German and English speakers short videos of objects moving followed by four different types of pictures: pictures depicting the same endpoint (Goal) and traced trajectory (Path) as the video, pictures showing just the same endpoint, pictures showing just the same traced trajectory or pictures showing neither the same endpoint nor the same traced trajectory. They recorded the event-related brain potentials (ERPs) of the participants and report that German speakers showed larger P3 activations (associated with stimulus evaluation and target detection) when seeing same-endpoint pictures than they did when seeing same-traced-trajectory pictures. English speakers did not show this difference. They argue that is due to the linguistic differences in the language; German speakers habitually encode and pay attention to endpoints more than English speakers. However, Athanasopoulos & Bylund (2013) compared English and Swedish participants on a forced-choice memory task and found that performance in the task could be altered with the use of articulatory suppression (repeating unrelated words in the task to stop mental linguistic encoding). Participants viewed some Motion event video clips while either carrying out no accompanying task or while carrying out articulatory suppression. Later they were shown Motion event clips that were either the same as they had seen previously or with the endpoint (Goal) altered. It was found that when there was no articulatory suppression when viewing the initial Motion event clips, Swedish speakers were better at remembering endpoints than English speakers. However, when there was articulatory suppression during the viewing, no difference was found. This suggests that it is the mental linguistic encoding and explicit engagement of linguistic faculties that influences memory differences. Furthermore, some evidence indicates that paying more attention to Goals than Sources is not related to language but is a universal preference. For example, Regier & Zheng (2007) found that when participants of different languages (Arabic, Chinese and English) were shown pairs of video clips and asked to indicate if they were the same or not, participants were more likely to rate clips as the same when Goals of the Motion events were the same than if the Sources were the same. This cross-linguistic phenomenon is known as Goal bias. Lakusta & Landau (2012) looked at the extent of Goal bias in adults and children (around 4 years old). Participants were shown video clips of Motion events with clear Sources and Goals and then shown a second clip (with either the same Goal/Source or a different Goal/Source) and asked to indicate if it was the same as the first presentation. To prevent linguistic encoding of the events, participants were also instructed to continuously repeat a sequence of unrelated words and numbers during the task (verbal shadowing). Both adults and children were significantly better at detecting Goal rather than Source changes, implying more attention is given to endpoints. This also indicates that Goal bias may be non-linguistic as verbal interference did not prevent the effect and children in the early stages of language acquisition still showed robust Goal bias.

Research has also investigated whether speaking an S-language or a V-language influences the attention one pays to components in a Motion event and, in turn, if this affects one's memory for these components. For example, Trueswell & Papafragou (2010) investigated the distribution of attention in English and Greek speakers watching Motion events. They tracked the eye movements of English and Greek participants watching Motion event clips. If, during encoding, participants took part in a non-linguistic suppression task (tapping on the desk), they paid more attention to the details of the event relevant to their language preferences. However, if the participants either undertook articulatory suppression (counting aloud) or did no accompanying task, there was no difference between the English or Greek speakers. Papafragou, Hulbert & Trueswell (2008) similarly looked at how Greek and English speakers distributed their attention when watching Motion events. They tracked the eye movements of participants as they watched video clips while either preparing verbal descriptions or memorising the events. When participants were preparing verbal descriptions, their eyes focused on the event components typically encoded in their language, therefore creating significant differences between English and Greek participants' eye movements. In the memorising task, there were no cross-linguistic differences with participants allocating attention similarly. There were, however, differences once the Motion ended as participants attended to the components of the scene not usually encoded in verbs in their language, indicating that even when not preparing to describe the events, there is an influence of language preferences.

Although the studies above indicate some cross-linguistic differences in attention, there is limited evidence that the same is true for memory. Papafragou, Massey & Gleitman (2002) compared English and Greek adults and children on a delayed recognition task. Participants were shown Motion event images before being asked to describe them. The next day they were shown the same images and new images, which had been altered in either Path or Manner. They were asked to indicate whether there was no change, a Path change or a Manner change. It was found there was no language effect in ability to detect the changes. Likewise Engemann, Hendriks, Hickmann, Soroli & Vincent (2015) tested the recognition memory of Motion events in French and English speakers and report that, regardless of whether the participants verbalised the Motion events prior to the memory task, there was no recognition memory difference between the language groups. Gennari, Sloman, Malt & Fitch (2002) compared English and Spanish speakers' memory for Motion events. First participants were shown Motion event clips while either performing articulatory suppression (repeating a nonsense syllable), verbally describing the scene or conducting no task. After a distractor task, participants were shown a series of video clips and asked to indicate which they had seen previously. The recognition memory task showed no effect of language in any of the conditions. Although the studies above did not find an influence of language on Motion event memory, some studies have reported cross-linguistic differences. For example, Filipović (2011) looked at recognition memory for Motion events in monolingual English speakers, monolingual Spanish speakers and English-Spanish bilinguals. Participants were shown Motion event clips. Half were asked to describe the clips and half were not. They were later shown the same clips or variants of the clips and asked to select which they had seen previously. It was found that English monolinguals outperformed Spanish monolinguals, whether or not they had described the clips. English monolinguals also outperformed English-Spanish bilinguals who behaved more like Spanish monolinguals. Filipović argues that because Spanish has lexical patterns that are acceptable in both languages, English-Spanish bilinguals fall back on Spanish preferences. She also notes that the bilingual participants generally used Spanish both at home and at work, therefore Spanish may have been their preferred or dominant language. The studies above provide a mixture of results for the influence of language on attention and memory. However, many of the studies reveal that articulatory suppression interferes with the effect of language on attention or memory. In the next section I will explore an explanation for these findings.

2.2.4.3 Thinking-for-Speaking

Pourcel (2002) suggests that in order to empirically investigate Linguistic Relativity, one must ensure two controls; firstly all stimuli must be non-linguistic, secondly the participants' output must be non-linguistic. In this way one can avoid a bias in the cognitive behaviour of the participants due to linguistic interference and provide clear evidence for Linguistic Relativity. Much of the evidence presented above does not meet these criteria and, in numerous instances, language-specific differences are only found when participants know that they are expected to describe or memorise the clip that they are watching (for example, Papafragou & Selimis, 2010). The interference of articulatory suppression or verbal shadowing shown by some studies (for example, Trueswell & Papafragou, 2010) also indicates that participants may be rehearsing linguistic description while viewing the clips, therefore violating Pourcel's suggested controls. However, there is interesting evidence provided in these studies for another theory relating to language and thought. Slobin (2006) calls the process described above, where participants are influenced by language preferences when they are rehearsing or describing an event, thinking-for-speaking. He claims that when individuals are producing language (spoken, signed or written) there is a type of online thinking where the individual makes decisions about which components of an event to include based on both their conceptualisation of the event and what is readily encodable in their language. He argues that these preferences over time may lead individuals to pay more attention to certain linguistically relevant components of events when they are encoding them with the expectation of later relating them. This explains why participants show language-specific preferences when either explicitly engaging language (by describing an event) or by using language as a strategy (rehearsing a description of an event to remember it later) but do not show these preferences when they are prevented from accessing language (for example, via articulatory suppression).

Feist & Gentner (2007) tested the thinking-for-speaking hypothesis by showing English-speaking participants dyads of images showing Figure-Ground relations. Half were also shown an accompanying sentence describing one of the images. They were all then shown some of the images again along with new images and asked which they had seen before. Those who read an accompanying sentence were more likely to make false alarm errors with new images which also matched the accompanying sentences they had seen, implying that they had categorised the images linguistically and remembered the meaning of the sentences rather than the exact images.

The thinking-for-speaking hypothesis is of relevance for the current study because the methodology is designed to test this particular hypothesis.

2.3 Sign Languages & Motion Events

Up until now my discussion of Motion events has focussed on spoken languages. However, this study will address depiction of Motion events in a sign language, BSL. In order to understand the role of language-specific preferences for Motion events, it is important to look at languages that operate in both modalities (spoken languages primarily in the auditory modality and signed languages in the visual modality). Although the Motion event typology in Talmy (2000a) only references spoken languages, Talmy (2003) discusses his typology in relation to American Sign Language (ASL). He notes that differences in modality produce differences in the expression of Motion events, including marking finer spatial distinctions, being able to represent more in an individual sign than a spoken language could in a single spoken lexical item (such as including more Path information in one sign than one could in one word, see a signer describing Image 7 in Example 8, below). This potential to mark finer spatial gradience and combine more parts of Path (including Vector, Deixis, Conformation, Direction and Contour) in one sign than spoken languages can in one spoken lexical item will be examined in this study.

Image 7 Video clip of a woman walking away in a straight line past a tree towards a fence

TREE

GIRL

(r) MOVE.figure+from.x+to.y+past.z+away.from.self

(l) BE.entity+located.at.z

The girl moves away from me in a straight line from x to y past the tree.

Example 8 BSL utterance including multiple parts of Path information (Vector, Direction, Deixis and Contour). See Appendix 1 for sign notations used in this study.

Talmy also refers to the simultaneity found in sign language, as a spatial modality allows a signer to represent multiple components concurrently (such as Figure and Ground as seen in Example 9, below) in a way a spoken modality cannot. Indeed, Napoli & Sutton-Spence (2010) report that up to four different components may be expressed simultaneously in sign languages. They suggest that signers do not include more than four components because of the limitations of visual short-term memory. This spatial modality and simultaneity of sign languages make them a particularly interesting area to examine questions around Motion event preferences.

r) TREE+located.at.x

l) BE.figure+located.at.y

There is a tree there with a two-legged entity here.

Example 9 Simultaneity in BSL where both Ground and Figure are being signed concurrently

Below I will discuss the research on Motion event semantics and reference frames in different sign languages. After this, I will examine research on first and second language acquisition of Motion event preferences in sign languages. Finally, I will consider how the study of sign languages can contribute to debates around Linguistic Relativity.

2.3.1 Classification of Motion Events Preferences

2.3.1.1 Motion Event Semantics

To understand the construction of Motion event descriptions in sign languages, one must understand how verbs operate in these languages. Below I discuss the different types of verbs available in sign languages before moving on to describe previous research into Motion event preferences in sign languages.

2.3.1.1.1 Verbs in Sign Languages

As explained previously (see 2.2.2.1.1), Talmy considers that the semantic components expressed in the verb in Motion event descriptions provide the means of differentiating languages. Therefore, it is vital to understand how verbs have been examined in sign language research.

Many researchers have attempted to classify the different types of verbs in various sign languages (see, for example, Chang, Su & Tai, 2005, Fischer & Gough, 1978; Friedman, 1975; Johnston, 1991; Johnson & Liddell, 1987; Meier, 1982; Padden, 1983; Sutton-Spence & Woll, 1999). This study will use the analysis of Lidell (2000). He suggests that there are two types of lexical verb in sign languages. The first are Indicating verbs, which can change direction based on locative arguments. In English, the verb 'put' requires a location (such as 'on the shelf' or 'under the doormat'). In BSL this information about location may be included in the verb by modifying its direction (see an example using BSL DRIVE-TO in Image 10, below). Indicating verbs can also change direction depending on person (for example, first or third person) and/or the number of subjects and/or the number of objects involved (so INVITE-ONE-PERSON can have a different movement to INVITE-MANY-PEOPLE as shown in Image 11, below). Liddell (2000) argues that this directionality of movement is usually associated with the real or imagined location of the referent (for example, directing a verb towards one's boss's office to indicate the boss as the referent). Cormier, Fenlon & Schembri (2015) support this argument in BSL, noting that the use of space for Indicating verbs is motivated by specific mapping of referents. De Beuzeville, Johnston & Schembri (2009), having analysed verbs from an Auslan corpus, suggest that modifying direction in Indicating verbs is optional. Modification of direction can occur but it is not obligatory. The second group of lexical verbs are Plain verbs, which cannot be modified and keep the same form in all situations regardless of person, the number of referents or the location of subjects/objects. BSL Plain Verbs include SMOKE and LIKE (see Image 12, below). Schembri & Johnston note, writing about Auslan, that Plain verbs tend to be body-anchored (located on the body of the signer).

DRIVE-TO-LEFT

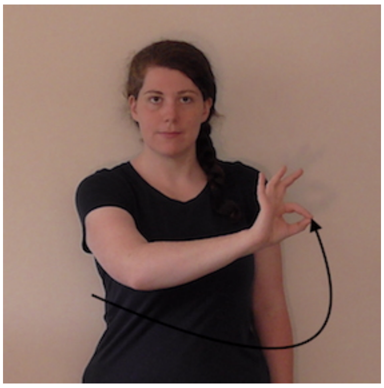
DRIVE-TO-RIGHT

Indicating verbs can change direction to reflect locative arguments

Image 10 BSL Indicating verb DRIVE-TO

I-INVITE-YOU(singular)

YOU(singular)-INVITE-ME



I-INVITE-YOU(plural)

The Indicating verb INVITE changes movement and orientation depending on the subject/object and number of referents.

Image 11 BSL Indicating verb INVITE

The movement and direction of LIKE is the same in all circumstances

Image 12 BSL Plain verb LIKE

Apart from the lexical verbs described above there is another type of verb relevant to the current study. These verbs are called Depicting verbs. Depicting verbs were first described as 'sign language classifiers' by researchers (Frishberg, 1975; Supalla, 1978) due to their perceived similarity to spoken language classifiers. I will first describe how Depicting verbs are similar to spoken language classifiers before explaining how they differ.

Depicting verbs are (partly lexical) signs that use handshapes to refer to groups of nouns in combination with motion and/or location (see Appendix 2 for a list of handshapes used for BSL Depicting verbs that are relevant to the current study). As with some spoken language classifiers, they associate with certain groups of nouns based on shared physical characteristics (see example 24, below, for the use of a spoken language shape-based classifier in Mandarin). Although the exact handshapes may vary, Depicting verbs are found in almost all recorded sign languages (Emmorey, 2003; Nyst & Perniss, 2004; Schembri, 2003). Supalla (1986) suggests that, as with classifiers in spoken languages, it would be ungrammatical to use most Depicting verbs without previously signing the noun involved. For example, one could not sign the G-handshape Depicting verb in lieu of PENCIL (see Image 13, below) without clear context in the surrounding discourse, but could use the G-handshape to refer back to a PENCIL that has previously been introduced in the discourse (or can be inferred from context). These initial similarities between Depicting verbs and spoken language classifiers are what led to their designation as 'sign language classifiers'. However, I will now discuss how Depicting differ from spoken language classifiers and how they function in Motion event descriptions.

(24)	一	條	魚
	yi	tiao	yu
	one	CL-long-shape	fish
	'one fish'		

Although Supalla (1986) states that using a Depicting verb before the noun it describes would usually be ungrammatical, it is possible in some instances. For example, in BSL the Depicting verbs used for PERSON and AEROPLANE (Sutton-Spence & Woll, 1999) may be signed to show movement of the referent without a preceding noun in the discourse (see Image 14, below). Equally, a Depicting verb may be used without a preceding noun if the referent is clear from context. In this way, Depicting verbs differ from spoken language classifiers. Another difference between Depicting verbs and spoken language classifiers is that the latter usually modify nouns (as seen in example 24, above). Depicting verbs have been considered as most similar to verbal classifiers in spoken languages, which use morphemes for size and shape in conjunction with verbs (Cormier, Quinto-Pozos, Sevcikova & Schembri, 2012). However, there is some debate over whether spoken verbal classifiers are truly classifiers as they are usually bound morphemes. For example, in Southern Athabascan the verb and classifier information are bound together in morphemes like '-ą' (meaning to handle a round object) or '-ne' (meaning to throw a round object). Therefore, these are sometimes considered classificatory verbs instead of true classifiers (Grinevald, 2000). Depicting verbs have presented similar difficulties, in that the handshape is always used in conjunction with a location or motion, and thus can never be considered truly 'segmentable'. Depicting verbs are also very productive and, unlike spoken language classifiers, can be used for a number of different purposes, including:

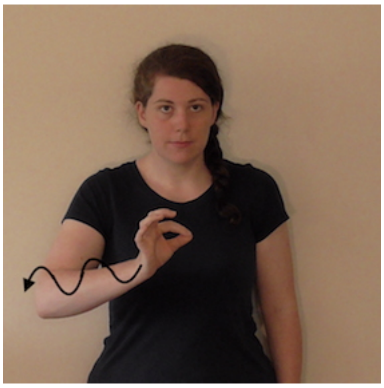
1. Describing the location of an entity, such as using a B-handshape and C-handshape to show a cup on a table (see Image 15, below).
2. Describing how an item is handled, such as using two O-handshapes to show the handling of a lightsaber (see Image 16, below). As Zeshan (2003) notes for Indo-Pakistani Sign Language (IPSL) and Cormier, Quinto-Pozos, Sevcikova & Schembri (2012) suggest for BSL, these are a productive set of handshapes and

have similarities to non-signers' gestures. This productiveness marks them as distinct from the classifiers of spoken languages, which are closed classes (Talmy, 2003).

3. Describing how an entity moves in space, such as using a B-handshape to show a car going past (see Image 17, below).

The nomenclature for this group of signs has been much debated. As mentioned previously, these signs have been labelled 'classifiers'(Frishberg, 1975; Supalla, 1978), but also 'spatial-locative predicates' (Liddell & Johnson, 1987), 'polysynthetic signs' (Takkinen, 1996) 'polycomponential signs' (Slobin et al, 2003), 'depicting constructions' (Cormier et al, 2012) and many other terms. For more on this debate, see Schembri (2003). In this study I will use the term 'Depicting verbs' to refer to the overarching category of signs that use handshapes to refer to groups of nouns in combination with motion and/or location; that is to say, all of the functions described in the list above (Johnston & Schembri, 1999). I will use the term 'Depicting verb of Motion' to refer only to the last function described in the list above.

a) An acceptable use of a G-handshape Depicting verb following a referent



PENCIL

BE.entity+located.at.x

A pencil is here.

b) An unacceptable use of a G-handshape Depicting verb to refer to 'pencil' without a preceding noun or clear context

*BE+?+located.at.x

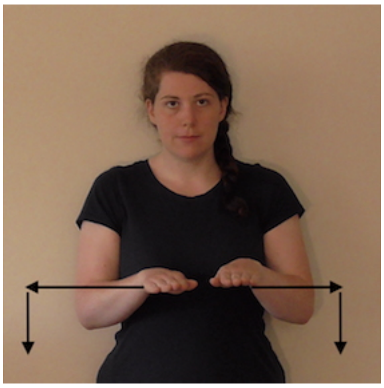
**A long thin ? is here.*

Image 13 G-handshape being used to refer to 'pencil' a) grammatically following the noun b) ungrammatically in isolation without context

MOVE.entity+from.x+to.y+past.self

An aeroplane moves past from x to y.

Image 14 Y-handshape being used grammatically in isolation to reference 'aeroplane'



TABLE

CUP

(r) BE.entity+located.at.x

(l) BE.entity+located.at.y

The cup is on the table.

Image 15 B-handshape and C-handshape being used in the third picture to describe a cup on a table

(r) HOLD.entity

(l) HOLD.entity

[I was] holding [the lightsaber].

Image 16 Two O-handshapes being used to show the handling of a lightsaber

MOVE.vehicle+from.x+to.y+past.self+contour.a

[The car] moves past in a curved line from location x to y.

Image 17 B-handshape being used to describe a car going past

Depicting verbs of Motion are of particular interest to Motion event research as they play a vital role in Motion event descriptions. Having laid out the types of verbs that can be used in BSL (Plain, Indicating and Depicting) I will now move on to discuss how Motion events have been researched in different sign languages.

2.3.1.1.2 Previous Research

Motion event terminology has proven troublesome for the signed modality. Difficulty lies in defining which element in a sign language is the verb root and, therefore, which verb is the main verb around which Talmy (2000a, 2000b) builds his typology. Cross-linguistically a common structure (Supalla, 1990; Tang, 2003) for a Motion event description in sign languages is to use a Manner verb followed by a Depicting verb of Motion to describe Path. There has been debate around which parameter of these verbs is equivalent to the verb root. Some researchers (Liddell & Johnson, 1987; Schick, 1990; Supalla, 1986, 1990) suggest that the movement or location of signs may be seen as the verb root. However, others (such as McDonald, 1982) argue that the handshapes of Depicting verbs of Motion form the verb root. Engberg-Pedersen (1993) and

Slobin et al (2003) state that decomposing the parameters of sign language verbs to find the verb root is not helpful. They point out that, as signs are always a handshape occurring with motion, it is illogical to claim that one specific parameter (be it the handshape, orientation or movement) is the verb root.

Supalla (1990) investigated Motion events in ASL and concluded that it was an S-language because he considered the Manner verb to be the main verb and the Depicting verb of Motion to be a 'reduced serial verb' (therefore fulfilling a satellite function), noting how signers produced constructions similar to English sentences like 'a human limps round in circle'. However, Slobin & Hoiting (1994) argue that the Manner verb cannot be the main verb in ASL because it is optional. Many researchers (Engberg-Pedersen, 1993; Liddell & Johnson, 1987; McDonald, 1982; Schick, 1990) instead suggest that the verb root may be found within Depicting verbs of Motion. As Depicting verbs of Motion indicate Path information, this would suggest that sign languages are V-languages. However, Tang (2003), writing about Hong Kong Sign Language (HKSL), and Slobin (2013), writing about ASL, argue that because Figure information combines with the Motion component in Depicting verbs of Motion, sign languages are also like Talmy's Figure-type languages.

As has been explored above, Depicting verbs of Motion can provide a plethora of information simultaneously. For example, one Depicting verb of Motion in BSL can give detail about Motion, Path, Manner and Figure (see in Example 18, below). Talmy (2003) also notes this preponderance of spatial categories that are able to be represented simultaneously in a Depicting verb, including (but not limited to) Figure information, orientation, Motion, Path contour, length of Path and Manner information (for a full list of suggested categories, see Talmy, 2003, p.191). However, there are restrictions on the information that can be conflated in Depicting verbs of Motion. For example, Tang (2003) notes that in

HKSL Manner can only be conflated in Depicting verbs of Motion when a handshape is used for a 'legged entity'. Supalla (1990) reports the same finding for ASL. Additional Manner information in Depicting verbs of Motion and other verbs (Plain and Indicating) can be provided by NMFs (like puffing cheeks or grimacing to show intensity, see Image 19, below). By changing the movement of Plain and Indicating verbs (see above), they can also be inflected for aspectual information (like durativity or intensity) and for additional Manner detail (for example, signing RUN very quickly to indicate sprinting or using facial expression to show the mood of the Figure).

Noting the difficulty of categorising sign languages based on Talmy's original typology, Slobin & Hoiting (1994) suggest a new category for sign languages based on their research on ASL and Sign Language of the Netherlands (NGT). They propose that sign languages are complex verb-framed languages. They argue that sign languages are V-languages because their spatial modality requires that they represent spatial relations (including Path) when describing events; signs must be located in space and, therefore, obligatorily contain spatial information. However, they are complex because they are also able to simultaneously represent other components (such as Figure and Manner). They suggest that complex verb-framed languages may be seen as akin to the serial verb spoken languages (as discussed in 2.2.2.1.2). Taub & Galvan (2001) investigated the production of Motion event descriptions in ASL through 10 adult narratives of a story. They report that participants optionally combined a number of different components of Motion events in various ways, producing a possible 37 different encodings for just one event. However, Path information was never left out of descriptions with ASL frequently combining Motion and Path in one element (through a Depicting verb of Motion mapping out Motion *and* Path information). This indicates that ASL operates more similarly to a V-language than an S-language, as predicted by Slobin & Hoiting (1994).

MOVE.figure+from.x+to.y+past.self+contour.a+manner.walk

[She] walks past in a curvy line from location x to location y.

Example 18 Depicting verb of Motion providing Motion, Path, Manner and pronominal Figure information simultaneously

RUN+nmf.intense

[I] run hard.

RUN+nmf.easy

[I] run easily.

Image 19 NMFs marking extra Manner information on a verb

With sign languages being considered V-languages, there has also been discussion of how these spatial languages handle boundary-crossing events (see 2.2.2.1.3). Slobin & Hoiting (1994) argue that Depicting verbs of Motion that indicate the crossing of a boundary in sign languages require an arc movement (see an example from this study in Image 20, below). However, Tang (2003) reports that in Depicting verbs of Motion in HKSL, vehicles and animals do not take an arc movement and humans only do when exiting an enclosure. Galvan & Taub (2003) also note that when boundary crossing is involved, complex Paths can be broken up into separate verbs containing different parts of Path (Vector, Deixis or Conformation) so there may be a sequence of verbs equivalent to 'the man walks approaches enters the tunnel' (see an example in BSL in Image 21, below).

MOVE.figure+from.x+to.y+manner.walk

(r) MOVE.figure+from.y+to.z+via.a

(l) BE.entity+located.at.y

[She] walked through [the tunnel].

Image 20 Depicting verb of Motion with arc movement in a boundary-crossing event

HOUSE

MAN

RUN

(r) MOVE.figure+from.x+to.y+past.self

(l) BE.entity+at.y

ENTER

The man approaches and enters the house, running.

Image 21 Description of a boundary-crossing event with complex Path semantics distributed across multiple verbs

Further evidence for Slobin & Hoiting's designation of sign languages as complex verb-framed languages comes from Tai & Su (2013). They conducted a study comparing the Motion event descriptions of Taiwan Sign Language (TSL) users and Mandarin speakers. They report similarities between these two languages despite the different modalities. They suggest that TSL is a complex verb-framed language and even extend this terminology to Mandarin, suggesting that they are typologically similar as they conflate the components of Motion, Manner and Path. The key difference, they argue, is that in Mandarin these components cannot be produced simultaneously while a TSL Depicting verb can represent all of these components at once. They go on to suggest that Talmy's traditional typology should be revised to recognise signed and spoken languages with this pattern, proposing a tripartite distinction of S-languages, V-languages and complex verb-framed languages. Furthermore, they argue that to understand the typology of a language, one must look across both modalities and include analysis of co-speech gestures in spoken languages. They argue for this added analysis because they suggest that co-speech gestures are capable of encoding more refined Manner information. However, other researchers have reported that co-speech gestures do not provide additional information, but merely reflect the spoken language preferences (Kita et al, 2007; Kita & Özyürek, 2003). In fact, Mol & Kita (2012) report that gesture and speech are so closely linked that manipulating participants' co-speech gesture (asking them to describe Path and Manner in either separate or conflated gestures) influenced how they packaged the information in simultaneous speech (including Path and Manner in a separate or same clause). With this debate in mind, some studies have compared sign languages with gesture or co-gesture in the description of Motion events.

Cormier et al (2012) argue for acknowledging the link between gesture and Depicting verbs and present evidence for the gestural origins of different types of Depicting verb (including Depicting verbs of Motion). Schembri, Jones & Burnham (2005) compared the gesture (without co-occurring speech) of Australian non-signers with the signing of ASL signers, Auslan signers and TSL signers. Participants were shown animated films and asked to describe the events they saw in their particular sign language for signers and in gesture (without speech) for non-signers. They found that there were greater similarities between the sign languages than there were between the gesture of non-signers and the sign languages. Notably the main difference between the sign languages was not the location or movement of the signs, but the handshapes used. This suggests that sign languages may have a similar underlying structure for representing Motion events, much as spoken languages exhibit similar structures (for example, being either a V-language or an S-language). Similarly, Singleton, Morford & Goldin-Meadow (1993) compared the gesturing of hearing non-signers with ASL descriptions of Motion events and report that they were very similar with the exception of handshape choice. Taub, Piñar & Galvan (2009) also found similarities between co-speech gesturing and signing. They showed English speakers, Spanish speakers and ASL signers a cartoon and elicited Motion event descriptions. All three languages preferred to convey Figure and Ground information in specific signs or words (lexical) rather than trying to map these components in the space in front of them through signing or gesture (spatial). In ASL this involved producing Ground and Figure signs prior to spatially mapping the other information through Depicting verbs of Motion (note that this preference has been previously noted in the elicited data of many sign languages, see Napoli & Sutton-Spence, 2014). All the languages showed a preference for spatially mapping Path information (through Path gesturing in English and Spanish and Depicting verbs of Motion in ASL). However, Manner was most commonly expressed in speech rather than gesture in English and Spanish. These results indicate that although there are different strategies for representing Motion events in signed and spoken languages, there are some cross-modal similarities, perhaps indicating some universal structures across the modalities. Having explained the relationship between signed and spoken languages in Motion event semantics, below I will discuss their relationship in the use of reference frames.

2.3.1.2 Reference Frames

To be able to compare Motion events in signed and spoken languages, it is important to understand how they are able to represent topographic space. The following studies will explain the difference between visual space and grammatical space in signed languages. Atkinson, Woll & Gathercole (2002) investigated a deaf BSL signer with Williams Syndrome, a neurodevelopmental condition that, among other things, affects understanding of space. They found that the syndrome did not cause any impairment in her signing ability except when performing spatial representation tasks, such as describing locations, where she was characteristically impaired. This is the same pattern as found in those with Williams Syndrome who use a spoken language (Landau & Hoffman, 2005); the language itself is unaffected, but reference to spatial aspects is impaired. Other indications that use of space for linguistic means and understanding of space in general are separate can be found in case studies of brain damage. Poizner, Klima & Bellugi (1990) and Emmorey, Corina & Bellugi (1995) note that signers with right hemisphere damage show impairment in their topographic sign skills but no deficiency in their use of space for syntactic or grammatical means. Signers with left hemisphere damage, conversely, are able to produce topographic descriptions but are impaired in grammatical abilities like pronominal reference and verb agreement. When Emmorey et al (1995) studied a hearing signer with brain damage, they found that she was impaired in non-language spatial abilities (such as reconstructing patterns) but did not have any specific linguistic issues with either English or ASL apart from when describing topographic space. For example, when producing topographic descriptions, she was able to use the correct signs for objects but she could not locate them appropriately in her signing space.

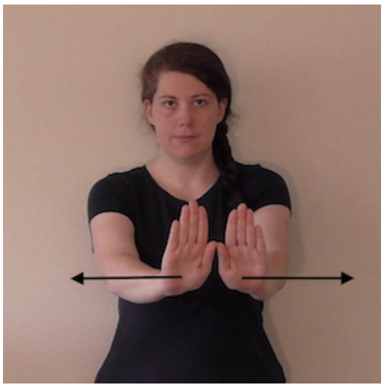
Although one might expect the descriptions of space in sign languages and spoken languages to be very different, examinations of simple locative constructions indicate remarkable similarity across the two modalities. Emmorey, Tversky & Taylor (2000) analysed English speakers and ASL signers descriptions of memorised maps. They discovered that in both languages there was an optionality of perspective, either an allocentric survey perspective (descriptions from a bird’s-eye viewpoint) or an egocentric route perspective (descriptions from a person’s viewpoint). They report that these perspectives occurred in both languages, although signers were more likely to adopt an allocentric survey perspective. There is also evidence in BSL (Sutton-Spence & Woll, 1999) that signers tend to use an allocentric survey perspective for simple topographic descriptions.

One crucial way in which signed languages and spoken languages differ is that users of spoken languages only have to make decisions about perspective in circumstances where the description of location is absolutely necessary (such as in locative constructions or when describing topography). However, users of sign languages frequently have to locate referents within the physical space in front of them, even when location information is not essential (see a description of Image 22 in Image 23, below). Many sign languages (including BSL and ASL) describe everyday scenes (as opposed to the simple topographic descriptions mentioned above) from the signer perspective, requiring an interlocutor to mentally rotate the scene to understand it (Emmorey, Klima & Hickok, 1998; Sutton-Spence & Woll, 1999).

Each sign language, like each spoken language, has a preferred way of describing space. However, some sign languages that have developed relatively recently are still in the early stages of setting this standard. This is the case for Nicaraguan Sign Language (NSL), which emerged as a language during the late 1970s after a school for the deaf was established in Nicaragua, bringing together deaf students from various regions and combining their individual home-sign systems. Now there are deaf children for whom NSL is their first language and studies have sought to investigate the difference between the signing of the first cohort of NSL-signers, who initially developed the language, and the second cohort of NSL-signers, who acquired the language ten years later. Pyers, Shusterman, Senghas, Spelke & Emmorey (2010) found that first cohort signers were less consistent in their use of space than second cohort signers and that the second cohort signers outperformed the first cohort in tasks involving spatially guided searches. Senghas (2011) notes that the first cohort used space in a more limited way than in other recorded sign languages. They did not use space for pronominal reference and did not spatially modulate verbs as found in numerous other sign languages (see 2.3.1.1.1). For example they would sign SEE neutrally and not modulate it left or right to indicate which direction a referent was looking in. The second cohort of signers, however, used space in a more universally standard way and showed pronominal reference and verb modification. They also found that first cohort signers did not use space consistently when describing events and a signer might sometimes describe space from a first-person (viewer) perspective and might sometimes rotate it for the interlocutor. However, most second cohort signers showed internal consistency and either always used a first-person perspective or always rotated the perspective for the interlocutor, with the majority preferring the first method (the preference found in ASL, BSL, Auslan and other sign languages). As the study of NSL indicates, the acquisition of spatial relations in sign languages has been of great interest to researchers. Below I will discuss the first and second language acquisition of some language-specific preferences for Motion events in sign languages.

Image 22 Video clip of a woman standing outside some shops

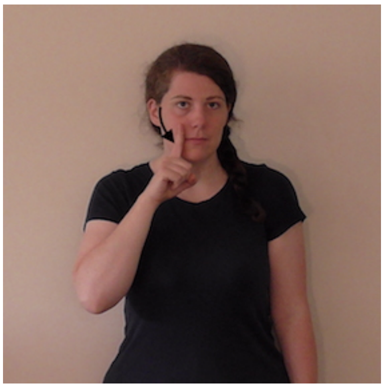
SHOP



BE.entity+located.at.x

CAR

BE.vehicle+located.at.y [c]



WOMAN

BE.figure+located.at.z

There are some shops in the background with a car on the right. A woman is standing in front.

Image 23 Use of first-person perspective to describe a scene

2.3.2 Acquisition of Motion Event Preferences

2.3.2.1 First Language Acquisition

Of particular interest in the development of children's description of spatial relations in sign languages has been whether children acquiring a signed language develop spatial referencing skills at the same age as children acquiring a spoken language. Evidence from Morgan, Herman, Barriere & Woll (2008) suggests that the occurrence of linguistic preferences for describing Motion events may be later for children acquiring a sign language. They report on the acquisition of Motion event descriptions by a child learner of BSL. Interactions between the child and his mother (also a native BSL signer) were recorded between the ages of 1;10 and 3;0. Before the age of two, the child preferred to describe motion by enacting it, pantomime-like, with his whole body. This is similar to the preferences of hearing children, who also use their own bodies as a means of representing objects (such as miming kicking to show a footballer). After 2;0 he had begun to use objects around him and finger tracing to demonstrate information about Ground, Path and Manner. However, by age three, he was nowhere near target forms for BSL. Morgan et al (2008) also looked at the performance of 18 signing children aged 3;0 to 4;11 on a BSL motion and location sentence comprehension task. Their results indicate, again, that the children did not have an advantage for describing spatial relations due to acquiring a signed rather than a spoken language. In fact, despite the iconicity of spatial relations in BSL, even the oldest children in the study (4;11) struggled to correctly comprehend motion and location sentences. Similarly, Engberg-Pedersen (2003) explored children's descriptions of Motion events involving falling in Danish Sign Language. She notes that before the age of 8;4 children mainly used a V-handshape in Depicting verbs of Motion describing falls, overextending the handshape for animate legged entities to inanimate objects (such as a beehive) and not matching adult preferences. They also showed difficulty indicating the correct orientation of the Figure during the fall (that is to say, facing forwards or backwards). One explanation for the delays described above may be to do with the modality. Although sign languages are not gesture, they share some of the features of complex gesture and therefore require children to reach certain developmental stages (such as having well-established handedness, fine motor skills and the ability to rotate perspective) before they are able to produce target-like signs.

Smith & Cormier (2014) report on the use in BSL of Depicting verbs and constructed action (a pragmatic feature where signers take on the role of a character in a scene to show actions or emotions) by children aged 8;0–10;0 describing a cartoon. Children used Depicting verbs productively and frequently, with eight out of the ten children using it in their descriptions. Deaf children from deaf families preferred the use of Depicting verbs to constructed action, although this preference was reversed for deaf children from hearing families. This suggests that the age of acquisition (generally later for children of hearing parents) and the signing ability of the caregivers (generally lower for children of hearing parents) might influence the child's language. However, differences found in childhood signing do not necessarily persist into adulthood. For example, Beal-Alvarez & Trussell (2015) report on deaf adult ASL signers who varied in their age of acquisition of ASL from one to 19 years old. They found, in a narration task eliciting constructed action and Depicting verbs of Motion, there was individual variation but there was no effect of age of acquisition on the adults' signing.

Newport & Meier (1985) suggest that children may acquire Depicting verb morphology late in ASL because sorting entities by semantic or size/shape categories requires a child to reach certain cognitive stages (as mentioned above). Supalla (1982) studied the acquisition of ASL Depicting verbs of Motion by three children aged 3;6–5;11. He reports that the children used the correct Depicting verb of Motion handshape when describing Motion events in 84–95%

of instances. However, they struggled to simultaneously integrate Path and Manner in a Depicting verb. Additionally, unlike adults, the children often omitted a Depicting verb showing Ground. Schick (1990) also reported that children aged 4;5–9;0 acquiring ASL often omitted Ground Depicting verbs. Similarly, Sümer (2015) reports for Turkish Sign Language (TİD) that children aged 4;0–6;0 omitted Ground more frequently than adult signers. However, the signing children did regularly use Depicting verbs of Motion and provided more Manner information in their utterances than Turkish-speaking peers. Slobin et al (2003) report similar findings for children learning ASL and NGT. The children showed difficulties in the use of Depicting verbs for Ground, such as omitting them or choosing incorrect handshapes. However, they report that children as young as 3;8 produced Depicting verbs of Motion (for example, a Depicting verb of Motion showing a person walking away from the child). Sallandre, Schoder & Hickmann (2018) report on the acquisition of Motion event preferences in French Sign Language (LSF) and show that children as young as 5;0 produced Depicting verb of Motion descriptions featuring Path and Manner. They also report that the preference for including both Path and Manner in LSF Motion event descriptions increased with age (in 71% of utterances at 5;0–6;0, 76% of utterances at 7;0–8;0, 80% at 9;0–10;0 and 90% in adulthood). They found that some event types elicited Manner+Path constructions at earlier ages (Up/Down events) while some had fewer Manner+Path constructions even in adult descriptions (boundary-crossing events). This latter preference is of particular interest as LSF signers used Manner+Path utterances in boundary-crossing events less than English speakers (S-language) but more than one would expect of a typical V-language, contributing further evidence that sign languages are complex verb-framed languages (as suggested by Slobin & Hoiting, 1994).

2.3.2.2 Adult Language Acquisition

There is limited research into late acquisition of Motion event descriptions in sign languages. However, research into late acquisition of sign languages is of interest for this current study as late signers make up two of the participant groups involved. Williams & Newman (2016) report on phonological errors in ASL comprehension for late signers translating from ASL to English. They note that the highest number of phonological errors were attested in movement parameters where late signers used an incorrect translation based on a confusion of movement (see Image 4 in section 2.3). They also report that higher proficiency late signers made proportionally more phonological errors based on handshape than lower proficiency late signers (see Image 2 in section 2.3). However, the signs examined in the study were specific lexical signs not Motion event descriptions using Depicting verbs, where late accuracy may differ. Marshall & Morgan (2014) looked at how accurate late users of BSL (with 1–3 years of learning) were at producing Depicting verbs in locative constructions. When producing locative constructions, late signers were very accurate at encoding the location and orientation of the Depicting verb. However, they were far less accurate at using the appropriate handshape. They also compared the same late signers with non-signers on their accuracy in comprehending Depicting verbs in locative constructions. Participants were shown a video clip of a locative construction in BSL and were then asked to select which picture had been described from four possibilities. The late signers were extremely accurate in their comprehension but the non-signers were also above chance in their comprehension, suggesting that these constructions are potentially interpretable by non-signers due to some similarities to gesture. Cormier, Schembri, Vinson & Orfanidou (2012) support the finding of late signers' high accuracy in comprehending BSL Depicting verbs of Motion. They report on a grammaticality judgment task, which compared deaf native signers (from deaf families and acquired BSL from birth), deaf early signers (from hearing families and acquired BSL between ages two to eight) and deaf late signers (from hearing families and acquired BSL after age eight) on syntactic structures. Responses to Depicting verbs of Motion were significantly more accurate than most other constructions in all groups. Participants accurately judged Depicting verb of Motion constructions as ungrammatical when the order of the constituents was altered (from the grammatical Ground-Figure-Motion to the ungrammatical Motion-Ground-Figure). The researchers suggest that this may be due to a 'natural' order found in both Depicting verb of Motion constructions and in non-signers' gesture without speech; both standardly use the order Ground-Figure-Motion. Similarly, Marshall & Morgan (2014) suggest that their research points towards gesture conventionalising into Depicting verbs historically and this could serve as an explanation for why late signers are so accurate in this area. These studies raise questions about whether late signers are highly accurate in all parts of their Motion event descriptions, or just in the order of components due to the similarity to gesture. The current study aims to provide a better understanding of how early signers and late signers differ in their descriptions of Motion events in BSL.

2.3.3 Linguistic Relativity

In section 2.2.4, I discussed the theory of Linguistic Relativity in relation to Motion events in spoken languages. There is currently no research on the influence of BSL or other sign languages on conceptualisation of, or memory for, Motion events. However, below I will discuss the theory of Bodily Relativity and previous research that suggests knowledge of a sign language could influence cognitive processes.

2.3.3.1 Bodily Relativity

Casasanto's Body-Specificity Hypothesis, also known as Bodily Relativity, draws on both philosophical ideas of embodied cognition (the notion that human thoughts are intrinsically linked with one's body) and Linguistic

Relativity. Bodily Relativity suggests that experiencing the world through one's body is what shapes one's conceptualisation of the world and one's perceptions.

A major area of research for Bodily Relativity is handedness. Casasanto suggests that handedness influences our judgments of good and bad. When Casasanto & Jasmin (2010) analysed the co-speech gestures of presidential candidates in the final debates of the 2004 and 2008 US elections, it was discovered that the two right-handed politicians consistently associated positive messages with right-handed gestures and negative with left-handed gestures. The opposite was true for the two left-handed candidates. Similarly in experiments where participants were asked to assign 'good' and 'bad' objects into two boxes, participants significantly preferred assigning good objects to their dominant-hand side (Casasanto, 2009; Casasanto & Henetz, 2012; Kominsky & Casasanto, 2013). Willems, Toni, Hagoort & Casasanto (2009) also suggest that our understanding of verbs is related to our handedness, reporting that when participants undergoing functional magnetic resonance imaging (fMRI) read manual action verbs they activated the cortical areas involved in motor planning. This activation was left lateralised in right-handers but right lateralised in left-handers. Willems, Toni, Hagoort & Casasanto (2010) also found that when participants imagined performing a verb's action the same area was activated and was accompanied with primary motor cortex activation. Hauk, Johnsrude & Pulvermüller (2004) similarly report that when participants read action words, there was activation in the areas involved with action planning for the body part associated with that verb (for example, the word 'kick' would activate regions involved in action planning for the legs). These studies indicate, then, that our language, our handedness and our perceptions of the world are all linked. Relatedly, Kita & Alibali (2017) propose the 'gesture-for-conceptualization' hypothesis, which argues that gestures are not just a physical representation of mental concepts but instead are an aid to explore and package spatial information. They show that gestures can help reinforce memorisation and assist in spatial problem solving.

One might argue that handedness is just a symptom of brain lateralisation and the preferences found in the studies above are to do with brain structure, not hand dominance. There are indications, though, that Bodily Relativity is not related to brain lateralisation in early development, but is instead linked to habitual preferences. Wagner, Dal Cin, Sargent, Kelley & Heatherton (2011) showed smokers and non-smokers movie scenes during which smoking took place. They report that smokers had neural activity in the regions involved in the simulation of hand-based gestures when viewing smoking, while non-smokers did not. Similarly, Maguire et al (2000) compared fMRIs of London taxi drivers with control participants and discovered that the posterior hippocampi were significantly larger in the taxi drivers while the more anterior hippocampal region was larger in the controls. Additionally, the size of the posterior hippocampi in the taxi drivers positively correlated with the amount of time spent as a taxi driver. As the posterior hippocampus is often assumed to store spatial representations for navigation, it is suggested that plasticity in the brain allowed this area to increase with continued use.

The evidence given above seems to support the idea that categorisation and conceptualisation of the world could be related to outward traits. It is my suggestion that a combination of thinking-for-speaking and Bodily Relativity would lead us to believe that those individuals who have grown up using sign language will have a distinct experience of the world and conceptualise the world around them differently when preparing to communicate than those who have grown up using a spoken language. Prior research has shown advantages in perception for signers over non-signers. For example, early signers (deaf and hearing) have been shown to be better than non-signers (deaf and hearing) at discriminating between faces (Arnold & Murray, 1998; Bettger, Emmorey, McCullough & Bellugi, 1997; McCullough & Emmorey, 1997; McCullough, Emmorey & Sereno, 2005), identifying facial expressions (Goldstein & Feldman, 1996), remembering object locations (Cattani & Clibbens, 2005), discriminating between certain objects (Arnold & Mills, 2001), mental rotations (Emmorey et al, 1998) and memorising shapes (Cattani, Clibbens & Perfect, 2007). There may be an explanation for all of these advantages that encompasses the suggestions of thinking-for-speaking and Bodily Relativity, which is that when signers are taking part in these studies, they code much of the information linguistically and thus their memory is aided by coding into a visuospatial language. As von Essen & Nilsson (2003) found, participants remember action words better if they perform an action rather than just voice the action verb, but success for remembering is just as high when signing the action lexical verb as for when performing the action. Zimmer & Engelkamp (2003) report similar findings when comparing verbalising nouns or action phrases (a lexical verb alongside a noun) to either acting them out or signing them. They also report that iconicity (specifically how similar the lexical signs were to miming the action phrase) did not influence how likely signers were to remember items. Secora & Emmorey (2015) report on a study where ASL signers were shown directional motion sentences (for example, GLASSES YOU PUT-ON) and took part in a semantic judgment task where they pressed a button that was towards/away from the participant. When the verb semantics (towards/away) matched the button position (towards/away) participants showed faster response times than when the verb semantics and the button position were incongruous. This reflects previous findings of action simulation effects found in written and spoken English (Borreggine & Kaschak, 2006; Glenberg & Kaschak, 2002). However, Vinson, Perniss, Fox & Vigliocco (2016) report that deaf native BSL signers showed action simulation effects when reading written English sentences (for example, 'I posted the box to you') but not when watching equivalent BSL video clips of Indicating verbs (for example, I-POST-TO-YOU). The authors note that the results in Secora & Emmorey (2015) were driven by one-person Indicating verbs (PUT-ON-FACE) as opposed to the two-person verbs explored in their study (x-POST-TO-y). They suggest that the more complex semantics involving the transfer of an object may eliminate the action simulation effect. Watkins & Thompson (2017) compared how handedness of signers influenced their reaction time for sign comprehension. They found that one-handed signs were recognised more quickly by both right- and left-handers when produced by a right-handed signer. However, two-handed asymmetrical signs (such as GUITAR, where the two hand orientations and locations differ) were recognised more quickly when the sign handedness matched viewer handedness, with right-handers quicker to respond to right-handed signs and left-handers quicker to respond to left-handed signs. This finding is interesting as right-handedness is dominant in the population and one might therefore assume that groups would be more familiar with comprehending right-handed signs, regardless of sign complexity. However, the authors argue that while comprehending simple signs does not engage the motor system, comprehending more phonologically complex signs (asymmetrical two-handed) does require motor system engagement in line with the suggestions of Hickok, Houde & Rong (2011).

It is important to note that Linguistic Relativity and Bodily Relativity are not without criticism. For example, Li & Gleitman (2002) suggest that many of the differences found in research on Linguistic Relativity are cultural not linguistic. However, Casasanto (2008) suggests that almost all arguments against Linguistic Relativity boil down to criticisms of experimental design. In 3.4 I will explain the measures taken in the current study to address such criticisms.

Work on Linguistic Relativity has typically focussed on comparing two languages that function primarily in one modality (spoken) and occasionally also considering the role of a second modality through gesture. However, I would argue that if linguistic differences in perception and memory are to be found anywhere, it is likely to be between languages principally operating in two different modalities (spoken and signed). Again, it is important to note that the differences we might expect from a signed language do not come from the deafness often associated with it. As has been shown above, different brain organisation can be due to habitual preferences and therefore when looking at studies of deaf individuals one must dissociate deafness from language. Therefore, one must assume that when certain structures or behaviours are found in all deaf people (regardless of the age of acquisition or of preference for a particular language) these relate to auditory deprivation. However, when a difference in structure or behaviour is found between deaf/hearing users of a sign language and deaf/hearing non-signing individuals, one must assume that this is due to the language.

There are studies that indicate knowledge of sign language, as opposed to a spoken language, influences certain cognitive abilities. Research has found a link between specific linguistic features and certain cognitive abilities. For example, Thompson, Vinson & Vigliocco (2009) investigated the categorisation of signs in the mental lexicon of ASL signers. Participants were asked to indicate, by pressing a button, whether a picture and a following sign referred to the same object. In one condition, the iconic feature of the sign (for example, BIRD, produced with thumb and forefinger as the mouth, representing a bird's beak) was salient (a bird pictured from the front, beak in view), whereas in the second condition, the iconic property was not salient (a picture of a bird flying, beak not as clearly in view). English-speaking non-signers were also presented with the same pictures followed by English words. ASL signers responded faster when the iconic property of the sign was salient in the picture than when it was not, whereas non-signers showed no difference. This indicates that ASL speakers may categorise the features of objects by the signs they use for them.

Vinson, Thompson, Skinner & Vigliocco (2015) replicated this finding in BSL. They also investigated the effect of motion iconicity, where the direction of a sign matches the perceived direction semantics of the concept (for example ROCKET in BSL has an upward movement and the concept of a ROCKET has 'upwards' semantics). Participants were asked to watch a sign and then make a decision as quickly as possible on whether the sign moved upwards or downwards. BSL signers showed quicker response times for congruous sign direction and semantic direction than for incongruous sign direction and semantic direction. English-speaking non-signers did not show this difference. In another study, Thompson, Vinson & Vigliocco (2010) gave users of BSL and non-signing participants a decision task on signs. Participants had to indicate whether the dominant fingers in the sign handshape were straight or curved. If the sign was highly iconic, the signing participants took longer to make the decision about whether a sign had curved/straight fingers. Iconic signs inhibited both response times and accuracy. This indicates that even though the meaning of the sign was not required, it interfered anyway. Similarly, Grote (2013) suggests that there is 'Modality Relativity' from her research on German and German Sign Language (DGS). She reports that DGS signers and German speakers differ in their semantic concepts due to their language. Deaf DGS signers, hearing bilingual DGS signers and German speakers were given a forced-choice judgment task where they were presented with a picture of a noun (for example, a cucumber) and then pictures of either a paradigmatically related concept (for example, a carrot) or a syntagmatically related concept (for example, 'cutting'). DGS signers (regardless of hearing status) showed a significantly stronger preference for selecting a syntagmatic relation while German speakers showed an equal preference for syntagmatic and paradigmatic relations. Grote proposes that the link between a referent and a syntagmatically related concept is reinforced in DGS (but not German) because a noun and a related action can be produced simultaneously (something which is not possible in a spoken language). She notes that this link is not reinforced for a referent and a paradigmatically related concept in DGS because these tend to be produced sequentially, as in a spoken language. Sehyr & Cormier (2016) report on categorical perception for handling Depicting verbs by deaf BSL signers and hearing non-signers. Although both groups showed categorical perception for the handshapes used in handling Depicting verbs, deaf BSL signers showed slower response times than hearing non-signers for handshapes at a perceptual boundary, indicating linguistic interference. These studies indicate that using a sign language may influence how one categorises objects (Thompson et al, 2009), distinguishes between handshapes (Sehyr & Cormier, 2016; Thompson et al, 2010) and views semantic relations (Grote, 2013).

There have been some studies that have investigated whether acquiring a signed language can influence memory. For example, Larson & Chang (2007) compared children who were taught ASL alongside English with those who were not. It was found that children learning ASL showed a slight advantage over those who did not in remembering details of a story they had been told, but the difference was not significant. Wang (2012) studied the working memory of Auslan sign language interpreters to see whether having acquired a sign language as an adult improved working memory. He reports finding no difference in working memory between sign language interpreters and spoken language interpreters. Although studies have addressed memory for Motion events in spoken languages (see section 2.2.4.2), there have not yet been any studies that compare spoken languages and signed languages. This study will address this lacuna and will investigate the thinking-for-speaking hypothesis in memory for Motion events by BSL users and English speakers. The next chapter will explain the methodology for this investigation.

3 METHODOLOGY

3.1 Introduction

The aim of this chapter is to outline the methodology used in this study. I will start by describing how the research method was chosen and designed before providing details of the apparatus, materials and procedure used.

3.2 Purpose & Hypotheses

This study will create a better understanding of how early users of English and BSL differ in terms of their expression of motion, how late users of BSL are different from early signers in their descriptions and how linguistic preferences may influence memory for these events. I have chosen Motion events as an area of investigation because BSL and English have different ways of expressing space due to the former being a three-dimensional spatial language and the latter being a primarily linear spoken language (there may also be optional simultaneous gesture in the visual modality). Comparing descriptions from monolingual English speakers, early signers (hearing and deaf) and late signers (hearing and deaf) will show how they differ in the components they include and the way they are packaged.

This study will provide an insight into the conceptualisation of, and memory for, Motion events in both BSL and English. If the two modalities differ in their strategies for encoding descriptions linguistically, does this also lead users of the languages to differ in their mental encodings of the events? By comparing the memory for Motion events of early signers, late signers and monolingual English speakers it will be possible to see whether this seemingly non-verbal non-linguistic skill is influenced by language preferences. This will contribute to debates relating to Linguistic Relativity (as discussed in 2.2.4 and 2.3.3).

There are four main research questions in this study. Firstly, how do early signers and monolingual English speakers (in speech and co-speech gesture) differ in their inclusion and packaging of Motion event components? Secondly, how do early BSL signers and late BSL signers differ in their inclusion and packaging of Motion event components? Thirdly, how do early BSL signers and monolingual English speakers differ in their recognition memory for Motion event components? Fourthly, how do early BSL signers and late BSL signers differ in their recognition memory for Motion event components?

The hypotheses of this study are as follows:

1. Both monolingual English speakers and early BSL signers will regularly include all four basic components of Motion events (Motion, Figure, Ground and Path) as well as Manner information in their Motion event descriptions. However, early BSL signers will provide fuller Path detail than monolingual English speakers through the use of BSL Depicting verbs of Motion (which are capable of combining more parts of Path than English verbs, including Vector, Deixis, Conformation, Direction and Contour).
2. Both early signers and late signers will regularly include all four basic components of Motion events (Motion, Figure, Ground and Path) as well as Manner information in their Motion event

descriptions. However, early signers will provide fuller Path detail than late signers through the use of BSL Depicting verbs of Motion (which are capable of combining more parts of Path than English verbs, including Vector, Deixis, Conformation, Direction and Contour). Late signers will be influenced by their early English and so will only include Path information that is regularly included in English.

3. If one's early childhood language can influence focus of attention to components of Motion events important to descriptions in that language then early signers will perform better than English monolinguals at the recognition memory task (because, being a spatial language, BSL entails a higher level of detail in descriptions than English).
4. If a language acquired as an adult can influence focus of attention to components of Motion events important to description in that language then late signers will perform better than English monolinguals at the recognition memory task (because, being a spatial language, BSL entails a higher level of detail in descriptions than English).

3.3 Justification of Design

In designing my study, I reviewed the methodologies used in previous research and considered how suitable they were for studying Motion events along with how appropriate they were for sign language research. Below I will consider the benefits and disadvantages of some of these methodologies. I will not include all possible methodologies because many involve data or equipment that would be unavailable (for example, fMRI studies) or because the methodology would not be adaptable to deaf participants (for example, spoken stimuli). I will consider two issues related to methodologies: firstly the type of stimuli used to elicit data and secondly the tasks used in conjunction with these stimuli.

3.3.1 Stimuli

3.3.1.1 Picture Storybooks

A large number of studies have used picture stories to elicit description of motion (Cardini, 2008; Naigles, Eisenberg, Kako, Highter & McGraw, 1998; Taub & Galvan, 2001). One of the most frequently used stories to elicit Motion event description is 'Frog, Where Are You?' (Mayer, 1969). This collection of drawings portraying Motion events, collectively called the Frog Story, depicts a small boy and his dog searching for a lost frog and engaging in a series of Motion events along the way (for example, climbing up a tree and falling down a ravine). Child and adult language data from various languages have been collected through participants describing the Frog Story. These include ASL (Taub & Galvan, 2001), BSL (Morgan, 2002), Italian (Cardini, 2008), Spanish (Naigles et al, 1998), Mandarin (Xu, 2013), Basque (Ibarretxe-Antuñano, 2004), Tzeltal (Brown, 2000) and many others. Due to its popularity, one of the main advantages of using the Frog Story to elicit Motion event data is that it is easily comparable with cross-linguistic data. It is also a simple task to administer, as participants are simply shown the pictures and asked to tell the story. This produces structured and reliable data as all participants are given the same stimuli and, therefore, should produce utterances which are comparable inter- and intra-group. However, there are some disadvantages to using this picture description method. Firstly, as Slobin (2004) notes, it encourages a particular narrative style and the speech elicited may exhibit a level of rhetoric that would not be found in everyday Motion event description. Secondly, the pictures involve personal interpretation and may be misunderstood. This could lead to data that may not be comparable. It is also impossible to elicit nuances of Motion event description through pictures. For example, it would be difficult to depict the difference between running at a moderate pace and running very quickly in an illustration. Considering the limitations outlined, this study did not use static picture stimuli.

3.3.1.2 Video Clips

Video clips are often used in Motion event studies as, unlike with picture stimuli, the participant does not need to infer motion from the scene they are looking at. Video clips include the Motion that researchers are investigating instead of relying on participants to imagine it. Video clips can either be animations or live action clips. Animations that have been used to elicit Motion event descriptions include 'The Banjo Frog' and 'Pear Film' (Feiz, 2011). Another common choice is a section of the Looney Tunes' cartoon 'Canary Row' as it contains a number of Motion events played out by the two main characters, Sylvester and Tweety-Pie (such as Tweety-Pie swinging back-and-forth on his perch, Sylvester climbing up a drainpipe and Sylvester rolling down a hill). As with the Frog Story, one advantage of using the 'Canary Row' video clip is the availability of cross-linguistic data. It has also been used to investigate co-speech gesture (Alibali, Heath & Myers, 2001; Choi & Lantolf, 2008; Kita & Özyürek, 2003; Taub et al, 2009). Although 'Canary Row' has been used to elicit data from deaf individuals (Taub et al, 2009), the cartoon uses auditory devices to assist understanding of the action (Sylvester being told to 'get out' or the crash of pins falling as he rolls into a bowling alley), which puts a deaf audience at a disadvantage. Pre-existing cartoons, like 'Canary Row', also do not allow the experimenter to choose exactly which Paths and Manners are elicited. The same limitation exists with using excerpts from live action films as stimuli (as found in Furman, Dorfman, Hasson, Davachi & Dudai, 2007; Kuriyama, Soshi, Fujii & Kim, 2010; Matlock, Sparks, Matthews, Hunter & Huette, 2012). If a researcher wishes to control the exact components elicited then they must use specially designed video clips.

There are animated stimuli that have been specifically designed for researching Motion events, for example 'Tomato Man' (Kita et al, 2007; Özyürek et al, 2008; Özyürek, Kita & Allen, 2001) and 'Hoppy' the cartoon man (Engemann et al, 2015; Hendriks & Hickmann, 2015; Hendriks et al, 2008). Video clips of live action have also been designed to elicit Motion event description (Gentner et al, 2013; Gullberg & Narasimhan, 2010; Lakusta & Landau, 2012; Özyürek et al, 2008; Swallow, Zacks & Abrams, 2009). An advantage of creating stimuli is the ability to completely control which components are included in clips, allowing for counterbalancing within the stimulus set. Animations and live action video clips share this same advantage but have different disadvantages. Animations can be expensive and difficult to create, requiring knowledge of graphic design. Live action video clips can also be difficult to produce, especially when trying to maintain a high level of consistency across clips.

This study used specifically designed live action video clips as these were considered the most appropriate for eliciting specific components and allowing counterbalancing within the set. Explanations of the components explored in the video clips, and how they were counterbalanced, is included in 3.4.1.

3.3.2 Tasks

The simplest means of eliciting Motion event descriptions is to present stimuli to participants and ask them to describe what they have seen. The descriptions can then be coded for which components are included and how they are packaged (for example, whether Manner information is included and whether it is found in a verb or a satellite). This is the most prevalent methodology in Motion event research (Alibali et al, 2001; Brown, 2000; Cardini, 2008; Choi & Lantolf, 2008; Feiz, 2011; Hendriks & Hickmann, 2015; Ibarretxe-Antuñano, 2004; Naigles et al, 1998; Xu, 2013). It is an extremely effective means of collecting linguistic data and, unlike observing spontaneous production, the descriptions elicited are comparable across participants and across groups.

Ideally participants are asked to describe the Motion events to an interlocutor (Brown & Gullberg, 2010a) rather than to the experimenter or a camera to reduce the influence of observer effects. This study did not have native signers present during experiments due to financial limitations. However, early and late signing participants were told that their descriptions would be seen by a native signer who would be asked to select the video clips being described from an array.

As this study is interested in both how Motion events are encoded and how this affects memory, it was necessary to include a memory task as well as a description task. Previous research has used forced-choice judgment tasks to investigate whether differences in linguistic coding affect the perceived salience of components of Motion events (frequently Path and Manner). In forced-choice judgment tasks, participants are shown a target clip before being shown a pair of clips (usually one identical to the target except for the Path and one identical to the target except for the Manner). They are then asked to select which of these two clips is most like the target clip seen previously. This methodology has been used in many different studies (Athanasopoulos & Bylund, 2013; Cardini, 2010; Papafragou & Selimis, 2010; Soroli, 2012; Soroli & Hickmann, 2010) to compare which components speakers of various languages find the most salient.

A task typically used to test recognition memory for Motion events involves showing participants target items and then later, in the testing phase, showing unaltered or altered items one-by-one and asking participants if they had seen that exact item before. This has been used to successfully test recognition memory in a number of languages (Engemann et al, 2015; Filipović, 2011; Gennari et al, 2002; Papafragou et al, 2002; Trueswell & Papafragou, 2010). One issue with the methodology just outlined is that it is hard to disambiguate informed recognition from guesswork or random selection.

Therefore, my study used a variant more similar to the forced-choice judgment task measuring saliency. Participants were shown two clips simultaneously in the testing phase (one they had seen before and one altered in one component of the Motion event) and then asked to choose which they saw previously. This means that they were tested on specific components of the Motion event and it was possible to disambiguate which components they were paying attention to (for example, they might always select the correct clips when Path was changed, but might be at chance when Manner was changed). In this task participants were forced to respond even if they did not know the answer. This could have made it difficult to discriminate between correct guesses and true recognition, potentially affecting the results and conclusions of the study. Therefore I added an extra measure at the test stage where participants were asked to rate their confidence for each item. This allowed later analysis of which items were answered correctly due to guesswork and which were due to informed recognition.

As the premise of studying recognition memory for Motion events is that it is influenced by the linguistic preferences of one's language, it was necessary to measure other aspects of memory that one would not expect to be influenced by language to act as comparisons. A task that has been used frequently to measure non-linguistic short-term memory is the span test. A span test consists of a participant being shown a string of items (digits, letters or symbols) before being asked to recall them. Each time they successfully recall a string, the number of items is increased by one until they are unable to recall the whole string. The highest number of items that a participant can remember is considered a measure of their memory span. Participants may be asked to recall them in the exact same order (ordered recall), no particular order (free recall) or a backwards order (backwards recall). It is suggested that the number of items that can be held in typical short-term memory is 7±2 (this is often called Miller's Law named after the claims about memory span by Miller, 1956). However, traditional span tests were deemed inappropriate for my study for two reasons, outlined below.

Firstly, the digit span task is not truly non-linguistic as it has been shown to be influenced by the language of participants. Ellis & Hennelly (1980) and Murray & Jones (2002) compared bilingual participants using English and Welsh on a digit span task. Both studies found that when participants carried out the task in Welsh, they could recall fewer digits than when completing the same task in English (and therefore showed a shorter span and seemingly poorer short-term memory). They attribute this to the difference in length of articulation for strings of English and Welsh digits, with Welsh digits taking longer to articulate. Stigler, Lee & Stevenson (1986) found that Chinese children showed longer digit spans than American children (by around two digits) and suggest that this is due to shorter pronunciation of Chinese digits compared to English digits. Evidently there are serious difficulties with comparing one language population with another using a traditional span task.

The second issue is that deaf participants, especially those who prefer sign language over oral communication, have been shown to be impaired in span tasks and do not fall within the standard Miller's Law range (Conrad, 1970; Wallace & Corballis, 1973). Jacquemot & Scott (2006) suggest that span tasks rely on phonological coding and use the phonological loop, therefore one should expect a difference between deaf and hearing participants based on their differing familiarity with auditory information. With this in mind Boutla, Supalla, Newport & Bavelier (2004) suggests that instead of seeing signers as the exception to Miller's Law (an expected span of 7±2), we should see this span as being inflated through use of a hearing strategy of converting visual input into phonological coding, allowing longer strings of information to be remembered. Flaherty & Moran (2001) showed that when phonological coding is not as easily accessible, deaf and hearing participants perform similarly on the span task. They used unfamiliar Japanese Kanji as stimuli for recall by Japanese speakers and deaf signers of Japanese Sign Language. Kanji, unlike alphabetical orthographic systems, do not give any indication of phonology. When Kanji were shown to participants, there was no effect of language/hearing status, with both groups performing similarly well. This implies that when neither group can use a phonological code, their abilities are capped at the same level, supporting the claims of Boutla et al (2004). All of these studies suggest that span tasks relying on phonological coding are not an accurate measure of non-linguistic short-term memory and are biased against deaf individuals. Therefore, despite the frequent use of span tasks in studies on memory, I will not be using any span tasks that rely on phonological coding in my study. Hall & Bavelier (2009) argue that too much research on working memory capacity focuses on short-term memory measures that overemphasise the importance of phonological coding. The memory tasks in this study were selected to minimise the focus on phonological coding. None of the tasks involved remembering words, letters or numbers. Only one task included remembering nameable objects. The tasks did not have any auditory cues/stimuli to allow for a fair comparison of deaf and hearing participants. There is a further description of the tasks selected in section 3.4.2.4.

3.4 Stimuli Design & Research Design

The research for this project was experimental and quantitative. The independent variables were the hearing status (hearing or deaf) and the BSL knowledge (none, early or late) of participants. The dependent variables were the detail given in linguistic description of Motion events (description task), success at recognising previously seen Motion events (recognition task) and scores on a memory and attention task battery.

3.4.1 Stimuli Design

Stimuli for the recognition task and the description task were a battery of 72 live action Motion event video clips, each 5 seconds long, arranged into 36 dyads. Dyads are two video clips that are identical apart from a change in one component of the Motion event (either Figure, Ground, Path, Manner, Path Detail or Manner Detail). See an example from a Figure dyad in Image 24, below. Filming was standardised to ensure that the clips within each dyad did not differ in the Figure's orientation in relation to the viewer (such as whether the Figure is seen from either the front or back). For example stills from a dyad in every component, see Appendix 3.

The stimuli did not contain every possible combination of Path, Manner, Figure and Ground because some combinations are impossible (for example, a man running across water) or unnatural and striking (such as a woman cycling down stairs). The stimuli set tested every component of the Motion event in 6 different situations (see Appendix 3 for a full list of the stimuli). No exact situations were repeated. The nine different Paths (up, down, in, out, left, right, towards, away and around) were each represented exactly eight times in the stimuli set. The two different Figures (man and woman) were represented exactly 36 times in the stimuli set. This means that the various Paths and Figures were equally represented in the set. Manner and Ground could not be represented evenly due to some Manners only being available in some Grounds (such as swimming in a swimming pool). Due to this, some Manner verbs were represented more often (14 walk, 14 run, 12 cycle, 10 climb, 8 step, 8 swim, 4 jump and 2 float). Similarly, some Grounds were represented more often (18 park, 14 swimming pool, 12 stairs, 12 archway, 8 climbing wall, 8 street).

There were also filler clips (see Appendix 3, for a full list) to disguise the exact nature of the study. Filler clips were either non-Motion events or self-contained

Motion events. See an example of a still from a non-Motion filler clip and Motion filler clip in Image 25, below.

A man jumps forward away from a tree.

A woman jumps forward away from a tree.

Image 24 Dyad with Figure change

A man jogs on the spot.

A woman looks at a climbing wall.

Image 25 Self-contained Motion filler clip and non-Motion filler clip

3.4.1.1 Piloting Stimuli

As the stimuli were being used to measure recognition memory, it was important to ensure that dyads of clips were as similar as possible to each other. For this reason, the video clip recognition task was piloted on 16 hearing participants. After the task, four participants were asked to explain how they knew which clips they had seen before to investigate if there were any specific strategies employed. They were also asked whether there were any obvious differences between any clips that helped them. During this discussion, it was discovered that one set of clips contained an extraneous variable that aided recognition. A group of clips were filmed in front of a tree with a low-hanging branch on one side. Participants used this branch as a reference point and were therefore better at detecting Path changes as they remembered how Figures moved with respect to the branch. Therefore all clips filmed in front of this tree were re-filmed. See Image 26, below, for a comparison of the clips used in this pilot study versus the re-filmed clips.

A woman cycles around a tree (with branch).

A woman cycles around a tree (no branch).

Image 26 Pilot study video clip and re-filmed video clip

3.4.1.2 Pseudorandomisation of Stimuli

During the video clip presentation, participants were exposed to a total of 48 video clips (36 Motion event video clips and 12 filler clips). Half of the participants saw clip one of the dyads and half saw clip two. Presentation order was pseudorandomised (see Appendix 4 for a full explanation of the pseudorandomisation measures used). Stimuli were divided into six blocks (A–F) with every block containing a single clip from each of the six possible changes (Figure, Ground, Path, Manner, Path Detail or Manner Detail) as well as two filler clips (one Motion filler and one non-Motion filler). All participants saw all blocks but, to prevent interference from first-order carryover effects, blocks were presented in 6 unique orders, created by using a balanced 6 x 6 Latin Square (see Appendix 4 for all the possible orders). As half of participants saw clip one and half clip two, this created 12 unique presentations. The presentation order of the clips within the blocks was randomised.

In the recognition task, whether a correct choice was presented on the left or right of the screen was pseudorandomised creating two task variations, A and B. The presentation of dyads within the task was randomised because if the presentation had been counterbalanced, it could have created a pattern discernible to participants.

In the description task the video clips were divided into 12 blocks (1–12) where no clips from the same dyad or with the same component change were in the same block (see Appendix 4). All participants were shown the same order of blocks but presentation order within each block was randomised.

3.4.2 Research Design

3.4.2.1 Video Clip Presentation

When participants started the task, they were told: ‘You are about to be shown a series of short video clips. Press any key to start.’ They were not told to pay attention to any particular aspect or to memorise the clips. Participants then watched the video clips.

3.4.2.2 Recognition Task

In this task participants were shown two video clips, first one on the left and then one on the right. The clips were shown sequentially and were not on screen simultaneously. They were then asked to indicate which of the two clips they saw earlier by pressing the blue button (left) for the left clip or the red button (right) for the right clip. They were then asked to indicate how confident they were in their decision on a scale of 1 to 4 (with 1 being 'completely unsure' and 4 being 'completely sure'). They were not told if they were right or wrong. Before taking part in the real trials, participants had a practice round using four pairs of filler video clips. This allowed participants to get used to the format of this task.

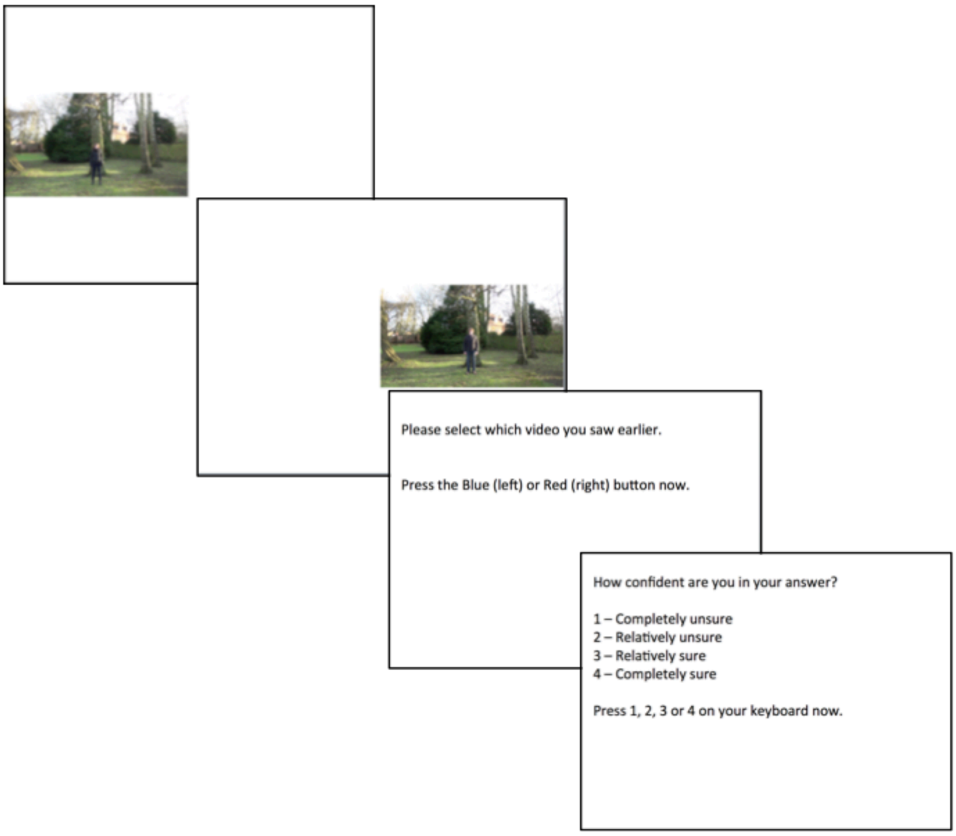


Image 27 Stills from the Recognition Task

3.4.2.3 Description Task

In this task participants were asked to describe the video clips they saw earlier. Participants were told before they started this task that it was important that they were as accurate as possible in their responses as a native English speaker (for English monolinguals) or native BSL signer (for all other groups) would be shown their descriptions and asked to select the clip they were describing from an array. They were asked to watch each video clip in full before turning towards the experimenter (and video camera) and answering the question

'What happened?' All participants were filmed, including English monolinguals, to allow any co-speech gesture to be coded.

3.4.2.4 Memory and Attention Task Battery

Cambridge Brain Sciences was set up by Dr Adam Hampshire and Dr Adrian Owen to provide a collection of tasks designed to measure various cognitive skills. The tasks are based on proven tests of memory, attention and spatial reasoning and are freely available on an online platform. They have been used and validated in numerous academic studies (Aysegul, 2016; Brewin, Ma & Colson, 2013; Codish, Becker & Biggerstaff, 2016; Owen et al, 2010). A small battery of tasks from Cambridge Brain Sciences was selected to give measures of participants' memory, visuospatial abilities and attention. None of these tasks relied on auditory stimuli/cues or required remembering letters or numbers. Only one task involved nameable objects. Below are short descriptions of the tasks.

Spatial Span Task

This span task did not rely on phonological coding (which is a problem for deaf participants as discussed in 3.3.2). The task measured spatial short-term memory. In this task participants had to try to remember a sequence of flashing boxes that appeared on the screen one after the other. When the boxes had finished the sequence, they had to click on the boxes in the same order in which they flashed. If they were correct, the next problem had one more box in the sequence. If they made a mistake then the next sequence of boxes was one shorter. After three errors, the test ended. See Image 28, below, for a still from the Spatial Span task.

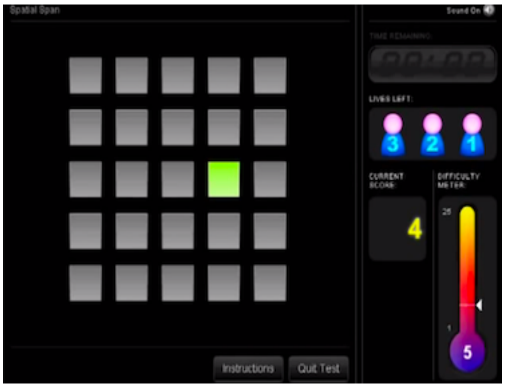


Image 28 Still of Cambridge Brain Sciences' Spatial Span Task

Interlocking Polygons Task

This task measured visuospatial processing and reasoning. In this task, two images appeared on the screen, one containing two overlapping shapes and the other containing just one shape. Participants had to decide if the single shape was identical to one of the overlapping shapes or if it was different. They clicked Match (green) or Mismatch (red) to indicate their answer. If they got it correct, the next problem was more difficult. If they got it wrong, the next problem was easier. They had to solve as many problems as they could in 90 seconds. See Image 29, below, for a still from the Interlocking Polygons task.

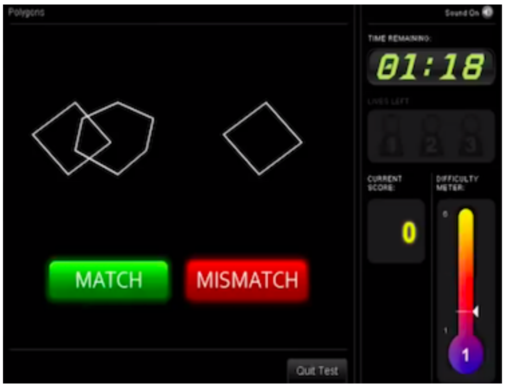


Image 29 Still of Cambridge Brain Sciences' Interlocking Polygons Task

Feature Match

This task measured attention. Two boxes appeared on the screen, each containing a complex array of abstract shapes. The participants had to decide if the two boxes were identical or different. They clicked Match (green) or Mismatch (red) to indicate their answer. If they got it correct, the next problem was more difficult. If they got it wrong, the next problem was easier. They had to solve as many problems as they could in 90 seconds. See Image 30, below, for a still from the Feature Match task.

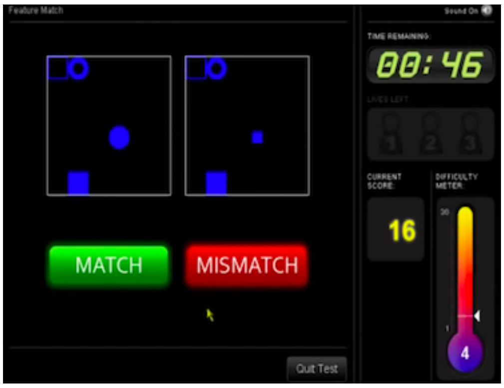


Image 30 Still of Cambridge Brain Sciences' Feature Match Task

Rotations Task

This task measured attention and spatial processing. In this task, two boxes appeared on the screen, each filled with red and green squares. The participants had to decide if one of the boxes was rotated whether it would be identical to the other box or if it would be different. If it would be identical, then they clicked Match (green). If it would be different, they clicked Mismatch (red). If they got it correct, the next problem was more difficult. If they got it wrong, the next problem was easier. They had to solve as many problems as they could in 90 seconds. See Image 31, below, for a still from the Rotations task.

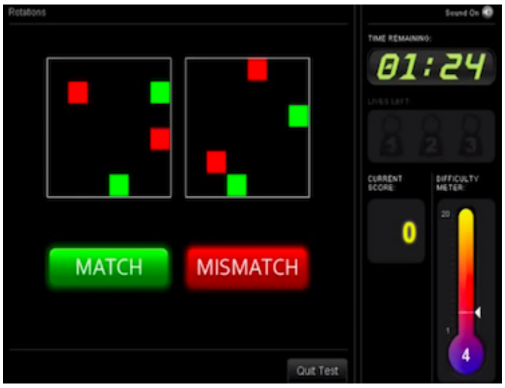


Image 31 Still of Cambridge Brain Sciences' Rotations Task

Paired Associates Learning

This task measured spatial memory and object memory. In this task participants had to remember which object appeared in which location. A set of boxes appeared on the screen. The boxes opened one after the other to reveal an object inside. Participants had to remember which object appeared in which box. Then the objects were displayed one after the other in the centre of the screen. When this happened, they had to click on the box that contained that object. If they were correct, the next problem had one more object for them to remember. If they made a mistake, the next problem had one less object to remember. After three errors, the test ended. See Image 32, below, for a still from the Paired Associates Learning task.

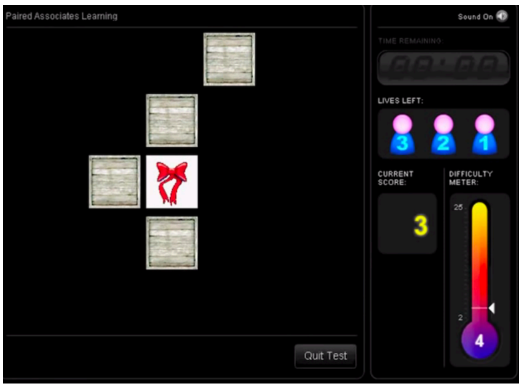


Image 32 Still of Cambridge Brain Sciences' Paired Associates Learning Task

3.5 Participants & Setting

Participants were:

1. 6 deaf (a hearing threshold of over 55 decibels) early BSL signers. Recruitment criteria for this group were being profoundly deaf from birth and having acquired BSL at home before the age of 7.
2. 12 hearing early BSL signers. Recruitment criteria for this group were being hearing and having acquired BSL at home before the age of 7.
3. 7 deaf (a hearing threshold of over 55 decibels) late BSL signers. Recruitment criteria for this group were being profoundly deaf from birth and having acquired BSL as an adult (over the age of 16).
4. 12 hearing late BSL signers. Recruitment criteria for this group were being hearing, having acquired BSL as an adult (over the age of 16) and being a trainee English-BSL interpreter (this involved having studied BSL for at least two years and having regular contact hours learning about BSL interpretation from a qualified BSL interpreter and teacher).
5. 13 hearing native English speakers. Recruitment criteria for this group were being hearing, having acquired English at home from birth, speaking no other languages fluently and being naive to any sign languages.

For details about BSL age of acquisition, family members using BSL in the home and interpreter status for signing participants, see Appendix 5. All participants had normal or corrected-to-normal vision and no participants reported being fluent in any other spoken or sign language besides English or BSL. None of the participants had cochlear implants. Some participants in the deaf groups used hearing aids occasionally or frequently, but this was not recorded. Therefore, it is not possible to be certain how much individuals were exposed to spoken English on a regular basis. No measure of English fluency was undertaken in this study, but all participants responded to recruitment notices in written English indicating knowledge and understanding of written English. All hearing early BSL signers were early English-BSL bilinguals (having learned both BSL and English before age seven).

Differences in group sizes were due to recruitment issues. As the deaf population makes up less than 1% of the UK population, it was expected that the numbers in the deaf groups would be smaller than the others. Although an effort was made to match ages across the five groups, there were differences in the average age and variation of ages in each group. The overall mean across groups was 38.66 (SD = 13.13) but the group means and standard deviations were as follows; deaf early signers (M = 41, SD = 10.64), hearing early signers (M = 38.67, SD = 14.02), deaf late signers (M = 51.86, SD = 4.53), hearing late signers (M = 33.08, SD = 12.23) and English speakers (M = 35.62, SD = 13.56). These differences were down to demographic factors, such as trainee interpreters tending to be younger as a general population and there being a greater proportion of late deaf signers in older age groups. Although an effort was made to recruit the same number of male and female participants, there were many more females (N = 43) than males (N = 7). This disparity was due to an attempt to match groups on gender. As female trainee interpreters outnumber male trainee interpreters, matching this group required there to be more females in every group. Participants were not directly matched for education level and had a range of educational backgrounds (GCSEs, A-Levels, Undergraduate degree, Professional qualification or Postgraduate degree as highest educational qualification). All these factors were taken into account in analysis (see section 4.2).

All hearing early BSL signers learned BSL at home from birth from deaf parents. The deaf early BSL signers showed more variation in the age at which they acquired BSL, whether they had deaf or hearing parents and how many other BSL signers there were in their childhood home (Appendix 5). This disparity will be considered later in 5.2 Limitations.

All participants were remunerated for their time at a rate of £7 for the experiment. Signing groups were recruited via opportunity and snowball sampling at deaf social clubs in London, Cambridgeshire, Coventry and Birmingham. Experiments took place in deaf social clubs as well as at participants' homes or offices and in quiet public locations (such as bookshops or small cafes). English-speaking participants were recruited via opportunity sampling through social media in Cambridgeshire, Coventry and Birmingham.

3.6 Procedure

The procedure in all instances was:

1. Participants received an information sheet before completing a consent form (see Appendix 6) and background questionnaire (see Appendix 7).
2. Video Clip Presentation: Participants were exposed to an initial set of Motion event video clips.
3. Memory and Attention Task Battery: Participants took a short battery of tasks measuring memory, attention and visuospatial processing skills.
4. Recognition Task: Participants were presented with the entire battery of Motion event video clips and were asked to indicate, by pressing buttons, which of the clips in each dyad they had seen previously. For each dyad they also gave a certainty rating. No feedback was given on their choices.

5. Description Task: Participants were shown all the Motion event video clips again in a new order and were asked to describe the clips. Their responses were recorded on a video camera.
6. Participants were fully debriefed (see Appendix 8) and signed a photograph and video release form (see Appendix 9).

All instructions and forms were offered in both written English and BSL for all signing groups.

3.7 Apparatus

The apparatus required in all instances was:

1. One high quality video-camera (with tripod) to record participant responses
2. One MacBook Air laptop
3. One table
4. Two chairs

The apparatus was set up so the experimenter was sitting on one chair at the table. The video camera was positioned behind the experimenter's shoulder, facing towards the participant. The laptop was on the table, facing the participant. When participants were required to describe the video clips, they turned to address the experimenter.

3.8 Analysis

The responses from the recognition task were scored for accuracy in each of the six components (Figure, Ground, Path, Manner, Path Detail and Manner Detail). Motion event descriptions were transcribed and coded (see section 3.8.1, below). Results from the memory and attention task battery were collected and scored by Cambridge Brain Sciences. Linguistic descriptions were compared using a variety of statistical methods (see 4.1). The relationship between the various predictors mentioned in section 3.5, scores in the recognition task and scores in the memory and attention task battery were modelled (see 3.8.2, below). Looking at the interaction of these factors was intended to help explain differences between groups, as follows:

- If all groups performed equally well on the recognition task and the memory and attention task battery then one would conclude that knowledge of a sign language does not influence general cognitive abilities nor specific memory for Motion events.
- If deaf participants outperformed the other groups on the recognition task and/or the memory and attention task battery, then it appears that auditory deprivation is the likely explanation for this advantage, as opposed to knowledge of a sign language.
- If early signers (hearing and deaf) outperformed both late signers (hearing and deaf) and monolingual English speakers on the memory and attention task battery, then this suggests that early exposure to sign language may provide general cognitive benefits, not because of the linguistic features but instead due to its visual modality.
- If early signers (hearing and deaf) outperformed both late signers (hearing and deaf) and monolingual English speakers solely in the recognition task, one could conclude that early knowledge of sign language provides a memory advantage due to its specific linguistic features (the inclusion of certain Motion event descriptions not found in English). This would suggest that early linguistic preferences could influence a seemingly non-linguistic function even when explicit linguistic encoding has not taken place.
- If all signers outperformed monolingual English speakers on the memory and attention task battery then it would suggest that acquisition

of a sign language at any age may provide general cognitive benefits, not because of the linguistic features but instead due to its visual modality.

- If all signers outperformed monolingual English speakers solely in the recognition task, one could conclude that knowledge of sign language at any age provides a memory advantage due to its specific linguistic features (the inclusion of certain Motion event descriptions not found in English). This would also suggest that late linguistic preferences could influence a seemingly non-linguistic function even when explicit linguistic encoding has not taken place.

Below I will describe the coding and transcription of the linguistic data in more detail before discussing how models for the behavioural data were created and selected.

3.8.1 Explanation of Coding System

All English video clips were transcribed by the experimenter. Although co-speech gesturing was intended to be coded, none of the English monolinguals produced gestures during their descriptions. All BSL video clips were coded by the experimenter through a simplified version of Cormier & Fenlon (2014)'s BSL Corpus Annotation Guidelines (see 3.8.1.1, below). A random selection of seven video clips from each participant was separately coded by a native BSL signer. BSL transcription and coding (including segmenting descriptions into clauses) for each clip were checked for intercoder reliability and had 96% agreement.

When either coder was uncertain of how to transcribe or code an item, a group of three other early signers were asked for their input. Their suggestions for transcription/coding were then accepted. After the English and BSL video clips were transcribed, they were then coded for inclusion and packaging of Motion event components through a simplified version of Hickmann et al's Motion Event Coding Manual (see 3.8.1.2, below).

3.8.1.1 Explanation of BSL Transcription

Each participant's recording session was cut into the individual Motion event descriptions and each description was saved as a separate .mov file with the naming convention 'participantnumber–eventnumber.mov' (for example, 11646-F1a.mov).

After this, all descriptions were coded in Excel spread sheets. There were 6 rows for each clip:

1. Free translation
2. Dominant hand English gloss (DH-Gloss)
3. Non-dominant hand English gloss (SH-Gloss)
4. Non-manual features (NMF)
5. Dominant hand Motion event semantic category (DH-Cat)
6. Non-dominant hand Motion event semantic category (SH-Cat)

Table 1 Example of a short coded Motion event description

Clip	Row Name	Coding	
11646-P1a	Free Translation	A man climbs down	
	DH-Gloss	MAN	CLIMB-DOWN
	SH-Gloss		CLIMB-DOWN
	NMF	man	climb
	DH-Cat	Figure	Motion+Manner+Path
	SH-Cat		Motion+Manner+Path

Free translation

This row was completed after coding the other rows and contains a translation of the BSL utterance into grammatical English.

Dominant hand English gloss (DH-Gloss)

Every sign made on the dominant hand was given an English gloss in a separate cell. Two-handed signs were glossed in both the dominant and non-dominant gloss rows. Gloss conventions were as follows:

- Lexical Signs: Many signs have direct translational equivalents in English. For these, the English word was used in capitals to denote the sign (for example, MAN, SHOP or RUN). Negation was glossed with a dash followed by NOT after the sign (for example, RUN-NOT). There are some verbs in BSL that inflect for spatial information. These were coded as the verb followed by a dash with the spatial information (for example, JUMP-DOWN, CLIMB-UP). Only lexicalised signs were transcribed in this way; for signs that used Depicting verb handshapes to depict movement in space, see 'Depicting verbs' below. Lexical verbs which share handshapes and movement with Depicting verbs of Motion (for example, JUMP) were distinguished from Depicting verbs of Motion following the criteria laid out in Cormier & Fenlon (2014)'s BSL Corpus Annotation Guidelines. Verbs were coded as lexical if a signer mouthed an English keyword (such as 'jump') while producing the sign and/or did not look at their hands while producing the sign. Verbs and nouns that share the same sign form (such as CYCLE and BICYCLE) were distinguished by mouthing of English keywords (for example, 'cycle' or 'bike') and presence of a preceding preposition (for example, ON). Where a coder was uncertain for coding Lexical verbs/Depicting verbs of Motion or verbs/nouns, uncertainty procedures were followed (explained above). Lexical verbs were distinguished from constructed action (a type of gesture that describes the way in which an action was done) in two ways. Firstly, if a signer mouthed an English keyword (such as ‘frontcrawl’ or ‘backstroke’), the sign was coded as a lexical verb rather than constructed action. Secondly, for any potential constructed action, uncertainty procedures were followed to decide if the sign was a lexical verb or constructed action.

- Gesture: These were signs that were not conventionalised and could be understood by a non-signer. In this study, there were two types:
    - G:WELL – a commonly used palm up gesture that is often used as a filler. It was found frequently at the start of descriptions and can mean something equivalent to ‘well’, ‘so’ or ‘anyway’
    - G:CA[…] – used for constructed action, a type of gesture that describes the way in which an action was done and is easily interpretable from context (for example, G:CA:HOLD-ONTO-HANDLEBARS)
- Pointing: Points in BSL can have a number of different functions. The following functions were present in data from this study:
    - PT:PRO3SG – A point that indicates reference to a singular entity
    - PT:LOC – A point to a particular location (singular locative)
    - PT:LOCPL – A point to more than one particular location (plural locative)
    - PT:BODY – A point to a particular body part
- Fingerspelling: Fingerspelling is the use of the BSL alphabet to spell out short words or proper nouns. Fingerspelling was glossed as ‘FS’ followed by the word (usually a proper noun) that was fingerspelled (for example, FS:VOLVO or FS:ASHRAF)

- Depicting Signs: These involve the use of a handshape to depict the location or movement of an entity in the signing space. They were glossed as DepictingType(Handshape)-MovementType:Referent (for example, DSEW(1-UP)-MOVE:HUMAN, DSEP(1-DOWN)-MOVE:BODY-PART or DSEW(FLAT-LATERAL)-AT:VEHICLE), as follows:
    - Depicting Type could be depicting a whole entity (DSEW) or depicting part of an entity like a body part (DSEP)
    - Movement Type could either be MOVE for the Path movement of a referent through space or BE for the location of a referent in space.
    - Handshape coded the particular Depicting verb handshape used in the depicting sign (see Appendix 2 for full list of handshapes used)
    - Referent could be BODY-PART, HUMAN, VEHICLE or ENTITY

Non-dominant hand English gloss (SH-Gloss)

Every sign made on the non-dominant hand was given an English gloss in a separate cell. The same conventions were used as in the DH-Gloss row.

Non-manual features (NMF)

Any co-occurring English mouthing was coded in a cell on the row beneath the sign. English mouthing was written in lower case letters (for example, 'man' or 'jumping'). Other non-manual features were not coded as this would have been time intensive and the current study does not focus on the use of NMFs.

Dominant hand Motion event semantic category (DH-Cat)

Where a sign made on the dominant hand contained a component of the Motion event, the cell beneath in the DH-Cat row would be coded to note what was included. The coded components were as follows:

- Figure
- Ground
- Motion
- Manner
- Path

Where a sign included more than one of these components, they were coded with a + in between (for example, Motion+Manner or Motion+Manner+Path).

Non-dominant hand Motion event semantic category (SH-Cat)

Where a sign made on the non-dominant hand contained a component of the Motion event, the cell beneath in the SH-Cat row would be coded to note what was included, as above in DH-Cat.

3.8.1.2 Explanation of Motion Event Coding

Coding gives information about the inclusion and packaging of Motion event components in descriptions, that is to say *what* information an utterance contains and *where* that information is contained. The process is explained below.

1) Segment

Participants often gave a series of utterances and not all were directly concerned with the Motion event. For example, they might describe the clothing of the Figure (like 'the girl has ripped jeans') or the weather ('it is a sunny day'). Alternatively, they would provide multiple clauses relating to the Motion event. Therefore the utterances had to be segmented into clauses by adding [c] after each clause in the transcriptions. An example is below:

'There's a young man in the middle of the pool in front of the camera. [c] He's swimming away. [c] He's using front crawl.'

English utterances were divided into clauses by identifying predicates and arguments. Clauses that were incomplete were identified by prosodic cues, mainly intonation or extended pauses. Clauses in BSL were also identified through a combination of approaches, based the suggestions of Hodge & Johnson (2015) for Auslan. Utterances were roughly divided into possible clauses by identifying predicates and arguments (see Hodge & Johnson, 2015). Although there is an argument for some Depicting verbs to be treated as stand-alone clauses (see Johnston, 2016), they were not automatically considered clauses during this stage of identification because this would involve making assumptions about their purpose. The possible clauses (those identified by looking at the predicates and arguments) were then reaffirmed or further divided through the use of prosodic cues. These prosodic cues included, but were not limited to, extended blinks, changing eye gaze, head rotation and dropping hands to a neutral position (see Fenlon et al, 2007; Ormel & Crasborn, 2011 and Channon, 2015). Using prosodic cues to further divide clauses meant that some Depicting verbs were identified as stand-alone clauses but others were identified as forming part of a larger clause. Clauses that were incomplete were also identified by these prosodic cues. Segmentation of clauses was included in the measure of intercoder reliability. Where a clause boundary was uncertain, the procedure for uncertainty (discussed above) was carried out.

2) Identify Target Motion Event Clause

After utterances were segmented, it was necessary to identify the target Motion event clause to code. The target Motion event clause was identified as the clause expressing Path information. If more than one clause expressed Path information or no clause expressed Path information, the criterion of semantic richness was applied to select the target Motion event clause. The clause that was highest in semantic content was selected. For example, a clause expressing Path and Manner information would be selected over a clause expressing just

Path information. Manner information was given higher semantic status over Figure and Ground. For example, a clause expressing Path and Manner would be selected over a clause expressing Path and Ground.

3) Code the Target Motion Event Clause

Coding was completed in an Excel spreadsheet. There were seven cells to complete for each utterance: Verb 1, Verb 2, Path Satellite, Manner Satellite, Other Satellite, Figure and Ground. Below is an explanation of coding for each cell.

- Verb 1: If there are two verbs, select the one that includes Path. If neither/both verbs include Path, select the one that occurs first in the utterance. Code for Verb 1 follows the pattern VMM+Txx+Mxx (for example, CLIMB-UP is VMM+Tve+Mmv or 'approach' is VMM+Tgo+Mno):

    1. Type VMM+
    2. Select the Path type:

    - Tve: Vertical Path (for example, 'ascend' or CLIMB-UP)
    - Tbo: Path with boundaries (for example, 'exit')
    - Tdi: Directional Path (for example, JUMP-LEFT)
    - Tdx: Deictic Path (for example, 'come' or COME)
    - Tso: Source Path (for example, 'depart')
    - Tgo: Goal Path (for example, 'approach')
    - Thv: Horizontal Path. This specifies a horizontal Path but differs from Directional and Deictic Path types because there is either no specific direction (for example, 'sidestep' versus JUMP-LEFT) or because it does not specify the relation of the movement in

relation to the speaker (for example, JUMP-FORWARD versus JUMP-TOWARDS-ME)

- Tpa: Other Path aspects (for example, ‘pass’)
- Tno: No Path information

3. Select the Manner type:

- Mmv: Manner of Motion (for example, ‘run’ or CYCLE)
- Mno: No Manner information

- Verb 2: If there is only one verb, code Vm0 in this cell. If there are two verbs, use the same format as in Verb 1.
- Path Satellite: If there is no Path Satellite, code T0. If there is a Path Satellite, code with the pattern EP+Txx (for example, ‘up’ is EP+Tve or OUT is EP+Tbo):

1. Type EP+
2. Select the Path type:

- Tve: Vertical Path (for example, ‘up’ or DOWN)
- Tbo: Path with boundaries (for example, ‘in’ or OUT)
- Tdi: Directional Path (for example, ‘left’ or RIGHT)
- Tdx: Deictic Path (for example, ‘towards me’)
- Tso: Source Path (for example, ‘from’ or FROM)
- Tgo: Goal Path (for example, ‘to’ or TOWARDS)
- Thv: Horizontal Path. This specifies a horizontal Path but differs from Directional and Deictic Path types because there is either no specific direction (for example, ‘to the side’ versus ‘left’) or because it does not specify the relation of the movement in

relation to the speaker (for example, 'jump forwards' versus 'jump towards me')

- Tpa: Other Path aspects (for example, 'around')

- Manner Satellite: If there is no Manner Satellite, code M0. If there is a Manner Satellite, code with the pattern EM+Mxx (for example, 'on a bike' is EM+Mdv or 'like a monkey' is EM+Mmv):

  1. Type EM+
  2. Select the Manner type:

  - Mmv: Manner of Motion (for example, 'like a monkey' or CA:SWINGING-ARMS)
  - Mpo: Manner expressing position (for example, 'on one leg')
  - Mmi: Inferred Manner (for example, 'there is a cyclist')
  - Mdv: Adverbial Manner (for example, 'on a bike')
  - Mad: Adverbial Manner detail (for example, 'stealthily' or FAST)
  - Mbd: Causative body (for example, 'by moving his legs')

- Other Satellite: This cell is for satellites that include information that is not Manner or Path. If there is no Other Satellite, code N0. If there is an Other Satellite, code with the pattern EO+xxx:

  1. Type EO+
  2. Select information expressed:

  - Loc: General location expressed (for example, 'in the park' in 'he runs left in the park')
  - Ecran: Screen or camera referenced (for example, 'across the screen' in 'he cycles across the screen')

- Figure: Select from the following Figure codes:

  - FigP: Figure present in target Motion event clause
  - FigC: Figure not present in target Motion event clause, but present in another clause
  - FigImp: No Figure in either the target Motion event clause or any other clause
- Ground: Select from the following Ground codes:
  - GrdP: Ground present in target Motion event clause
  - GrdC: Ground not present in target Motion event clause, but present in another clause
  - GrdImp: No Ground in either the target Motion event clause or any other clause
  - GrdV: Ground is not a separate element but is included in a verb or satellite (for example, in 'upstairs' or in a Depicting verb of Motion showing walking upstairs)

Table 2 Example of completed coding for six utterances

	Verb 1	Verb 2	Path Satellite	Manner Satellite	Other Satellite	Figure	Ground
11646 F1a	VMM+Tdi+Mmv	Vm0	T0	EM+Mad	N0	FigP	GrdImp
11646 F1b	VMM+Tdi+Mmv	VMM+Tdi+Mno	T0	M0	N0	FigP	GrdImp
11646 F2a	VMM+Tdi+Mno	VMM+Tno+Mmv	T0	M0	N0	FigC	GrdImp
11646 F2b	VMM+Tdi+Mno	VMM+Tno+Mmv	T0	M0	N0	FigP	GrdImp
11646 F3a	VMM+Tdi+Mmv	Vm0	T0	M0	N0	FigC	GrdP
11646 F3b	VMM+Tdi+Mmv	Vm0	T0	M0	N0	FigC	GrdImp

3.8.2 Explanation of Model Selection

The relationship between various predictors, the recognition task and the memory and attention tasks was examined through creation of Generalised Linear Models (GLMs). I used *R* (*R* Core Team, 2016) and the package *lme4* (Bates, Maechler, Bolker & Walker, 2015) to perform analyses. For each task, the process to develop a model was as follows: First, a GLM with all putative predictors and interactions was generated. The model was then refined via stepwise deletion of non-significant terms; non-significant predictors/interactions were removed individually until the model contained only significant terms. With the creation of each new model the standardised residuals were checked for normality and heteroscedasticity to confirm that the data met the assumptions of the proposed model. After the generation of multiple possible models, I used Akaike's Information Criterion (AIC) to determine which model was most parsimonious with respect to the data (Burnham & Anderson, 2002). The AIC value of the model is as follows:

$$\text{AIC} = 2k - 2\ln(L)$$

where k is the number of estimated model parameters in the model, and L is the maximised value of likelihood function for the model (where L is the probability (P) of the data (χ) given the model with parameter values represented by θ). The model with the lowest AIC value is likely to be the most parsimonious. However, because AIC is only an estimate of parsimony (Richards, 2005) I compared a candidate set of models as follows: For each task, I determined which model had the lowest AIC and then calculated the difference between the AIC value of each model in turn (AIC_M) and the minimum AIC model (AIC_{min}). The calculation AIC_M-AIC_{min} gave the ΔAIC value of each individual model. Any models with a ΔAIC value >6 were eliminated from consideration. Next, to prevent selection of an overly complex model, any candidate models that had another candidate model nested within them were eliminated (Richards, 2008). For example, a model containing three predictors was eliminated if there was another model that contained just two of those same predictors. Models that remained in the candidate set are reported in full in Appendix 11. Selected models will be presented in section 4.2. Where a model is selected this means that it explains the largest amount of variability in the data with the fewest number of predictors. The selected models are, therefore, considered the most acceptable explanation of the data given the predictors available. However, in every model there will be variability in the data that cannot be accounted for by the predictors and so no selected model can be said to fully explain the data.

4 RESULTS

This results chapter is divided into two sections: 4.1 Linguistic Analyses and 4.2 Behavioural Analyses. In 4.1 I address hypotheses 1 and 2 using the linguistic data collected. In 4.2 I address hypotheses 3 and 4 using a combination of the behavioural and linguistic data collected.

4.1 Linguistic Analyses

In this section I compare the linguistic descriptions of 72 video clips by 48 participants (6 deaf early signers, 11 hearing early signers, 6 deaf late signers, 12 hearing late signers and 13 monolingual English-speaking non-signers). Data were not obtained for one deaf late signer, who declined to complete this part of the study. Linguistic data were lost for one hearing early signer due to equipment failure. Equipment failure also affected three other participants for individual clips, as follows: one deaf early signer (one clip), one English monolingual (one clip) and one hearing late signer (six clips). In total this left 3,448 descriptions for analysis (431 by deaf early signers, 792 by hearing early signers, 432 by deaf late signers, 858 by hearing late signers and 935 by English monolinguals).

In the linguistic analyses below, I investigate hypotheses 1 and 2:

1. Both monolingual English speakers and early signers will regularly include all four basic components of Motion events (Motion, Figure, Ground and Path) as well as Manner information in their Motion event descriptions. However, early signers will provide fuller Path detail than monolingual English speakers through the use of BSL Depicting verbs of Motion (which are capable of combining more parts of Path than English verbs, including Vector, Deixis, Conformation, Direction and Contour).
2. Both early and late signers will regularly include all four basic components of Motion events (Motion, Figure, Ground and Path) as well as Manner information in their Motion event descriptions. However, early signers will provide fuller Path detail than late signers through the use of BSL Depicting verbs of Motion (which are capable of combining more parts of Path than English verbs, including Vector, Deixis, Conformation, Direction and Contour). late signers will be influenced by their early English and so will only include Path information that is regularly included in English.

Before analysing individual components of Motion events, I will provide a short overview of the linguistic data. As mentioned in Chapter 3, the 72 Motion event clips were made up of 36 dyads that elicited descriptions of six different components of Motion events (Figure, Ground, Manner, Path, Path Detail and Manner Detail). All descriptions were transcribed (for BSL data) and coded for inclusion and packaging of Motion event components, as explained in sections 3.8.1.1 and 3.8.1.2, above.

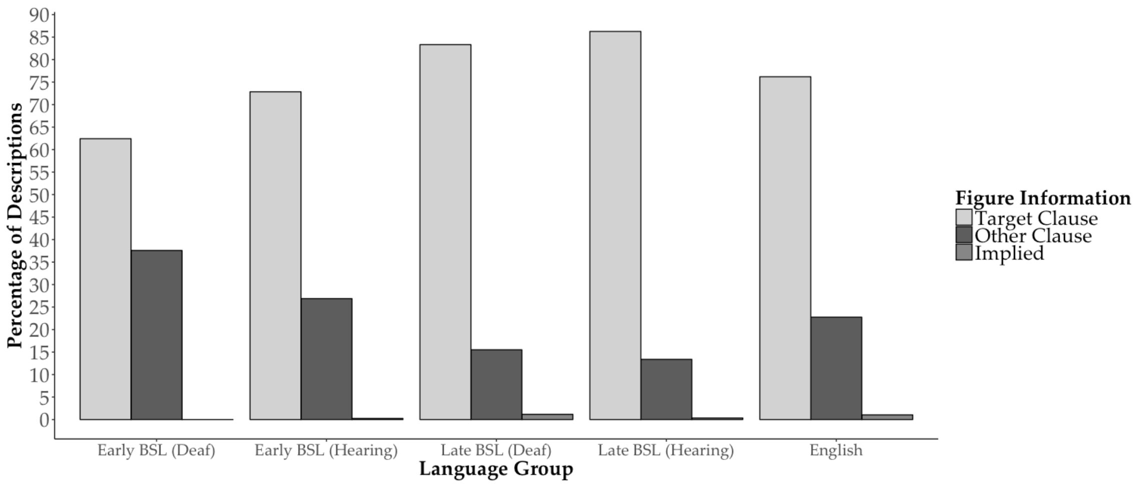
In the following sections (4.1.1 to 4.1.3) I explore the inclusion and packaging of Motion event components (Figure, Ground, Manner and Path) in BSL and English utterances. In each section, I begin by comparing monolingual English speakers with early BSL signers (hearing and deaf). Next, I compare the four different groups of BSL signers on the inclusion and packaging of components. After considering the different components of Motion events, I move on to examine the verbs produced in Motion event descriptions in 4.1.5, including discussion of the use of Depicting verbs of Motion by different BSL groups.

4.1.1 Figure

Analysis revealed that Figure information varied across descriptions in two ways: the inclusion of Figure information (included or implied) and whether that Figure information was within the target Motion clause or outside of it (see Graph 3, below). I investigated whether packaging of Figure information differed between English descriptions by English monolinguals and BSL descriptions by early signers (hearing and deaf). Next, I looked at whether inclusion and packaging of Figure information differed between BSL groups.

As there were 15 potential comparisons for Figure data (comparing 5 groups across Figure in target clause, Figure in other clause and Figure implied), a Bonferroni adjustment was made to maintain an α level of 0.05. Results are considered significant at $\alpha = 0.05/15 = 0.003$.

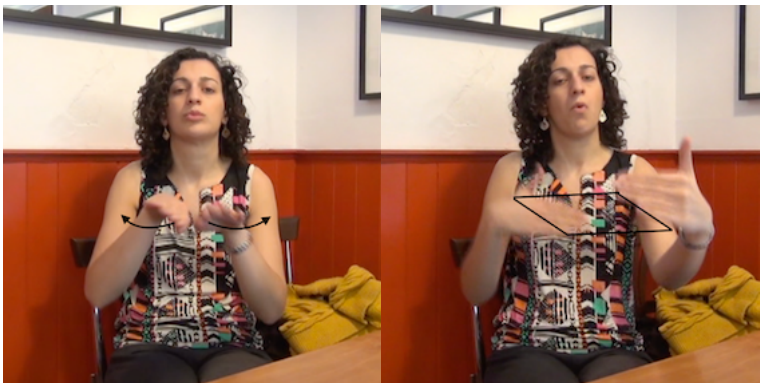
99.8% of early BSL descriptions included Figure information compared to 91.3% of English descriptions. However, one English speaker did not include Figure information in any descriptions. Removing this speaker from analysis, the percentage of English descriptions including Figure information rose to 99%. As both groups were at ceiling level with Figure inclusion and the number of Figure omissions were so few (two descriptions by early signers and nine descriptions by English speakers once the speaker who never included Figure was removed from analysis), no comparison was undertaken. I also investigated whether the packaging of Figure information differed between languages. A chi-square test of independence was performed to examine the relation between language (English or BSL) and Figure packaging. The relation between these variables was significant, χ^2 (1, N = 2072) = 15.45, $p < 0.001$. English speakers showed a stronger preference for including Figure information in the target Motion event clause than early BSL signers. See two descriptions of Image 33 in Example 34, below, showing examples of typical Figure packaging in English and early BSL.



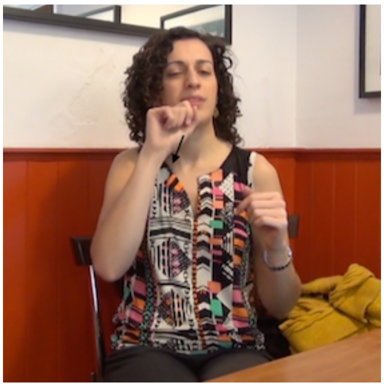
Graph 3 Inclusion and packaging of Figure information in descriptions by all groups

Image 33 Video clip of a man swimming backstroke across a swimming pool

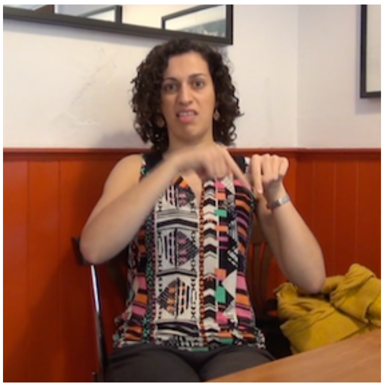
a) Figure outside target clause in description by deaf early BSL signer



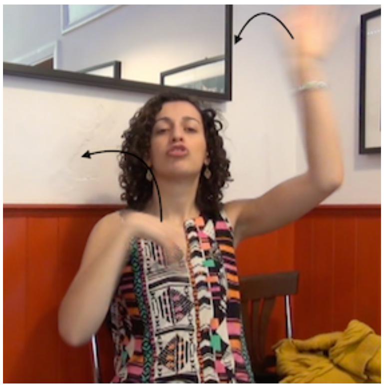
SWIMMING-POOL



MAN



PT:LOC [c]



SWIM+manner.backstroke

(r)MOVE.figure+from.x+to.y+past.self
+manner.swim
(l)PT:LOC

A man is there in a swimming pool. [He] swims backstroke past from x to y.

b) Figure in target clause in description by English speaker

‘There’s a male doing backstroke across a swimming pool.’

Example 34 Figure packaging outside the target clause in early BSL and in the target clause in English

Concentrating now on BSL descriptions only, a Fisher's exact test was performed to examine the relation between BSL group and inclusion of Figure information. The relation between these variables was not significant (p = 0.067). Next, I investigated whether the packaging of Figure information differed between groups. The relation between these variables was highly significant, χ^2 (3, N = 2500) = 119.13, $p < 0.001$. A post-hoc comparison of residuals found that deaf early signers were significantly more likely to include Figure in another clause ($p < 0.001$) and hearing late signers were less likely to do so ($p < 0.001$). See Example 36, below, for a typical example of Figure packaging by deaf early signers and hearing late signers in a description of Image 35.

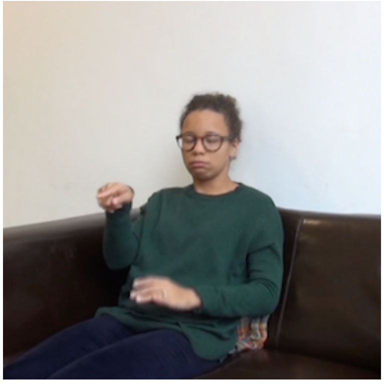
Image 35 Video clip of a man climbing up a climbing wall

a) Figure outside target clause in description by deaf early BSL signer

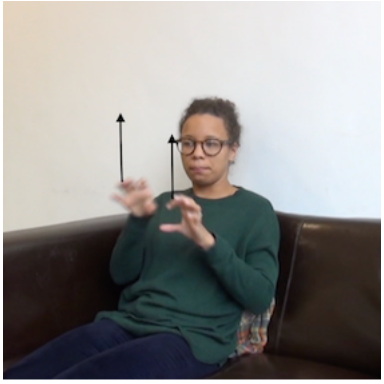
WALL

YOUNG

MAN



PT:LOC [c]



CLIMB-UP

A young man is there on a wall. [He] climbs up.

b) Figure in target clause in description by hearing late BSL signer

WALL

MAN

CLIMB-UP

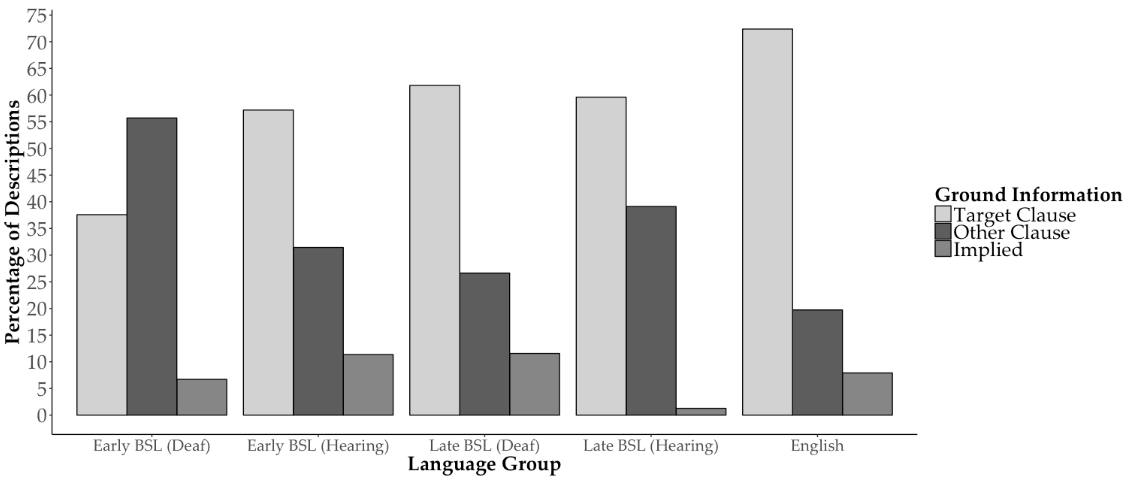
A man climbs up a wall.

Example 36 Figure packaging outside the target clause by a deaf early signer and within the target clause by a hearing late signer

To summarise, language (BSL or English) did not have a significant effect on Figure inclusion. Language was significantly related to the packaging of information ($p < 0.001$). Native English speakers showed a stronger preference for including Figure information in the target Motion event clause than early signers. BSL group did not have a significant effect on Figure inclusion. However, there was a significant relation between BSL group and Figure packaging ($p < 0.001$), with deaf early signers more likely to include Figure outside the target Motion event clause and hearing late signers more likely to include Figure within the target Motion event clause.

4.1.2 Ground

Analysis revealed that Ground information, like Figure information, varied in whether it was included (or implied) and in whether it was within the target Motion clause or outside of it (see Graph 4, below). I investigated whether the inclusion and packaging of Ground information differed between English descriptions by English speakers and BSL descriptions by early signers (hearing and deaf). Next, I looked at whether inclusion and packaging of Ground information differed between BSL groups.



Graph 4 Inclusion and packaging of Ground information in descriptions by all groups

As there were 20 potential comparisons for Ground data (comparing 5 groups across Ground separately in target clause, Ground conflated with Path in target clause, Ground in other clause and Ground implied), a Bonferroni adjustment was made to maintain an α level of 0.05. Results are considered significant at $\alpha = 0.05/20 = 0.0025$.

A chi-square test of independence was performed to examine the relation between early language (English or BSL) and inclusion of Ground information. The relation between these variables was not significant, χ^2 (1, N = 2158) = 2.15, p = 0.14. Next, I compared packaging of Ground information in English and BSL. A chi-square test of independence was performed to examine the relation between early language (English or BSL) and packaging of Ground information in either the target Motion event clause or in another clause. The relation between these variables was highly significant, χ^2 (1, N = 1965) = 112.88, $p <$ 0.001. English speakers showed a stronger preference for including Ground information in the target Motion event clause than early BSL signers. See Example 38, below, for typical packaging of Ground in English and BSL in a description of Image 37.

Image 37 Video clip of a woman cycling into an archway

a) Typical packaging of Ground outside target clause by deaf early signer

ARCHWAY

FENCE [c]

(r) GIRL

(l) BE.figure+located.at.x

(r) FAST

(l) PT:LOC

CYCLE

MOVE.vehicle+from.x+to.y+away.from.self

There is an archway here and a fence there. A girl cycles quickly away from x to y.

b) Typical packaging of Ground in target clause by English speaker

'A woman cycled into the tunnel.'

Example 38 Ground packaging outside the target Motion event clause in BSL and within the target Motion event clause in English

The way Ground information was included in the target clause also differed between English descriptions and early BSL descriptions. The majority of English descriptions (98.7%) and early BSL descriptions (95.4%) that included Ground information in the target Motion clause had Ground as a separate constituent (for example, in the signs TREE/STAIRS or words 'tree'/'stairs'). However, in nine English descriptions (1.3% of all instances of Ground in the target clause), Ground was conflated with Path in expressions like 'run upstairs' or 'walk downstairs.' A similar pattern was found more frequently in early BSL descriptions; in 28 early BSL descriptions (4.6% of all instances of Ground in the target clause) Ground conflated with Path as part of a Depicting verb of Motion (these will be discussed further in 4.1.5.3).

Looking at BSL only, a chi-square test of independence was performed to examine the relation between BSL group and inclusion of Ground information. The relation between these variables was highly significant, χ^2 (3, N = 2513) = 78.40, $p < 0.001$. A post-hoc comparison of residuals found that hearing late signers were significantly less likely to omit Ground information ($p < 0.001$) than other groups. Next, I investigated whether the packaging of Ground information differed between groups. A chi-square test of independence was performed to examine the relation between BSL group and packaging of Ground information (either as a separate sign in the target clause, part of a Depicting verb of Motion in the target clause or in a separate clause). The relation between these variables was highly significant, χ^2 (6, N = 2333) = 106.70 $p < 0.001$. A post-hoc comparison of residuals found that deaf early signers showed a significantly greater preference for expressing Ground information in a separate clause than other groups ($p < 0.001$). See Example 40, below, for examples of packaging of Ground in a typical deaf early BSL description and a typical hearing late BSL description of Image 39.

Image 39 Video clip of a man cycling past a tree

a) Typical packaging of Ground outside target clause by deaf early signer

TREE

BE.entity+located.at.x

MAN

PT:LOC [c]

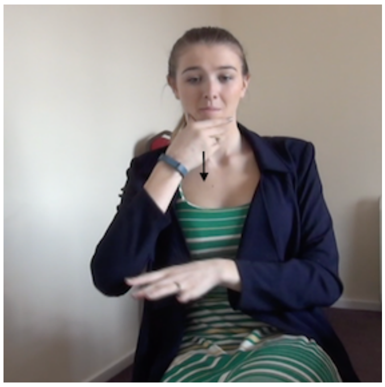
CYCLE

(r) MOVE.vehicle+from.y+to.z+past.x
+towards.self
(l) BE.entity+located.at.x

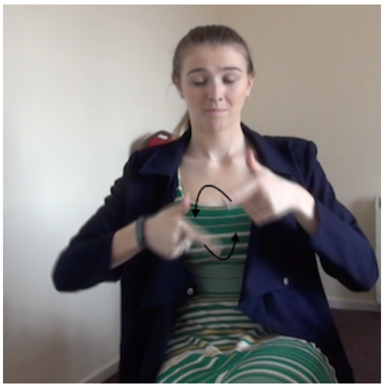
A tree and a man are there. [He] cycles towards me past [the tree] from y to z.

b) Typical packaging of Ground in target clause by hearing late signer

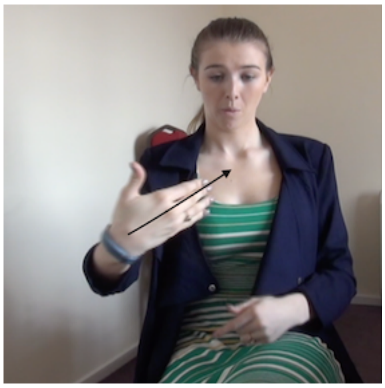
TREE



MAN



CYCLE



MOVE.vehicle+from.x+to.y+towards.self

A man cycles towards me from x to y near a tree.

Example 40 Ground packaging outside the target Motion event clause by a deaf early signer and within the target Motion event clause by a hearing late signer

To summarise, there was no significant relation between language and Ground inclusion, with both early BSL signers and native English speakers equally prone to omitting Ground information. There was, however, a significant effect ($p < 0.001$) of language on packaging of Ground information in the target Motion event clause, with native English speakers showing a stronger preference for including Ground information in the target Motion event clauses than early BSL signers. The relation between BSL group and Ground inclusion was found to be significant ($p < 0.001$) with late signers including Ground information more frequently than other BSL groups. A significant relation ($p < 0.001$) was also found between BSL group and packaging of Ground information, with deaf early signers showing a greater preference for expressing Ground information in a separate clause than other groups.

4.1.3 Path

Analysis revealed that there was variation in descriptions in regard to whether Path information was represented in a verb, a satellite or in both. I began by looking at inclusion of Path information across all descriptions. After this, I investigated whether packaging of Path information differed between English monolinguals and early signers. Next, I looked at whether packaging of Path information differed between different users of BSL.

Path information was provided in the majority (95.8%) of descriptions across all the groups. All groups had some descriptions that did not include Path information. A chi-square test of independence was performed to examine the relation between language (English and BSL) and omission of Path information. The relation between these variables was not significant, χ^2 (1, N = 2158) = 0.97, $p = 0.33$. A chi-square test of independence was performed to examine the relation between BSL group and omission of Path information. The relation between these variables was significant, χ^2 (3, N = 2513) = 40.77, $p < 0.001$. A post-hoc comparison of residuals found that hearing early signers were significantly more likely to omit Path information than other groups ($p < 0.001$). Grubb's test for outliers revealed that there were no individuals in the groups who were significantly more prone to omitting Path information. The majority of participants (72.9%) did not include Path information in at least one description (though which description varied). No group had a greater proportion of participants who omitted Path information at least once.

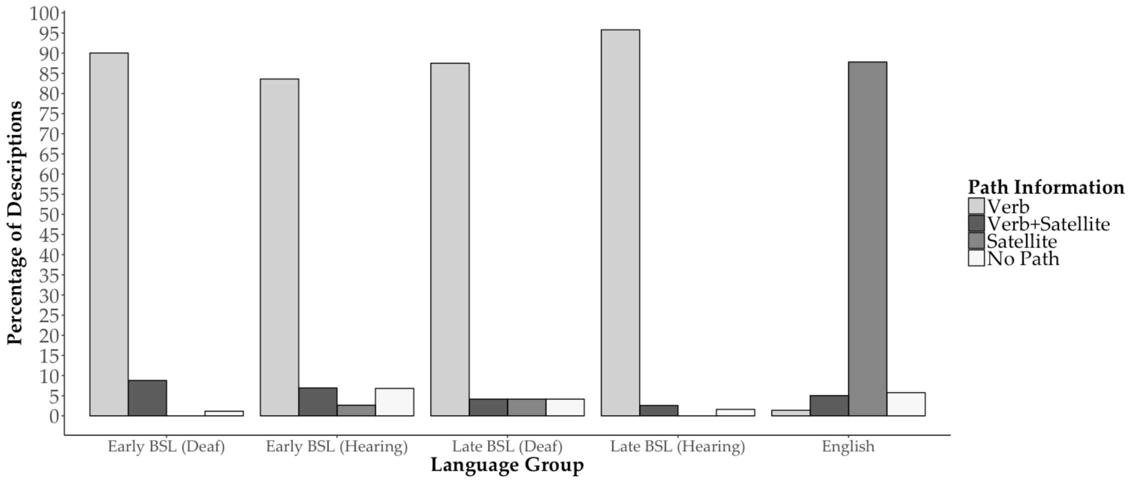
Event type, rather than group, was a factor in whether Path information was omitted. A chi-square test of independence was performed to examine the relation between Manner type (swimming, climbing, cycling, floating and walking/running/jumping) and omission of Path information. The relation between these variables was highly significant, χ^2 (4, N = 3448) = 235.69, $p <$ 0.001. A post-hoc comparison of residuals found that Path was significantly more likely to be omitted in swimming ($p < 0.001$) and floating ($p < 0.001$) events. Floating was the only Manner included in the array that could be perceived as Non-Agentive Motion. Only two video clips of 72 included floating and 26% of all descriptions of floating did not include Path information. It may be that participants are less likely to include Path information for floating because this is perceived as a Motion activity rather than a Motion event.

Additionally, as participants were asked to describe the video clips so they could be selected from an array, they may have been aware that Path information was more important for clips in a Path/Path Detail dyad. If Path and Manner information are considered to be in competition, then one might expect to see Path more frequently omitted in Manner/Manner Detail dyads. A chi-square test of independence was performed to examine the relation between dyad type and omission of Path information. The relation between these variables was highly significant, χ^2 (5, N = 3448) = 75.62, $p < 0.001$. A post-hoc comparison of residuals found that Path information was significantly more likely to be omitted in Manner dyads ($p < 0.001$) and significantly less likely to be omitted in Path dyads ($p = 0.002$). Indeed, only 5.5% of Path omissions occurred when the video clip was part of a Path/Path Detail dyad, compared to 33.1% where the clip was part of a Manner/Manner Detail dyad. However, it should be noted that Manner dyads contained all 'floating' events and 50% of all 'swimming' events which, as explored earlier, were more likely to have Path information omitted. Running a second chi-square test of independence with all swimming and floating events removed, no significant difference was found for dyad type. Therefore, the event type rather than dyad type is significant in the omission of Path information. I will now move on to examine the packaging of Path information in verbs and satellites.

As explained in section 2.2.2, English is considered an S-language because of its preference for including Path information outside of the verb in a satellite. Satellites in English come in a variety of forms, including spatial particles (such as 'up' in 'walk up' or 'across' in 'run across') and adverbs (such as 'forward' in 'swim forward'). With sign languages often being classed as V-languages (see section 2.3.1.1.2), one would expect fewer instances of Path satellites and a greater preference for including Path information in the verb. However, satellite-framed descriptions in BSL are also possible, with BSL having a variety of translational equivalents to English spatial particles (such as UP and THROUGH). In both BSL and English it is also possible to use a Path satellite as the sole Path information in a description (such as 'walk in(to)') or alongside a verb that includes Path (such as 'enter in').

I analysed Motion event descriptions for the use of Path satellites and verbs that included Path (see Graph 5, below). As there were 20 possible comparisons for the inclusion/packaging of Path information (5 groups compared across Path in verb only, Path in satellite only, Path in verb plus satellite and Path omitted) a Bonferroni adjustment was made to maintain an α level of 0.05. Results are considered significant at $\alpha = 0.05/20 = 0.0025$.

A chi-square test of independence was performed to examine the relation between language (English or early BSL) and packaging of Path information (in either verb only, satellite only or verb plus satellite). The relation between these variables was highly significant, χ^2 (2, $N = 2045$) = 1781.80, $p < 0.001$. A post-hoc comparison of residuals found that early signers were significantly more likely to use a Path verb ($p < 0.001$) and English speakers were significantly more likely to use a Path satellite ($p < 0.001$) to express Path information. See Example 42, below, for an example of typical Path packaging in English and early BSL in a description of Image 41.



Graph 5 Inclusion and packaging of Path information in descriptions by all groups

Image 41 Video clip of a man running leftwards past some shops

a) Typical packaging of Path in a verb in description by early signer

MAN

RUN

MOVE.figure+from.x+to.y+past.self

A man runs leftwards from x to y past

b) Typical packaging of Path in a satellite in description by English speaker
'The man runs past the shops.'

Example 42 Use of Path verb by an early BSL signer and Path satellite by an English speaker

I investigated whether the packaging of Path information differed between groups of BSL users. A chi-square test of independence was performed to examine the relation between BSL group and packaging of Path information (in either verb only, satellite only or verb and satellite). The relation between these variables was also highly significant, χ^2 (6, N = 2422) = 77.69, p < 0.001. However, in a post-hoc test there were no individual differences between groups that reached significance.

Next, I examined the Path information contained in the Motion event descriptions of the groups. There were a number of different types of Path expressed by the English speakers and BSL signers in this study, as follows:

- Vertical: Describing the movement of the Figure upwards or downwards (for example, the English verb 'ascend' in 'she ascends the stairs' or the English spatial particle 'down' in 'she walks down the stairs').
- Boundary: Describing the movement of the Figure across a boundary (for example, the English verb 'enter' in 'she enters the archway' or the English spatial particle 'into' 'She steps into the archway').
- Deictic: Describing a deictic Path (for example, the English verb 'come' and preposition 'towards' in 'she comes towards me').
- Source: Describing the movement of the Figure away from an entity (for example, the English preposition 'from' in 'he cycles from the shops').
- Goal: Describing the movement of the Figure towards an entity (for example, the English preposition 'to' in 'she walks to the tree').

- Source-Goal: Describing the movement of the Figure from one entity towards another entity (for example, the English satellite pair ‘from’ and ‘to’ in ‘he cycles from the road to the shops’).
- Directional: Describing the exact direction of the Figure (for example, the English satellite ‘left’ in ‘she walks left’ or the movement of a BSL Depicting verb of Motion showing the specific direction of a Path, such as showing a Figure moving left).
- Horizontal: Describing a horizontal Path but without specifying either the direction, as in Directional Path, or the relation to the speaker, like in Deictic Path (for example, the ‘side’ in ‘sidestep’ or the ‘FORWARDS’ in JUMP-FORWARDS).
- Other: Any other aspect of Path (for example, the English verb ‘pass’ in ‘she passes the shops’ or satellite ‘around’ in ‘she runs around’).

As mentioned in section 2.3.1.1, Talmy (2003) and Supalla (1982) note that sign languages are capable of providing many types of Path information simultaneously (for example, Vector, Deixis and Contour). Where I refer to Directional Path types, in English this applies only to the use of the relative directions ‘left’ and ‘right’ because English does not mark other Directional Paths that are not covered by Vertical (‘up’ or ‘down’) or Deictic (‘towards’ or ‘away’). In BSL Directional Path types refer to the use of a Depicting verb of Motion to show the exact Direction along three axes (sagittal, lateral and vertical axes), along both sagittal and lateral axes, along only the sagittal axis or along only the lateral axis. Where signers only described movement on the vertical axis, this was considered a Vertical Path type. Deictic Path types were not found in BSL as Depicting verbs of Motion specify more information than simply a towards/away relationship (because they can specify exact Direction, which can incorporate whether movement is towards/away from the viewer). BSL Path types were considered Horizontal Path when they did not show the actual direction of the Motion, but merely the fact that there was horizontal movement (for example, using a Depicting verb of Motion to show a person jumping forwards but not showing the actual direction of the movement relating to the signer or Ground).

Chi-square tests of independence were carried out to examine the relation between group and Path type in five Path events (Up/Down, Left/Right, In/Out, Towards/Away and Around). See Appendix 10 for Path types divided by group and event type. Analyses revealed highly significant differences between groups in Up/Down events (χ^2 (4, N = 1120) = 22.89, $p < 0.001$), Left/Right events (χ^2 (4, N = 535) = 44.12, $p < 0.001$), In/Out events (χ^2 (16, N = 879) = 322.55, $p < 0.001$), Towards/Away events ($\chi 2$ (12, N = 535) =334.98, $p < 0.001$) and Around events (χ^2 (4, N = 393) = 79.71, $p < 0.001$). Post-hoc comparisons of residuals revealed that English speakers were significantly more likely to use a Path type other than Directional compared to BSL groups in Left/Right events ($p < 0.001$), Towards/Away events ($p < 0.001$) and Around events ($p < 0.001$). They were also significantly more likely to use a Source, Goal or Source-Goal expression ($p < 0.001$) in Towards/Away events than BSL groups. See Example 44, below, for an example of an English speaker using a Goal Path type and a BSL signer using a Directional Path type when describing the Motion event in Image 43. For In/Out events, post-hoc comparisons of residuals revealed that English speakers showed a significantly stronger preference ($p < 0.001$) for using a Boundary Path type than other groups. See Example 46, below, for an example of an English speaker using a Boundary Path type and a BSL signer using a Vertical Path type when describing the Motion event in Image 45. Post-hoc comparison of residuals for Up/Down events revealed no group differences that reached significance, although English speakers' preference for Path type besides Vertical in Up/Down events compared to BSL groups approached significance ($p = 0.007$) at the Bonferroni-adjusted α level of 0.005.

Comparing only BSL signing groups, there was no significant difference between groups on Path type used for Up/Down, Left/Right or Around event types. However, there was a significant difference between groups on In/Out event types (χ^2 (12, N = 663) = 112.46, $p < 0.001$) with a post-hoc comparison of residuals revealing that hearing late signers used Directional Path types significantly more ($p < 0.001$) than all other groups. There was a significant difference between groups on Path type used for Towards/Away events (χ^2 (9, N = 533) = 59.79, $p < 0.001$). However, the most significant individual group difference, hearing early signers' preference for Horizontal Path type, did not reach significance ($p = 0.02$) at the Bonferroni-adjusted α level of 0.005. Therefore it is not possible to isolate the preference that was driving the significant difference between the Path type used by groups in Towards/Away events.

Image 43 Video clip of a woman walking across a car park to some shops

a) Early BSL signer's use of a Directional Path type in description

SHOP

BE.entity+located.at.x [c]

WOMAN

MOVE.figure+from.y+to.x+away.from.self
+manner.walk

Some shops are there. A woman walks away from me towards [the shops].

b) English use of a Goal Path type in description

'The lady walks towards the shops.'

Example 44 Use of Directional Path type by an early BSL signer and Goal Path type by an English speaker

Image 45 Video clip of a woman jumping into a swimming pool

a) Early BSL signer's description using a Vertical Path type

SWIMMING-POOL

WOMAN

BE.figure+located.at.x [c]

MOVE.figure+from.x+to.y+manner.jump

A woman stands by a swimming pool. [She] jumps down.

b) English description using a Boundary Path type

'She's jumping into the swimming pool.'

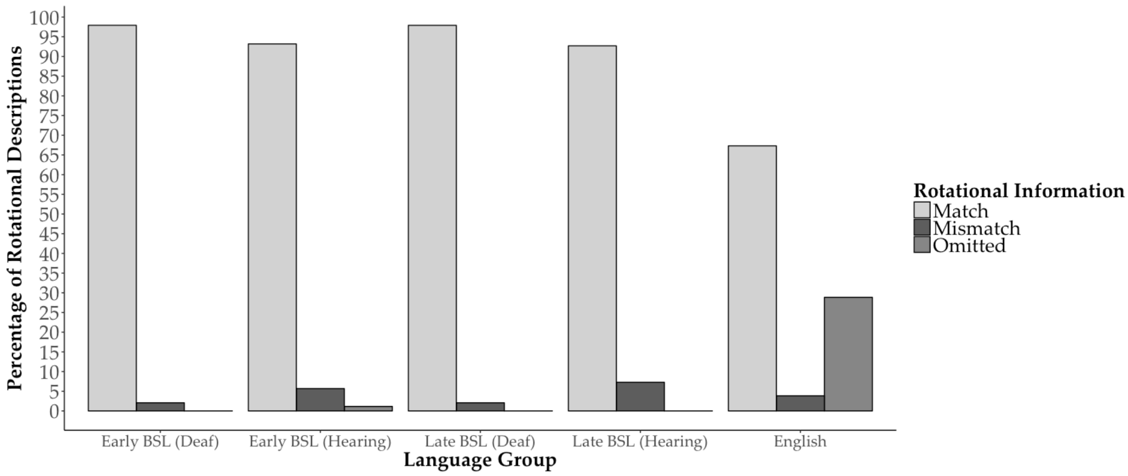
Example 46 Use of Vertical Path type by an early BSL signer and Boundary Path type by an English speaker

An aspect of particular interest in relation to Path used in Around events is that of rotational direction (clockwise/anticlockwise). In BSL, the typical strategy for describing an event where a Figure goes around in a circle is to use a Depicting verb of Motion (see Image 47, below). A Depicting verb of Motion of this type must mark rotational direction. The typical strategy in English, however, leaves marking of rotational direction as optional. An English speaker can say 'She ran around the tree' or 'She ran (anti)clockwise around the tree.' I compared the descriptions involving rotational direction across the groups for how often rotational direction information was provided and how often it matched the clip (see Graph 6, below). A chi-square test of independence was performed to examine the relation between group and inclusion of rotational direction information (either match, mismatch or not included). As there were 15 possible comparisons (5 groups across match, mismatch or not included), a Bonferroni adjustment was made to maintain an α level of 0.05. Results are considered significant at $\alpha = 0.05/15 = 0.003$. The relation between these variables was highly significant, χ^2 (8, N = 393) = 86.13, $p < 0.001$. A post-hoc comparison of residuals found that English speakers were more likely to omit rotational direction information compared to other groups ($p < 0.001$). It is important to keep in mind that participants were aware that rotational direction was contrastive in the dyads because they had previously completed the Motion event recognition task. Therefore inclusion of rotational directional information may have been inflated in English speakers and it is unlikely that English speakers would include this information in spontaneous speech as frequently. However, even with the awareness that there was a contrast in rotational direction, it is interesting to note that English speakers still did not include this information as often as BSL signers.

MOVE.figure+rotate.clockwise

[She] goes round clockwise.

Image 47 Depicting verb of Motion showing 'around'



Graph 6 The inclusion and matching of rotational direction by all groups

To summarise, there was no significant difference between languages (English and BSL) on likelihood to omit Path information. However, there was a relation between BSL group and omission of Path information, with hearing early signers significantly more likely to omit Path information than other groups ($p < 0.001$). Where Path information was omitted, there was a significant effect ($p < 0.001$) of event type on Path omission, with both floating and swimming event descriptions being more likely to show omission of Path. There was a significant difference ($p < 0.001$) between early BSL signers and English speakers in the inclusion of Path information in a verb or satellite, with BSL signers preferring to include Path in the verb and English speakers preferring to include Path in a satellite. A significant difference ($p < 0.001$) was also found between BSL groups on packaging of Path information. Analyses of Path type indicated that these varied between groups. In particular, English speakers were significantly less likely than other groups to use Directional Path in Left/Right Path events ($p < 0.001$), Around events ($p < 0.001$) and Towards/Away events ($p < 0.001$). English speakers were significantly more likely to use a Source, Goal or Source-Goal Path expression ($p < 0.001$) than other groups, although this was not their preferred strategy and is driven by the significant dispreference for this construction in the BSL signing groups.

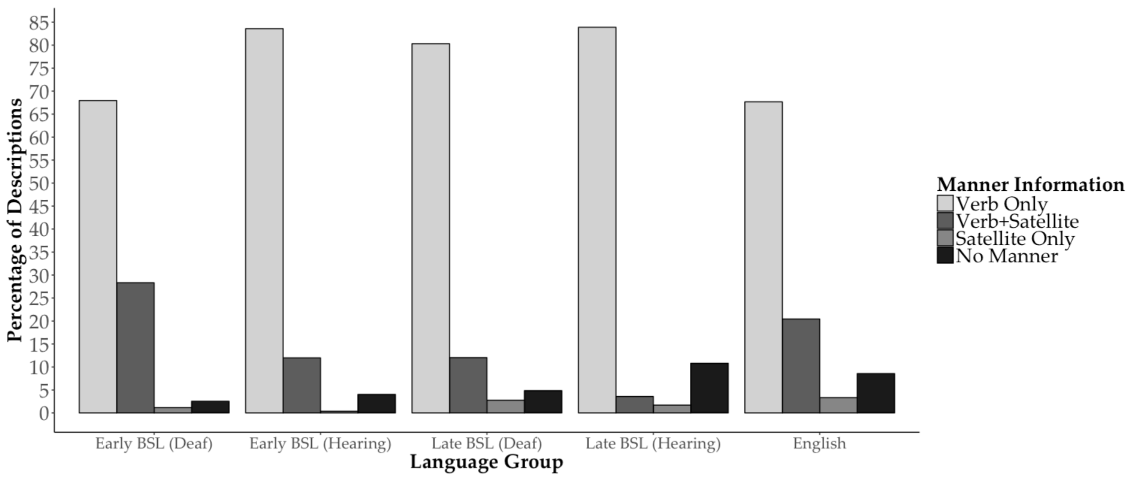
When looking specifically at Around events, English speakers were significantly more likely to omit rotational direction information compared to other groups ($p < 0.001$). Comparing only BSL signing groups, there was no significant difference between groups on Path type used for Up/Down, Left/Right or Around event types. However, there was a significant difference between groups on In/Out event types ($p < 0.001$) with hearing late signers using Directional Path types significantly more ($p < 0.001$) than all other groups.

4.1.4 Manner

Analysis revealed that there was variation in Motion event descriptions in regard to whether Manner information was represented in a verb, a satellite or in both. I began by looking at inclusion of Manner information across all descriptions. After this, I investigated whether packaging of Manner information differed between English descriptions and early BSL descriptions. Finally, I looked at whether packaging of Manner information differed between BSL groups.

First, I analysed whether Motion event descriptions included Manner information in the target Motion event clause (see Graph 7, below). Manner information was provided in the target Motion event clause in the majority (93.1%) of descriptions across all the groups. All groups had some descriptions that did not include any Manner information in the target clause and the majority of participants (79.9%) did not include Manner information in the target Motion event clause in at least one description (though which description varied). Grubb's test for outliers revealed that one English-speaking participant was an outlier ($Z = 4.60$, $p < 0.05$), omitting Manner information in 32 instances. With this participant removed, a chi-square test of independence was performed to examine the relation between groups and omission of Manner information. The relation between these variables was not significant, χ^2 (4, N =

48) = 4.50, p = 0.34. No group had a greater proportion of participants who omitted Manner information at least once.



Graph 7 Inclusion and packaging of Manner information in descriptions across groups

I investigated whether Manner type was a factor in whether Manner information was omitted. A chi-square test of independence was performed to examine the relation between Manner type (swimming, climbing, cycling, floating, jumping and other) and omission of Manner information. The relation between these variables was highly significant, χ^2 (5, N = 3448) = 68.79, $p <$ 0.001. However, in a post-hoc comparison of residuals there were no individual differences between Manner types that reached significance. Of the 237 instances where Manner information was not provided in the target Motion event clause, the Manner of the events was as follows: 71.3% walking/running, 17.3% climbing, 6.3% cycling, 3% swimming, 1.3% jumping and 0.8% floating. This may indicate that some Manners, such as walking, are less salient than others and therefore Manner information is more likely to be omitted.

As participants were asked to describe the video clips so they could be selected from an array, they may have been aware that Manner information was more important for clips in a Manner/Manner Detail dyad and less important for clips in other dyads. If Path and Manner information are considered to be in competition, then one might also expect to see Manner more frequently omitted in Path/Path Detail dyads. A chi-square test of independence was performed to examine the relation between dyad type and omission of Manner information. The relation between these variables was highly significant, χ^2 (5, N = 3448) = 31.91, $p < 0.001$. However, in a post-hoc comparison of residuals there were no individual differences between dyad types that reached significance, despite 20.3% of Manner omissions occurring in descriptions belonging to a Manner/Manner Detail dyad compared to 35% of descriptions belonging to Path/Path Detail dyads and 44.7% of descriptions belonging of Figure/Ground dyads.

Next I examined the role of language on the inclusion and packaging of Manner information. As there were 20 possible comparisons for the inclusion/packaging of Manner information (5 groups compared across Manner included in verb only, Manner included in satellite only, Manner included in verb plus satellite and Manner omitted from target clause) a Bonferroni adjustment was made to maintain an α level of 0.05. Results are considered significant at $\alpha = 0.05/20 = 0.0025$.

A chi-square test of independence was performed to examine the relation between language (English and BSL) and inclusion of Manner information in the target clause. The relation between these variables was highly significant, χ^2 (1, N = 2158) = 25.04, $p < 0.001$. Early BSL signers showed a stronger preference than English speakers for including Manner information in the target clause. A chi-square test of independence was performed to examine the relation between BSL groups and inclusion of Manner information in the target clause. The relation between these variables was highly significant, χ^2 (3, N = 2513) = 48.94, $p < 0.001$. A post-hoc comparison of residuals found that hearing late signers showed a significantly stronger preference ($p < 0.001$) than other groups for omitting Manner information from the target clause.

Next, I investigated the way in which Manner information was distributed in target Motion event clauses. In both BSL and English it is possible to use a Manner satellite as the sole Manner information in a description (such as 'enter sneakily') or alongside a verb that includes Manner (such as 'creep in sneakily'). A chi-square test of independence was performed to examine the relation between language (English or BSL) and packaging of Manner information (in either verb only, satellite only or verb plus satellite). The relation between these variables was highly significant, χ^2 (2, N = 2035) = 23.72, $p < 0.001$. A post-hoc comparison of residuals found that English speakers used satellite only Manner constructions significantly more frequently than BSL signers ($p = 0.0015$), although this was not the preferred construction in English and was still uncommon (used in just 3.3% of all descriptions). See Example 49, below, for an example of a native English description using satellite-only Manner packaging and an early BSL description using verb-only Manner packaging when describing Image 48.

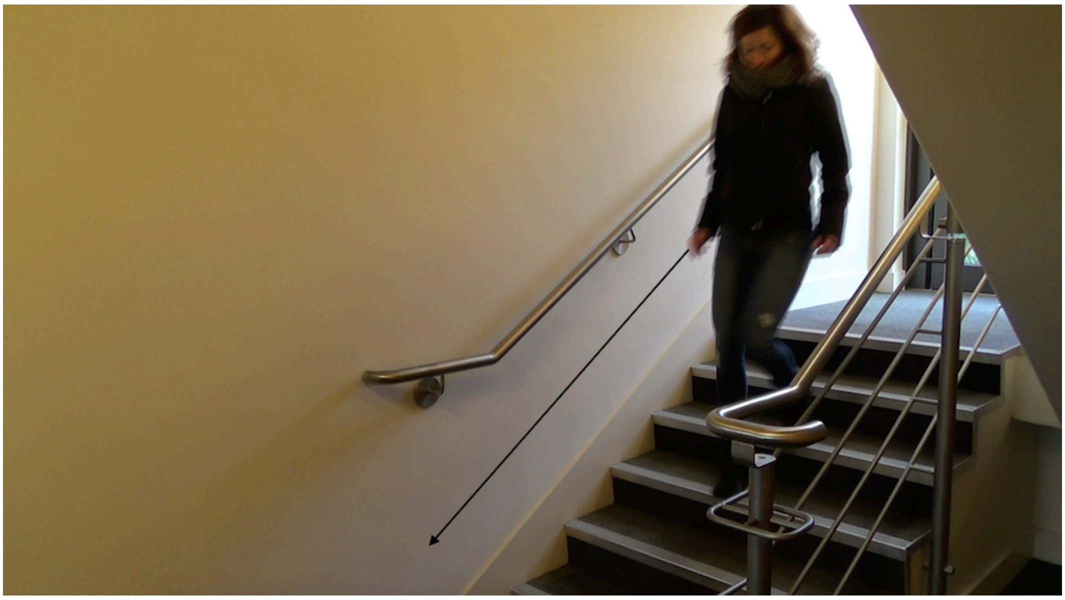
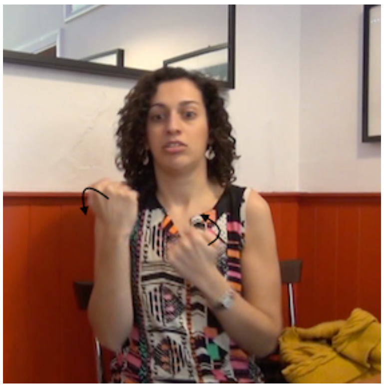


Image 48 Video clip of a woman jogging down the stairs

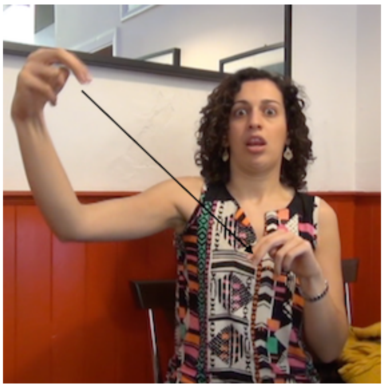
a) Early BSL signer's description using a Manner verb

STAIRS

WOMAN



RUN



MOVE.figure+from.x+to.y

A woman runs down the stairs.

b) English description using a Manner satellite

'She goes down the stairs fairly quickly.'

Example 49 Use of Manner verb by an early BSL signer and Manner satellite by an English speaker

Comparing BSL groups, a chi-square test of independence was performed to examine the relation between BSL group and packaging of Manner information (in either verb only, satellite only or verb and satellite). The relation between these variables was highly significant, χ^2 (6, N = 2356) = 193.96, $p < 0.001$. A post-hoc comparison of residuals found that deaf early signers significantly preferred the use of verb plus satellite constructions when expressing Manner ($p < 0.001$) compared to other groups, while hearing late signers significantly dispreferred this construction ($p < 0.001$). See Example 50, below, for an example of a deaf early signer using verb plus satellite Manner packaging and a hearing late signer using verb-only Manner packaging when describing Image 48. The Manner satellites used by deaf early signers added adverbial detail to the target Motion events. In the majority of instances (94.2%) where deaf early signers used verb plus satellite constructions, the additional Manner information in the satellite was to specify speed. They rarely marked this information solely on the verb itself through the use of NMFs or movement speed, unlike hearing late signers who preferred to mark Manner detail this way.

To summarise, there was no relation between language/group and inclusion of Manner information in the target clause. There was a significant relation between language (English or BSL) and the packaging of Manner information ($p < 0.001$), with English speakers using satellite only Manner constructions significantly more frequently than BSL signers. BSL groups also significantly differed in their packaging of Manner information ($p < 0.001$) with deaf early signers significantly preferring the use of verb plus satellite constructions when expressing Manner compared to other groups and hearing late signers significantly dispreferring this construction.

a) Deaf early BSL signer using a Manner satellite alongside a verb including Manner

STAIRS

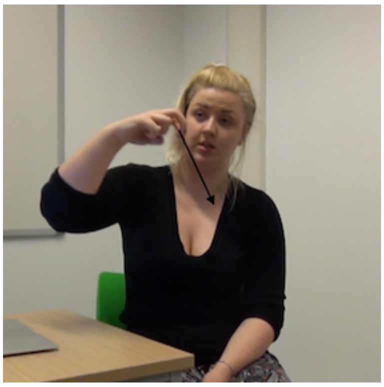
WOMAN

MOVE.figure+from.x+to.y+manner.walk

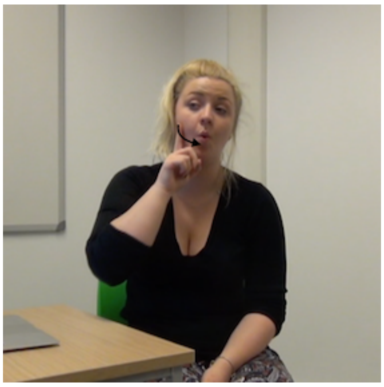
FAST

A woman walks quickly down the stairs.

b) Hearing late signer using a verb including Manner without a Manner satellite



STAIRS



WOMAN

MOVE.figure+from.x+to.y+manner.walk

A woman walks down the stairs.

Example 50 Use of Manner satellite by deaf early BSL signer and lack of Manner satellite by hearing late signer

4.1.5 Further Examination of Verbs

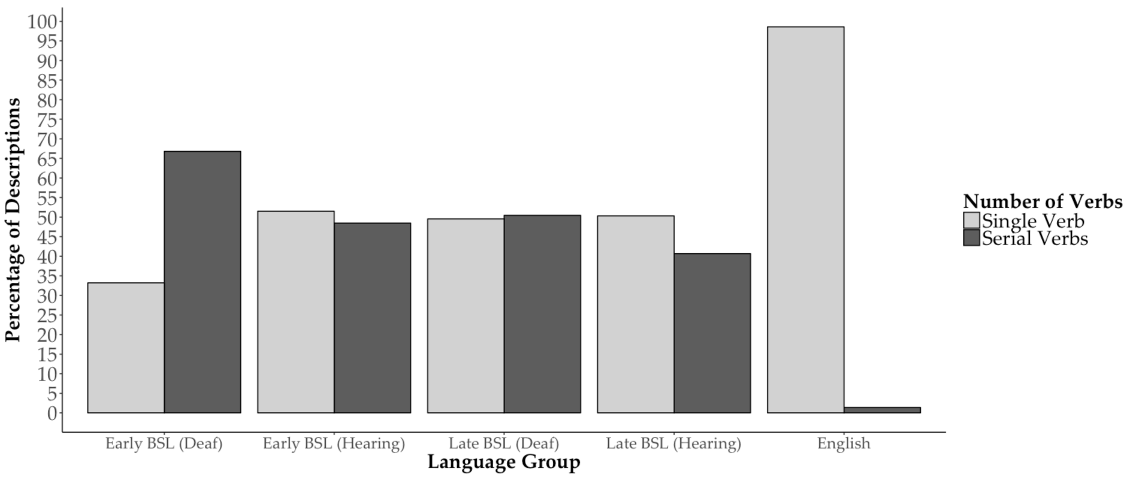
Having discussed the semantic content of English and BSL utterances above (in terms of Manner/Path information included in both verbs and satellites), I will now examine the use of verbs in more detail. First, I will analyse the number of verbs used by different groups in Motion event utterances. Next I will discuss the types of verbs used by different groups (Path, Manner, both or neither) as this has been alluded to in the previous section, but not fully addressed. Finally, I will consider the use of verbs specific to BSL.

4.1.5.1 Single & Double Verbs

As discussed in 2.2.2, some languages can include two or more verbs in a Motion clause (serial verb constructions). Although constructions with more than one verb are rare in English, it is possible to use two verbs in a Motion event description (for example, 'he comes running'). I investigated whether single verbs or double verbs were preferred in the descriptions by English speakers and early signers (see Graph 8, below).

As there were 10 potential comparisons for the overall inclusion of single/double verb data (use of a single or double verb across 5 groups), a Bonferroni adjustment was made to maintain an α level of 0.05. Results were considered significant at $\alpha = 0.05/10 = 0.005$.

A chi-square test of independence was performed to examine the relation between early language (English and BSL) and use of double verbs. The relation between these variables was highly significant, χ^2 (1, $N = 2168$) = 694.01 $p < 0.001$. English speakers were more likely to use a single verb and early BSL signers were more likely to use double verbs. See Example 52, below for a typical English description with a single verb and a typical early BSL description with a double verb when describing Image 51.



Graph 8 Use of single and double verbs in Motion event descriptions by all groups

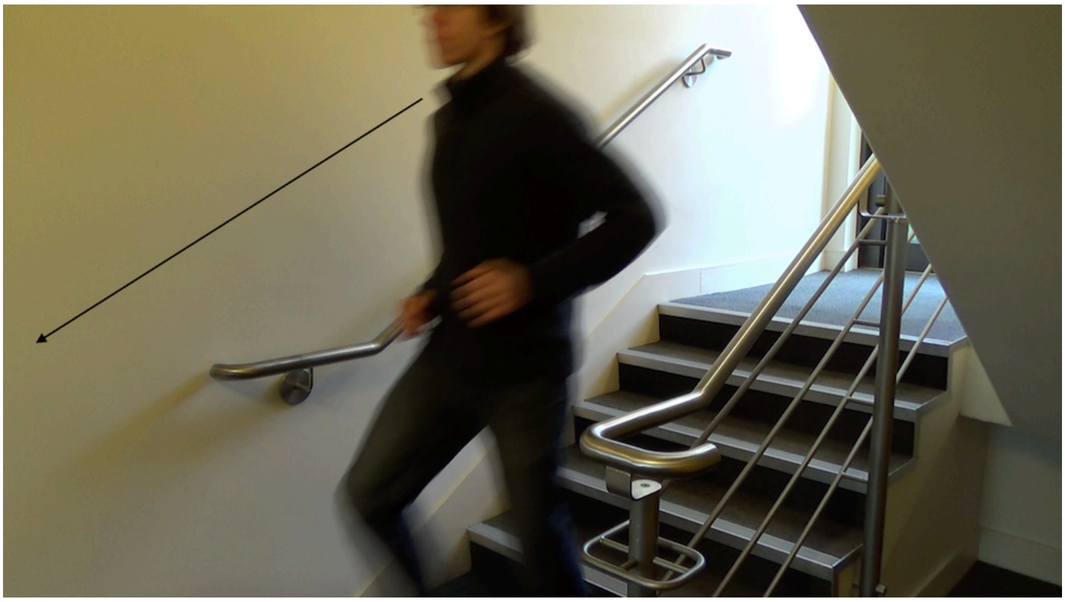


Image 51 Video clip of a man running down the stairs

a) Use of a double verb by early BSL signer

STAIRS

MAN

RUN

MOVE.figure+from.x+to.y+manner.run

A man runs down the stairs.

b) Use of a single verb by an English speaker

'A boy is walking down the stairs.'

Example 52 Use of double verbs by early BSL signer and single verb by English speaker

Next I compared the preferences for using a single or double verb across BSL groups. A chi-square test of independence was performed to examine the relation between BSL groups and use of double verbs. The relation between these variables was highly significant, χ^2 (3, N = 2523) = 37.31 $p < 0.001$. A post-hoc comparison of residuals found that deaf early BSL signers showed a stronger preference for double verbs (p = 0.0012) compared to other groups. See Example 54, below, for a hearing late BSL description using a single verb and a deaf early BSL description using a double verb when describing Image 53.

Image 53 Video clip of a man swimming frontcrawl towards the viewer

a) Deaf early BSL signer using a double verb in a description

MAN

PT:LOC

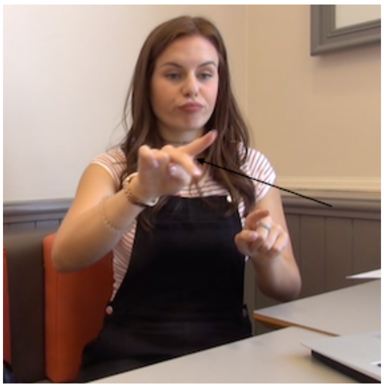
SWIM+manner.frontcrawl

MOVE.figure+from.x+to.y+towards.self

A man is swimming frontcrawl from x to y towards me.

b) Hearing early signer using a single verb in description

SWIMMING-POOL



(r) MAN
(l) BE+located.at.x

MOVE.figure+from.x+to.y+towards.self +manner.swim

A man is swimming from x to y towards me in a swimming pool.

Example 54 Use of double verb by deaf early BSL signer and single verb by hearing late signer

To summarise, there was a highly significant difference ($p < 0.001$) between BSL and English on use of double verbs, with early BSL signers strongly preferring use of double verbs and English speakers strongly preferring single verbs, and there was also a highly significant difference ($p < 0.001$) between BSL groups, with deaf early BSL signers showing a stronger preference for double verbs ($\chi^2 = 14.46$, $p < 0.01$) compared to other groups.

4.1.5.2 Verb Type

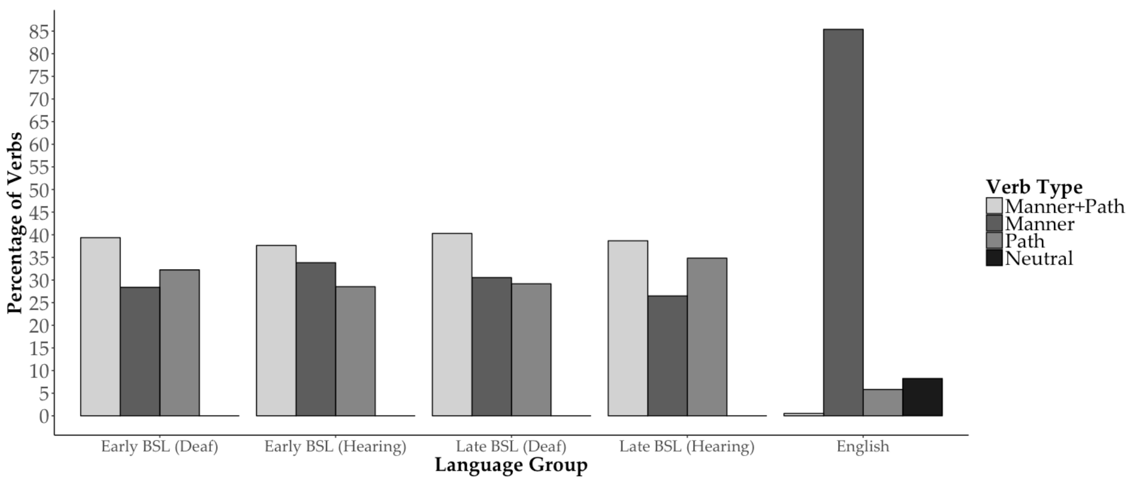
After looking at the number of verbs in target clauses, I analysed the verb type used by the different groups. There are four possible types of verb available for speakers and signers to use in Motion event descriptions:

- Neutral verbs: Verbs that express Motion but do not provide any Path or Manner information (such as ‘go’ in English).
- Path Verbs: Verbs that express Motion and Path without Manner (such as ‘enter’ or ‘cross’ in English).

- Manner Verbs: Verbs that express Motion and Manner without Path (such as 'swim' in English or RUN in BSL).
- Manner+Path Verbs: Verbs that express Motion, Manner and Path (such as JUMP-UP in BSL or 'sidestep' in English).

I analysed the data for the type of verb used in descriptions by different groups (see Graph 9, below). As there were 20 potential for the verb types used (Neutral, Path, Manner and Manner+Path across five groups) a Bonferroni adjustment was made to maintain an α level of 0.05. Results are considered significant at $\alpha = 0.05/20 = 0.0025$.

A chi-square test of independence was performed to examine the relation between language (English or BSL) and use of different verb types. The relation between these variables was highly significant, χ^2 (1, N = 2843) = 11125.68, $p <$ 0.001. A post-hoc comparison of residuals found that early BSL signers showed a significant preference for Manner+Path verbs ($p < 0.001$) compared to English speakers who showed a significantly stronger preference than early BSL signers for Manner ($p < 0.001$) and Neutral ($p < 0.001$) verbs. See Example 56, below, for a native English speaker using a Neutral verb and an early BSL signer using a Manner+Path verb when describing Image 55.



Graph 9 Verb type used in Motion event descriptions by all groups

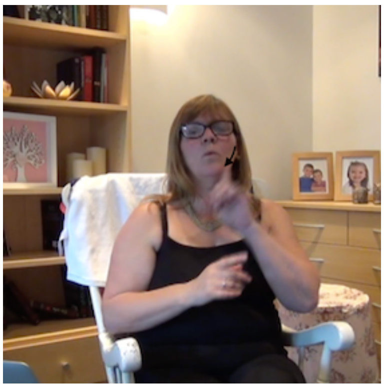
Image 55 Video clip of a woman walking up a ramp towards a tree

a) Early BSL signer using a Manner+Path verb

TREE

(r) TREE+located.at.y

(l) RAMP



WOMAN

MOVE.figure+from.x+to.y+manner.walk

A woman is walking up a ramp to a tree.

b) English speaker using a Neutral verb

'She's going up a ramp.'

Example 56 Use of Manner+Path verb by early BSL signer and Neutral verb by English speaker

Looking at BSL groups, a chi-square test of independence was performed to examine the relation between BSL groups and use of different verb types. The relation between these variables was not significant at the Bonferroni-adjusted error level of 0.0025, χ^2 (6, N = 3830) = 20.08, p = 0.003.

To summarise, the type of verb used by English speakers and early BSL signers was significantly different ($p < 0.001$) with early signers showing a significant preference ($p < 0.001$) for Manner+Path verbs compared to English speakers who showed a stronger preference than early BSL signers for Manner and Neutral verbs. There was no significant difference between BSL groups on type of verbs used.

4.1.5.3 BSL Verbs

4.1.5.3.1 Depicting Verbs

As explained in section 2.3.1.1.1, Depicting verbs of Motion can be used to show the movement of an entity in BSL (see Appendix 2 for a list of Depicting verb of Motion handshapes relevant to the current study). In the section above, I explored the information contained in verbs of all types. This section will deal only with Depicting verbs of Motion. Depicting verbs of Motion can show just Path information or both Path and Manner information (see Example 58, below, showing two descriptions of Image 57). However, they do not directly map onto Manner+Path and Path verbs described above. This is because a subset of the BSL Path verbs described above are Plain Path verbs (like PASS or ENTER) that do not change handshape depending on the Figure described, unlike Depicting verbs of Motion. In this section, I will now compare the preference for using a Depicting verb of Motion versus another verb in BSL signing groups. I will then examine the handshapes chosen for Depicting verbs of Motion by different signing groups. Finally, I will consider a specific case of Ground information being included in Depicting verbs of Motion.

A chi-square test of independence was performed to examine the relation between BSL group and inclusion of Depicting verbs of Motion. The relation between these variables was significant, χ^2 (3, N = 2513) =66.85, $p < 0.001$. A post-hoc comparison of residuals found that deaf early BSL signers used significantly more Depicting verbs of Motion overall ($p < 0.001$) and hearing early BSL signers used significantly fewer Depicting verbs of Motion overall ($p < 0.001$).

Image 57 Video clip of a woman walking a curved path past some shops

a) Early BSL signer using a Depicting verb of Motion to show only Path

WOMAN

WALK

MOVE.figure+from.x+to.y+past.self+contour.a

A woman walks a curved line past from x to y.

b) Early BSL signer using a Depicting verb of Motion to show Path and Manner

WOMAN

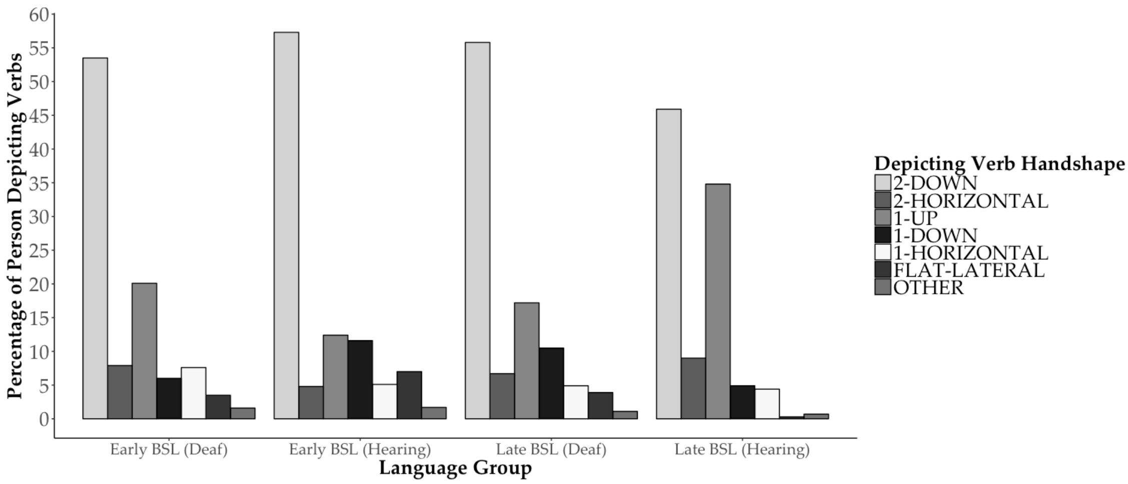
MOVE.figure+from.x+to.y+past.self+contour.a+manner.walk

A woman walks a curved line past from x to y.

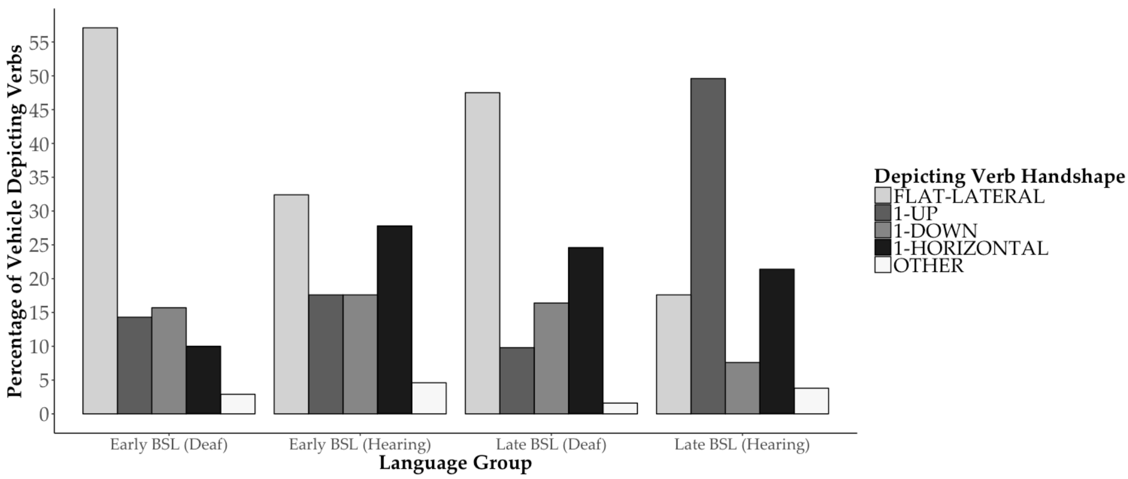
Example 58 Depicting verb of Motion showing just Path information and Depicting verb of Motion showing Path and Manner information

There were two types of Depicting verbs of Motion that appeared in Motion event descriptions: person Depicting verbs of Motion and vehicle Depicting verbs of Motion. Person Depicting verbs of Motion show the movement of a person as a Figure. Vehicle Depicting verbs of Motion show the movement of a vehicle as a Figure (in this study, the only vehicle was a bicycle). I carried out analyses on the handshape used in person and vehicle Depicting (see Graph 10 and Graph 11, below). A chi-square test of independence was performed to examine the relation between BSL group and type of handshape used for a person (G-UP, G-DOWN, G-HORIZONTAL, V-DOWN, V-HORIZONTAL, B-LATERAL or other, see Appendix 2 for details). The relation between these variables was highly significant, χ^2 (18, N = 1723) = 146.41, $p < 0.001$. A post-hoc comparison of residuals found that, at a Bonferonni-adjusted error level of α = 0.05/28 = 0.0018 (28 potential comparisons: seven handshapes across four groups), hearing late signers used the 1-UP handshape significantly more than other groups (p = 0.0014). A chi-square test of independence was also performed to examine the relation between BSL group and type of handshape used for vehicles (G-UP, G-DOWN, G-HORIZONTAL, B-LATERAL or other). The relation between these variables was again highly significant, χ^2 (12, N =

370) = 76.67, $p < 0.001$. However, in a post-hoc comparison of residuals there were no individual group differences that reached significance at the Bonferonni-adjusted error level of $\alpha = 0.05/20 = 0.0025$ (20 potential comparisons: five handshapes across four groups).



Graph 10 Handshapes used in person Depicting verbs of Motion by all BSL groups

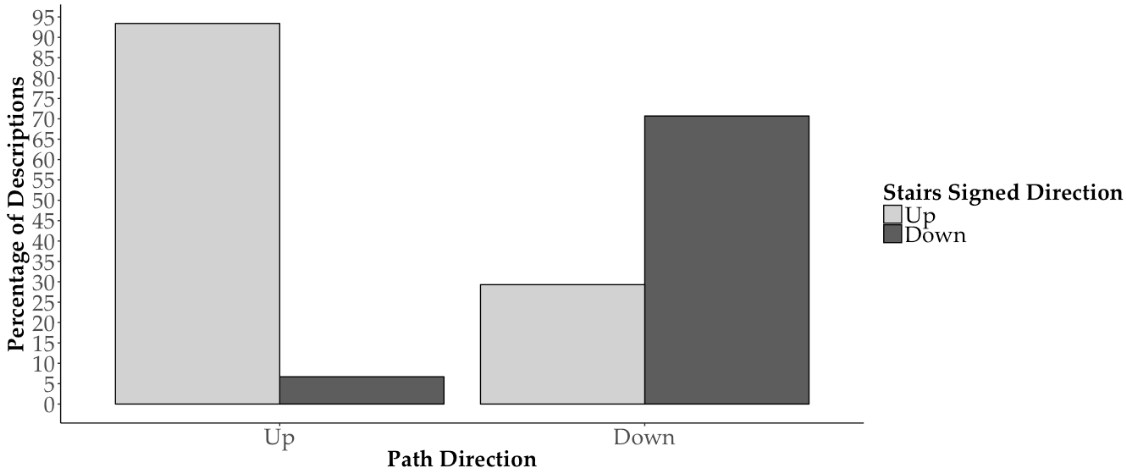


Graph 11 Handshapes used in vehicle Depicting Verbs by all BSL groups

As mentioned in section 4.1.2, some participants in every signing group conflated Ground information with Motion and Path as part of a Depicting verb of Motion (50 descriptions in total). This type of Depicting verb of Motion was only used when a Figure was going up or down the stairs. The sign STAIRS can be signed in two directions (upwards or downwards) and shares the same form as WALK-UP or WALK-DOWN (see Image 59 and Image 60, below). I investigated whether, even when Ground information was not conflated in a Depicting verb, the Path of the Figure influenced the signing direction of stairs (see Graph 12, below). A chi-square test of independence was performed to examine the relation between Path direction (up/down) and direction of Ground signing (up/down). The relation between these variables was significant, χ^2 (1, N = 406) = 163.80, $p < 0.001$. The direction of the Path (up/down) and the direction of Ground signing (stairs up/down) were found to be related, with signers significantly preferring to sign Ground to match Path.

Image 59 STAIRS or WALK-UP in BSL

Image 60 STAIRS or WALK-DOWN in BSL



Graph 12 Comparison of Path direction and signing direction for STAIRS

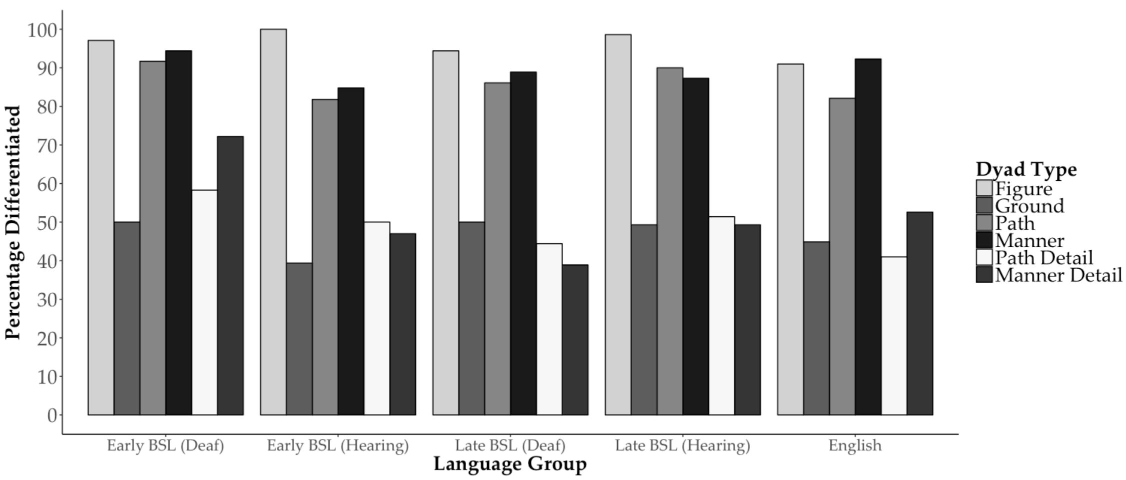
To summarise, deaf early BSL signers used significantly more Depicting verbs of Motion ($p < 0.001$) and hearing early BSL signers used significantly fewer Depicting verbs of Motion ($p < 0.001$) than other groups, often including Path information in a lexical verb (for example, CLIMB-UP) or using Manner verbs with Path satellites instead. There was also a significant difference between the groups on handshape used for person Depicting verbs of Motion ($p < 0.001$), with hearing late signers using the 1-UP handshape significantly more than other groups ($p = 0.0014$).

4.1.5.3.2 Plain and Indicating Verbs

As discussed in section 2.3.1.1.1, sign languages are considered to have different verb types (Plain and Indicating). The former group (Plain) are said to receive no inflection regardless of the referents or spatial information involved. RUN, CYCLE and SWIM are generally considered to be Plain verbs in BSL, expressing Manner information but unable to mark Path. However, these verbs were inflected for Path by some signers in all groups: in 3.4% of instances by deaf early BSL signers, 2.1% by hearing early BSL signers, 4.9% by deaf late signers and 4.7% by hearing late signers. A chi-square test of independence was performed to examine the relation between BSL groups and use of supposed Plain verbs inflected for Path. The relation between these variables was not significant, χ^2 (3, N = 1190) = 4.48, p = 0.21. However, in Chapter 5 I will discuss the occasions when different groups used these Path-inflected supposed Plain verbs.

4.1.6 Dyad Differentiation

The final analysis of this section investigates whether the groups distinguished between components when describing different dyad types (across the entire utterance, not just in the target Motion event clauses). For example, a Path dyad description would be considered to have distinguished between the Path component if the two video clips were described contrastively (for example, 'He climbs up the wall' and 'He climbs down the wall'). The percentage of descriptions that marked a difference between dyads was calculated for each group in each component type (see Graph 13, below). Of particular interest were the Path and Path Detail dyads as hypothesis 1 predicted that early BSL signers would be more likely to mark a difference in these components than English speakers. Hypothesis 2 predicted that late signers would be more likely to mark a difference in these two components than English speakers, but to a lesser extent than early BSL signers.



Graph 13 The differentiation of the dyad types by all groups

As there were thirty planned comparisons for dyad differentiation (comparing five groups on six components), a Bonferroni adjustment was made to maintain an α level of 0.05. Results are, therefore, considered significant at $\alpha = 0.05/30 = 0.002$. A Mann-Whitney analysis revealed that there was no significant difference between early BSL signers and English speakers on differentiation between Figure dyads ($W = 274.50$, $p = 0.6603$), Ground dyads ($W = 250.50$, $p = 0.6009$), Path dyads ($W = 270.50$, $p = 0.7856$), Manner dyads ($W = 246.50$, $p = 0.4898$), Path Detail dyads ($W = 288.00$, $p = 0.3152$) and Manner Detail dyads ($W = 274.50$, $p = 0.6603$). A Kruskal-Wallis analysis revealed that there was no significant difference between the four BSL groups on differentiation of Figure dyads ($H = 1.34$, $p = 0.7196$), Ground dyads ($H = 4.38$, $p = 0.2236$), Path dyads ($H = 1.76$, $p = 0.6232$), Manner dyads ($H = 2.32$, $p = 0.5083$), Path Detail dyads ($H = 2.26$, $p = 0.5201$) and Manner Detail dyads ($H = 5.73$, $p = 0.1256$).

4.1.7 Summary of Results for Linguistic Analyses

In this section I will summarise the results of the linguistic analyses. These results will be considered in relation to my hypotheses and previous research in chapter 5.

In relation to hypothesis 1, which posited that English speakers and early BSL signers would differ in their inclusion and packaging of Motion event components, the findings were as follows:

- Figure: Overall, language was significantly related to the packaging of Figure information ($p < 0.001$). Native English speakers were more likely to omit Figure information and showed a stronger preference for including Figure information in the target Motion event clause than early BSL signers.

- Ground: Overall, there was no significant relation between language and Ground inclusion, with early BSL signers and English speakers equally prone to omitting Ground information. There was, however, a significant effect ($p < 0.001$) of language on packaging of Ground information in the target Motion event clause, with English speakers showing a stronger preference for including Ground information in the target Motion event clause than early BSL signers.
- Path: There was no significant difference between languages on likelihood to omit Path information. However, across all groups Path was significantly more likely to be omitted in swimming ($p < 0.001$) and floating ($p < 0.001$) events. There was a significant difference ($p < 0.001$) between early BSL signers and English speakers in the inclusion of Path information in a verb or satellite, with early BSL signers preferring to include Path in the verb and English speakers preferring to include Path in a satellite. Significant differences were also found in the Path type expressed; English speakers were significantly less likely than other groups to use Directional Path in Left/Right Path events ($p < 0.001$), Around events ($p < 0.001$) and Towards/Away events ($p < 0.001$). English speakers were significantly more likely to use a Source, Goal or Source-Goal Path expression ($p < 0.001$) in Towards/Away events than other groups. English speakers also showed a significantly stronger preference ($p < 0.001$) for using a Boundary Path type than other groups in In/Out events. When looking specifically at Around events, English speakers were significantly more likely to omit rotational direction information compared to other groups ($p < 0.001$).
- Manner: There was no relation between language and inclusion of Manner information. There was a significant relation between language (native English or early BSL) and the packaging of Manner information

($p < 0.001$), with English speakers using satellite only Manner constructions significantly more frequently than BSL signers.

- Verbs: Overall, there was a highly significant difference ($p < 0.001$) between BSL and English on use of double verbs, with early BSL signers strongly preferring use of double verbs and English speakers strongly preferring single verbs. The type of verb used by English speakers and early BSL signers was also significantly different ($p < 0.001$) with early BSL signers showing a preference for Manner+Path verbs compared to English speakers who showed a stronger preference than early BSL signers for Manner and Neutral verbs.
- Dyads: There was no significant difference between early BSL signers and English speakers on differentiation between any of the dyads.

The relation of these findings to hypothesis 1 will be discussed in chapter 5.

In relation to hypothesis 2, which suggested that early BSL signers and late BSL signers would differ in their inclusion and packaging of Motion event components, the findings were as follows:

- Figure: BSL group did not have a significant effect on Figure inclusion. However, there was a significant relation between BSL group and Figure packaging ($p < 0.001$), with deaf early BSL signers significantly preferring to express Figure information outside the target Motion event clause and hearing late signers preferring to include Figure within the target Motion event clause.
- Ground: The relation between BSL group and Ground inclusion was found to be significant ($p < 0.001$) with late signers including Ground information more frequently than other BSL groups. A significant relation ($p < 0.001$) was also found between BSL group and packaging of Ground information, with deaf early BSL signers showing a greater

preference for expressing Ground information in a separate clause than other groups.

- Path: There was a relation between BSL group and omission of Path information, with hearing early BSL signers significantly more likely to omit Path information than other groups ($p < 0.001$). There was no significant difference between groups on Path type used for Up/Down, Left/Right or Around event types. However, there was a significant difference between groups on In/Out event types ($p < 0.001$) with hearing late signers using Directional Path types significantly more ($p < 0.001$) than all other groups.
- Manner: There was no significant difference between BSL groups on inclusion of Manner information. However, BSL groups did significantly differ in their packaging of Manner information ($p < 0.001$) with deaf early BSL signers preferring the use of verb plus satellite constructions when expressing Manner and hearing late signers significantly dispreferring this construction. In the majority of instances (94.2%) where deaf early BSL signers used Manner verb plus Manner satellite constructions, the additional Manner information in the satellite was to specify speed.
- Verbs: There was a highly significant difference ($p < 0.001$) between BSL groups on use of single or double verbs, with deaf early BSL signers showing a stronger preference for double verbs ($p < 0.01$) compared to other groups. There was also a significant difference ($p < 0.01$) between BSL groups on type of verbs used. Deaf early BSL signers used significantly more Depicting verbs of Motion overall ($p < 0.001$) and hearing early BSL signers used significantly fewer Depicting verbs of Motion overall ($p < 0.001$) compared to other groups. There was also a significant difference between the groups on handshape used for person

Depicting verbs of Motion ($p < 0.001$) with hearing late signers using the G-UP handshape significantly more than other groups ($p = 0.0014$).

- Dyads: There was no significant difference between BSL groups on differentiation between any of the dyads.

The relation of these findings to hypothesis 2 will be discussed in chapter 5.

4.2 Behavioural Analyses

In this section, I compare the behavioural data of 50 participants (6 deaf early BSL signers, 12 hearing early BSL signers, 7 deaf late signers, 12 hearing late signers and 13 English-speaking non-signers) on a series of tasks described in 3.4. The models in this section were created and selected through the methodology described in 3.8.2. All candidate and selected models for this chapter are listed in Appendix 11.

In this analysis, I investigate hypotheses 3 and 4:

3. If one's early language can influence focus of attention to components of Motion events important to descriptions in that language then early BSL signers will perform better than English monolinguals at the recognition memory task (because, being a spatial language, BSL entails a higher level of detail in descriptions than English).
4. If a language acquired as an adult can influence focus of attention to components of Motion events important to description in that language then late signers will perform better than English monolinguals at the recognition memory task (because, being a spatial language, BSL entails a higher level of detail in descriptions than English).

In this section I will first check that the pseudorandomisation measures for the Motion event memory task prevented any confounds. Next, I will examine potential models for the recognition task. Finally, I will look at potential models for the memory and attention task battery.

4.2.1 Pseudorandomisation

As explained in section 3.4, participants saw one of two sets of video clips (A or B) in the video clip viewing session. The recognition task also had two varieties (A or B), which varied the placement of correct answers on the left/right. This was part of the pseudorandomisation measures put in place for the methodology. I checked whether there were any effects for the set of video clips seen in the viewing session, the recognition task or any interaction of these two variables. A two-way analysis of variance was conducted on the influence of two independent variables (viewing session A/B and recognition task A/B) on score in the recognition task. There was no significant interaction effect for viewing session (A or B) and recognition task (A or B), $F_1 = 3.00$, $p = 0.09$. The main effect for viewing session (A or B) was not significant $F_1 = 0.87$, $p = 0.36$. The main effect for recognition task (A or B) was not significant $F_1 = 0.16$, $p = 0.69$. Therefore, there was no significant effect of viewing session or recognition task on performance in the recognition task.

4.2.2 Memory and Attention Task Battery

I performed GLM (Generalised Linear Model) analyses of all tasks in the memory and attention task battery to check for interactions prior to including them in models for the Recognition Task.

The initial predictors for all models were: Age, Gender, Interpreter status (qualified interpreter, trainee interpreter or non-interpreter), Education level (highest educational qualification achieved), Hearing status (deaf/hearing) and BSL knowledge (early, late or non-signer). Below is a summary of the selected models for the memory and attention tasks.

Spatial Span

Spatial Span scores were significantly associated with Age in a model with the predictors Hearing status and Age (adjusted $R^2 = 0.22$, $F_{2,47} = 8.00$, $p = 0.001$) with a negative correlation between years of age and score. However, removing Hearing status from the model resulted in non-normality of the error residuals (Shapiro-Wilk: $W = 0.93$, $p = 0.007$); consequently, the results of a model for Age alone are not considered valid as the modelling technique assumes normality of errors. Hearing status was retained as a (non-significant; $p = 0.20304$) predictor because it improves model fit by accounting for some of the variance and, therefore, the model for Hearing status and Age has been accepted as the most parsimonious, despite Age being the sole significant predictor ($p = 0.00397$).

Interlocking Polygons

Interlocking Polygons scores were found to have no significant association with any of the predictors. Therefore no models were considered appropriate. The model which explained most variation included just Hearing status as a predictor, but did not meet significance levels and only accounted for 4% of the variability in the data (adjusted $R^2 = 0.04$, $F_{1,48} = 2.85$, $p = 0.098$).

Feature Match

Feature Match scores were found to have a highly significant association with Age (adjusted $R^2 = 0.21$, $F_{1,48} = 14.08$, $p < 0.001$) with a negative correlation between years of age and Feature Match score.

Rotations

Rotations scores were found to have a significant association with Age (adjusted $R^2 = 0.087$, $F_{1,48} = 5.68$, $p = 0.02$) with a negative correlation between years of age and score. However, this model explained just 8.7% of the variability in the data.

Paired Associates Learning

Paired Associates Learning scores were found to have no significant association with any of the predictors above. Therefore no models were considered appropriate. The model which explained the most variation included just Hearing status as a predictor, but did not meet significance levels and only accounted for 2% of the variability in the data (adjusted $R^2 = 0.02$, $F_{1,48} = 2.11$, $p = 0.15$).

Age was the only significant predictor for any of the memory and attention tasks and scores in these tasks were not linked to hearing status or language. Therefore all the tasks were accepted for inclusion in the Recognition Task GLMs (as they were unlikely to present an issue of multicollinearity with the predictors of hearing status or language) to see if any of the abilities assessed in the tasks contributed to recognition ability.

4.2.3 Recognition Task

I analysed the relationship between score on the recognition task and a set of predictor variables using GLMs (as explained in 3.8.2). The potential predictors were as follows: score in Spatial Span task, score in Interlocking Polygons task, score in Feature Match task, score in Rotations task, score in Paired Associates Learning task, Age, Gender, Interpreter status (interpreter or non-interpreter), Education level (highest educational qualification achieved), Hearing status (deaf/hearing) and BSL knowledge (early, late or non-signer). I checked for outliers in the predictor variables or Motion task scores by running a series of Grubb's Tests. There were no outliers detected in any of the predictors or the recognition task scores. Before creating a model for the data, I tested for the presence of multicollinearity by calculating the variance inflation factor (VIF). All predictor variables had a VIF of < 1.5, indicating low likelihood of multicollinearity. Therefore no predictors were excluded from potential inclusion in the model.

As explained in 3.8.2, the methodology for selecting an appropriate model was as follows:

1. Create a GLM with the highest number of possible predictors and interactions. The initial predictors for all models are outlined above.
2. Remove non-significant predictors/interactions one-by-one until only significant terms remain. These are the candidate set of models.
3. With the creation of each new model, check the standardised residuals for normality and heteroscedasticity.
4. Use the Akaike's Information Criterion (AIC) to narrow down the candidate set.
5. Select the least complex and, therefore, most likely the most parsimonious model.

Recognition task scores were found to have a significant association with Paired Associates Learning ($p = 0.024$) in a model with the predictors Age and Paired Associates Learning (adjusted $R^2 = 0.066$, $F_{2,47} = 2.73$, $p = 0.08$) with a positive correlation between Paired Associates Learning score and recognition task score. However, the model itself did not reach significance and only accounts for 6.6% of variability in the data. Removing Age from the model resulted in the error residuals no longer having a normal distribution (Shapiro-Wilk: $W = 0.95$, $p = 0.03$). Therefore, the results of a model for just Paired Associates Learning are not considered valid because the non-normal distribution of error residuals violates the assumptions of the model. Therefore no models for the recognition task scores were deemed appropriate (as they did not meet the terms for model selection laid out in section 3.8.2).

Next, I created GLMs for scores on each of the dyad types (Figure, Ground, Path, Manner, Path Detail and Manner Detail). Scores on Figure, Ground, Path,

Path Detail and Manner Detail were found to have no significant association with any of the predictors. Scores for Manner dyads were found to have a significant association with just Age ($p = 0.046$) in a model with the predictors Age and Paired Associates Learning (adjusted $R^2 = 0.085$, $F_{2,47} = 3.28$, $p = 0.047$) with a positive correlation between Age and Manner score. However, removing Paired Associates Learning from the model resulted in Age no longer being significant. The model also explains just 8.5% of the variability in the data. Therefore, no models were accepted for scores in Manner dyads as they did not meet the terms for model selection laid out in section 3.8.2.

As explained in 3.4, participants were asked to rate their confidence for each choice they made on the Motion event recognition task on a scale of 1–4 (from completely unsure to completely sure). This gave three kinds of responses for the task:

- Correct: where the participant chose the correct video clip and also rated their confidence as sure or completely sure.
- Guess: where the participant chose either the correct or incorrect video clip but rated their confidence as unsure or completely unsure.
- False Alarm: where the participant chose the incorrect video clip but rated their confidence as sure or completely sure.

I created GLMs of the relationship between each of these three response types and the predictors outlined above. Correct responses were found to have a significant association with Feature Match scores and Age (adjusted $R^2 = 0.12$, $F_{2,47} = 4.36$, $p = 0.02$). As neither Age nor Feature Match were significant as sole predictors, this was considered the most parsimonious model. However, Feature Match and Age were found to be highly related (see 4.2.2) and so there was deemed to be an issue of collinearity. Therefore, on the basis of the presence of collinearity, this model was not accepted. Guess responses were found to have a significant association with just Age ($p = 0.024$) in a model with the predictors Age and Paired Associates Learning (adjusted $R^2 = 0.069$, $F_{2,47} = 2.80$, $p = 0.07$) with a negative correlation between years of age and Guess responses. However, the model itself did not reach significance and only accounts for 6.9% of the variability in the data. Removing Paired Associates Learning from the model resulted in the error residuals no longer meeting the assumption of normal distribution (Shapiro-Wilk: $W = 0.95$, $p = 0.045$) so that the results of a model for just Age are not considered valid. Therefore no models for Guess responses were deemed appropriate. False Alarm responses were found to have no significant association with any of the predictors.

As explained in 4.1.6, I analysed whether participants differentiated between video clip dyads when describing them. For example, a participant was considered to have distinguished between a Path dyad if the two video clips were described contrastively (for example, 'He climbs up the wall' and 'He climbs down the wall'). I investigated whether there was a relationship between the dependent variable of whether the participant differentiated between a dyad in their description (coded as differentiation = 1 and no differentiation = 0) and the independent variable of whether a participant chose the correct clip in that dyad in the Motion event recognition task (coded as correct choice = 1 and incorrect choice = 0). Their confidence score for each choice (on a scale 1-4) was also included as a possible predictor. I performed a generalised linear mixed effects analysis of the relationship between description differentiation and choice. As fixed effects, I entered choice and confidence (without interaction term). As random effects I included intercepts for participant and item (dyad), as well as by-participant and by-item random slopes for the effect of choice. P-values were obtained by likelihood ratio tests of the full model with the effect (Choice) in question against a model without the effect in question. Comparison of the models revealed that choice affected description differentiation ($\chi^2(1) = 5.30$, $p = 0.02$), with correct choice in the Motion event recognition task increasing the likelihood of a differentiation in description by 0.5 (±0.22 *SE*). A likelihood ratio test comparing the full model with and without confidence rating revealed that level of confidence was not significantly associated with differentiation in description ($\chi^2(1) = 0.44$, $p = 0.51$).

Table 14 Comparison of three models with different predictors for Description Differentiation

	Full Model (Choice+Confidence)				**Choice Only Mode**				**Confidence Only Model**			
	β	*SE*	*z*	*p*	*β*	*SE*	*z*	*p*	*β*	*SE*	*z*	*p*
(Intercept)	1.10	0.45	2.43	0.02	1.25	0.39	3.21	<0.01	1.10	0.53	2.07	0.04
Choice	0.50	0.22	2.28	0.02	0.53	0.22	2.42	0.02	-	-	-	-
Confidence	0.06	0.09	0.68	0.50	-	-	-	-	0.10	0.09	1.11	0.27

4.2.4 Summary of Results for Behavioural Analyses

In relation to hypothesis 3 and 4, which suggested BSL signers would perform better than English speakers in the Motion event recognition task due to BSL requiring a higher level of detail in description:

- Neither BSL knowledge nor hearing status were found to be significant predictors for scores in the Motion event recognition task. Paired Associates Learning scores were found to be significant ($p = 0.024$) in a model with the predictors Age and Paired Associates Learning. However, this model did not reach significance levels overall and was therefore not accepted.
- Neither BSL knowledge nor hearing status were found to be significant predictors for scores on the different Motion event components in the Motion event recognition task. Scores on Figure, Ground, Path, Path

Detail and Manner Detail were found to have no significant association with any of the predictors. Scores for Manner dyads were found to have a significant association with just Age (p = 0.046) in a model with the predictors Age and Paired Associates Learning (adjusted R^2 = 0.085, $F_{2,47}$ = 3.28, p = 0.047). However, removing Paired Associates Learning from the model resulted in Age no longer being significant. The model also explained just 8.5% of the variability in the data. Therefore, no models were accepted for scores in Manner dyads.

- Neither BSL knowledge nor hearing status were found to be significant predictors for Correct choices on the Motion event recognition task (instances where the correct clip was chosen and the participant rated their confidence as sure or completely sure). There was a relationship between Correct choices and both Feature Match and Age as predictors. However, due to the presence of collinearity and the fact that neither Feature Match nor Age were significant sole predictors, this model was not accepted. Guess responses were found to have a significant association with Age (p = 0.024) in a model with the predictors Age and Paired Associates Learning (adjusted R^2 = 0.069, $F_{2,47}$ = 2.80, p = 0.07) with a negative correlation between years of age and Guess responses. However, the model did not reach significance and no other models for Guess responses were deemed appropriate. False Alarm responses were found to have no significant association with any of the predictors.
- A significant positive relationship was found between choosing the correct clip out of a dyad in the recognition task and later differentiating between the clips in that dyad in the description task ($\chi^2(1)$ = 5.30, p = 0.02). Level of confidence was not significantly associated with differentiation in description ($\chi^2(1)$ = 0.44, p = 0.51).

The relation of these findings to hypotheses 3 and 4 will be discussed in chapter 5.

As discussed in section 3.8, the relationship between BSL knowledge and/or Hearing status and scores on the memory and attention tasks can provide an understanding of whether it is auditory deprivation or language that can influence seemingly non-linguistic cognitive skills. In relation to the role of language and hearing status on the memory and attention task battery:

- Neither BSL knowledge nor hearing status were found to be significant predictors for scores in the Spatial Span task. However, Age was found to have a relationship with Spatial Span scores in a model with the predictors Hearing status and Age (adjusted $R^2 = 0.22$, $F_{2,47} = 8.00$, $p = 0.001$) with a negative correlation between years of age and score.
- No predictors (including BSL knowledge and hearing status) were found to have a significant association with Interlocking Polygons scores.
- Neither BSL knowledge nor hearing status were found to be significant predictors for scores in the Feature Match task. However, Feature Match scores were found to have a highly significant association with Age (adjusted $R^2 = 0.21$, $F_{1,48} = 14.08$, $p < 0.001$) with a negative correlation between years of age and Feature Match score.
- Neither BSL knowledge nor hearing status were found to be significant predictors for scores in the Rotations task. However, Rotations scores were found to have a significant association with Age (adjusted $R^2 = 0.087$, $F_{1,48} = 5.68$, $p = 0.02$) with a negative correlation between years of age and score.
- No predictors (including BSL knowledge and hearing status) were found to have a significant association with Paired Associates Learning scores.

5 DISCUSSION

This study was intended to create a better understanding of how monolingual English speakers, early BSL signers and late BSL signers differ in their descriptions of Motion events. It also investigated whether linguistic packaging influences memory for Motion events. The linguistic descriptions have provided insights into how the languages (English and BSL) and groups (deaf/hearing early and deaf/hearing late) differ in their inclusion and packaging of Motion event components. The behavioural results relating to recognition memory have not conclusively answered the question of whether linguistic preferences influence memory. However, the results have revealed more avenues for exploration in the field of thinking-for-speaking. Below I will discuss how the results relate to the four hypotheses of the current study.

5.1 Findings

5.1.1 Hypothesis 1

First, I will discuss the results relating to hypothesis one, which was as follows:

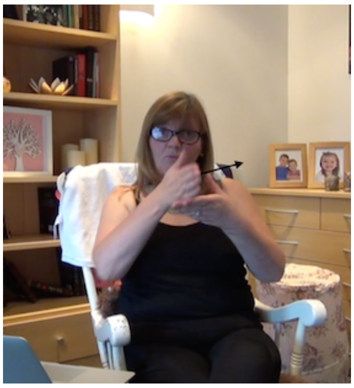
1. Both monolingual English speakers and early BSL signers will regularly include all four basic components of Motion events (Motion, Figure, Ground and Path) as well as Manner information

> in their Motion event descriptions. However, early BSL signers will provide fuller Path detail than monolingual English speakers through the use of BSL Depicting verbs of Motion (which are capable of combining more parts of Path than English verbs, including Vector, Deixis, Conformation, Direction and Contour).

As predicted by hypothesis 1, language did not have a significant effect on Figure inclusion. Omission of Figure information was very unusual in both languages. As participants described Motion events featuring the same two Figures one after another, the lack of Figure in some descriptions is likely to be due to topic drop because of the repetitive nature of the task. Figure omission was extremely rare in descriptions by early BSL signers (occurring just twice in 1223 utterances). Although the literature predicts omission of a Figure component where a Depicting verb handshape is typically only associated with one Figure type (for example, the Y-handshape for AEROPLANE or the V-handshape for PERSON; see Sutton-Spence & Woll, 1999), this was not the case for the utterances in the current study. One signer omitted Figure information but included the verb CYCLE and produced a B-LATERAL Depicting verb, perhaps with the implication in the semantics of 'cycle' that BICYCLE was the Figure (see Example 61, below). A second signer used a G-UP Depicting verb of Motion without referencing a specific Figure. However, as the signer had been describing Motion events featuring the same two Figures one after another, I would suggest that the Depicting verb in this instance is anaphoric, referring back to the Figure mentioned previously, rather than this being a case of true Figure omission. Indeed, the use of an anaphoric pronoun in English descriptions was very common, found in utterances such as 'she steps into the pool' and the Depicting verb of Motion in this instance may have acted in a similar way.

ARCHWAY

CYCLE



MOVE.vehicle+via.x

[He?] cycles through the archway.

Example 61 Use of B-LATERAL handshape in a Depicting verb of Motion showing a vehicle movement

As explored in section 2.3.1.1.2, Tang (2003) and Slobin (2013) argue that sign languages can behave somewhat similarly to Talmy's Figure-type languages, by combining Figure information with the Motion component in Depicting verbs of Motion. A true Figure-type language would include all Figure information in the verb. In BSL, although some Figure information is conflated with Motion in Depicting verbs of Motion (through the choice of handshape relating to Figure type), this information is almost always preceded by a separate Figure component.

English speakers showed a slightly stronger preference than early BSL signers for including Figure information in the target Motion event clause either with use of a noun (for example, ‘a woman ran down the stairs’) or a gendered anaphoric pronoun (for example, ‘she runs downstairs’). Early BSL signers also preferred this construction but produced Figure information outside of the target Motion event clause in 32.3% of instances as opposed to 21% of instances for monolingual English speakers. These constructions reflect those found in other sign languages (in ASL by Taub et al, 2009; in HKSL by Tang, 2003; in ASL and NGT by Slobin & Hoiting, 1994) where signers frequently convey Figure information before expressing the Motion.

Similarly, although monolingual English speakers and early BSL signers showed no difference in inclusion of Ground information (as hypothesis 1 predicted), early BSL signers showed relatively equal preference for including this information in the target Motion event clause and in another clause (55.7% and 44.3% of all Ground information) while English speakers strongly preferred including Ground in the target Motion event clause (78.6% of all Ground information). Foregrounding Ground information in a separate clause has been reported in a number of sign languages (Napoli & Sutton-Spence, 2010; Tang, 2003). In this way, BSL behaves similarly to V-languages such as Spanish (Slobin, 2004, 2006) in that signers set the scene (with Ground and Figure information) prior to describing the Motion itself. Even where early BSL signers provided Ground and Figure information in the same clause as Motion, they did so prior to expressing Motion. See Example 63, below, for an example of an early BSL signer ‘foregrounding’ Ground prior to relating the Motion when describing Image 62. English speakers tended to show tight packaging of both Ground and Figure information, with both typically represented in the same clause as Motion with the order Figure-Motion-Ground. Early BSL signers show a V-language preference for packaging and order, with Ground and Figure information expressed before Motion either within the same clause or in a separate preceding clause.

Image 62 Video clip of a man running rightwards past some shops

SHOP

BE.entity+located.at.x

CAR

BE.vehicle+located.at.y [c]

MAN

GREY

JUMPER

RUN

MOVE.figure+from.a+to.b+past.self

Shops and a car are there. A man in a grey jumper runs rightwards past from a to b.

Example 63 Early BSL signer providing Ground and Figure information prior to describing Motion

As was predicted in hypothesis 1, the omission of Path information was rare in both English (5.8% of descriptions) and BSL (4% of descriptions) and there was no significant difference between the languages in this preference. However, the packaging of Path information did differ between the languages, with early

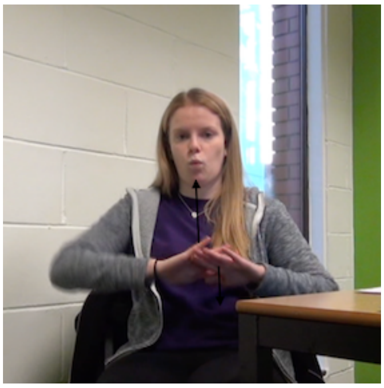
BSL signers preferring to include Path in the verb (94.7% of descriptions) and English speakers preferring to include Path in a satellite (92.8% of descriptions). This fits with prior research concluding that English is an S-language (Talmy, 2000a, 2000b) and sign languages are types of V-language (Slobin & Hoiting, 1994; Tai & Su, 2013; Taub & Galvan, 2001).

When looking at the type of Path information expressed by English speakers and early BSL signers, there was also a significant difference. In the Up/Down event types, English and BSL participants were similar, with both using vertical Path expressions most frequently (for example, ‘go up’ or ‘go down’ in English or a Depicting verb of Motion moving on the vertical plane). See Example 65, below, for a description of Image 64 by an early BSL signer and monolingual English speaker using the same Vertical Path expression.

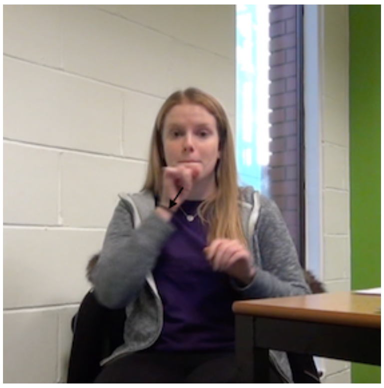
In both languages there was less variation in the means to describe vertical Motion than for most other Path types (with the exception of rotational direction, which will be discussed later in this section). As discussed in section 2.2.2.2, Vertical relations do not require a specific reference frame and are among the first spatial relations understood by children. Sallandre et al, (2018) report in LSF that adult and child signers encoded Manner+Path information more regularly in Up/Down events compared to other event types. Even in Up/Down events where the Figure moved along a sagittal/lateral plane (such as stepping down some stairs to the viewer’s left), both BSL and English speakers preferred to encode just Vertical information. These preferences in English, BSL and LSF, along with its early acquisition by children, may indicate a cross-linguistic preference for paying attention to vertical over horizontal Motion. As most interaction with the environment is on the horizontal plane, perhaps this preference for attending to vertical Motion is due to an inherent markedness of vertical Motion in human experience.

Image 64 Video clip of a man climbing up a climbing wall

a) Early BSL signer using a Vertical Path type

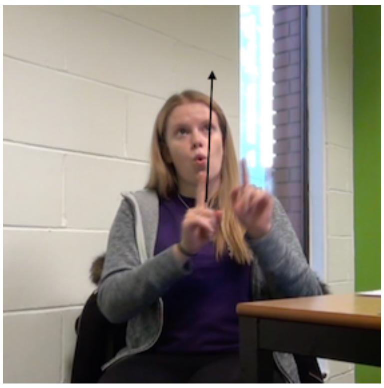


WALL



MAN

CLIMB-UP



MOVE.figure+from.x+to.y

b) English speaker using a Vertical Path type

'A man is climbing up an artificial wall.'

Example 65 Description of an Up/Down event by an early BSL signer and monolingual English speaker

For all other event types apart from Up/Down, BSL and English differed. Early BSL signers preferred Directional Path expressions for Towards/Away events. English speakers showed a stronger preference than early BSL signers for Goal (41.5%), Source (13%), Source-Goal (10.4%), and Horizontal (15.5%) Path types when describing Towards/Away events. They used Deictic Path more frequently in these events than for any other, but this was only used in 6.2% of utterances. Here, the stronger preference for Goal over Source may be a result of cross-linguistic Goal bias (Lakusta & Landau, 2012; Regier & Zheng, 2007). This preference for Goal/Source expressions by English speakers is also related to their preference to include Ground information in the target clause (as discussed above). Inclusion of Ground information in the target clause necessitates a Path expression that explains the relation of the Figure to the Ground in terms of Source or Goal. The Path choices also indicate a preference in English for including Vector information over Deictic information in Motion events. Early BSL signers preferred to use Depicting verbs of Motion showing Directional expression (53.3%) in Towards/Away events and always included conflated Deictic and Direction information in these instances (that is to say, they moved the Depicting verb of Motion to reflect how the Figure moved with respect to themselves). These preferences reflect the suggestions of Talmy (2009) that there are cross-linguistic differences in the inclusion of types of Path information.

Although early BSL signers used Directional expressions most frequently in Towards/Away events, they used Horizontal (16.6%) expressions in a specific set of circumstances. In two events a Figure jumped forwards towards the viewer away from a tree (see Image 66, below). The preferred BSL expression of this event, based on similar Towards/Away events, would be to use a Depicting verb of Motion with Directional Path to show the Figure movement forwards towards the signer. However, including Ground information (either as the sign TREE or with a Depicting verb) would have obscured the interlocutor's view (see Image 67, below). Therefore, all signers (regardless of hearing status or age of acquisition) adapted their signing by rotating their description so the event was described from the perspective of the character rather than the signer (see Example 68, below), as seen in Motion event descriptions by native child BSL signers in Smith & Cormier (2014). Signers could then produce a Horizontal expression of the Figure jumping forwards without the Directional information indicating that the movement was towards the signer.

Image 66 Video clip with a woman jumping forwards away from a tree


TREE


BE.entity+located.at.x


(r) WOMAN

(l) BE.entity+located.at.x


(r)MOVE.figure+from.a+to.b+towards.self +manner.jump

(l) BE.entity+located.at.x

A woman jumps forwards away from a tree towards me.

Image 67 Viewer perspective for Towards/Away descriptions blocks the interlocutor's view


YOUNG


WOMAN

(r) BE.figure+located.at.x

(l) BE.entity+located.at.y

TREE [c]

(r) MOVE.figure+from.a+to.b+manner.jump

(l) BE.entity+located.at.y

A young woman jumps forwards away from a tree.

Example 68 Character perspective using a Horizontal Path expression for a Towards/Away description

Early BSL signers preferred Directional Path expressions for Around events and were more likely to include rotational direction information (specifying clockwise/anticlockwise) than English speakers. This is due to the use of a Depicting verb of Motion where both Contour (the circular movement) and Direction (anticlockwise/clockwise) are included (see Example 70, below, for a description of Image 69). Although I classed the English preposition 'around' as an 'Other' Path type in this study (based on the coding suggestions of Hickmann et al), Talmy (2003) argues that in certain contexts 'around' indicates a circular Path, making it an example of Contour. In this case, all English speakers used the preposition 'around' to describe these events with 71.1% of utterances also including an adverb ('anticlockwise' or 'clockwise') to specify Direction. Therefore, although the information was packaged differently in BSL (Depicting verb of Motion conflating Contour and Direction) and English (preposition providing Contour and optional adverb providing Direction), the actual information included was the same in the majority of utterances. English speakers were less likely to include the rotational direction (clockwise/anticlockwise) than signers; inclusion of Direction was always included in BSL but optionally included in English. However, Contour information was always included in both languages. I suggest that this shows a possible cross-modal saliency of circular Contour information.

Image 69 Video clip of a woman cycling anticlockwise around a tree

a) Early BSL signer providing both Direction and Contour information

TREE

WOMAN

CYCLE

MOVE.vehicle+rotate.anticlockwise

A woman cycles anticlockwise around a tree.

b) English speaker providing both Direction and Contour information

'A lady cycles anticlockwise around a tree.'

Example 70 Description of an Around event by early BSL signer and English speaker

In Left/Right events, there was a preference for Directional Path type in both early signers (84.7%) and English speakers (68.5%). For example, a BSL signer might use a leftward movement of a Depicting verb of Motion and an English speaker might use the Path satellite 'to the left' to describe Path in the same event. However, in 35.5% of instances, English speakers did not specify the direction of movement, but instead gave information about Source/Goal ('from the tree' or 'to the shops') or boundary crossing ('across the climbing wall').

This use of Source/Goal may be related to the English preference for including Ground in the target clause (discussed above). To incorporate Ground into the utterance, English speakers can choose to use a Path expression with Source/Goal information. The use of Boundary expressions again allows incorporation of Ground information in the target clause (for example, 'across the climbing wall' or 'through the trees'). English speakers showed a stronger preference for Boundary expressions in Left/Right events than BSL signers and I propose that this is due to BSL signers eschewing the use of Boundary expressions to avoid the complications of the boundary-crossing constraint (Slobin & Hoiting, 1994).

English speakers' preference and early BSL signers' dispreference for Boundary expressions carried through to the Path types used in In/Out Motion events. English speakers used a Boundary expression in 83.3% of In/Out Motion event descriptions compared to 34% of descriptions by early BSL signers. BSL signers avoided the use of Boundary expressions by expressing Ground prior to Motion and then using a different Path type to imply boundary crossing. The Path type used depended on the Motion event being described. For Motion events where a Figure went into/out of a swimming pool, signers avoided Boundary expressions by describing the Ground and then focussing on the Vertical Path to imply boundary crossing (see Example 72, below, for a description of Image 71). For Motion events where a Figure went into/out of an archway, there were two strategies used by signers (one implying boundary crossing, the other using a Boundary expression). The first strategy was to avoid a Boundary expression and imply the boundary-crossing event by describing Ground followed by a Directional Path type (see Example 74, below, for a description of Image 73).

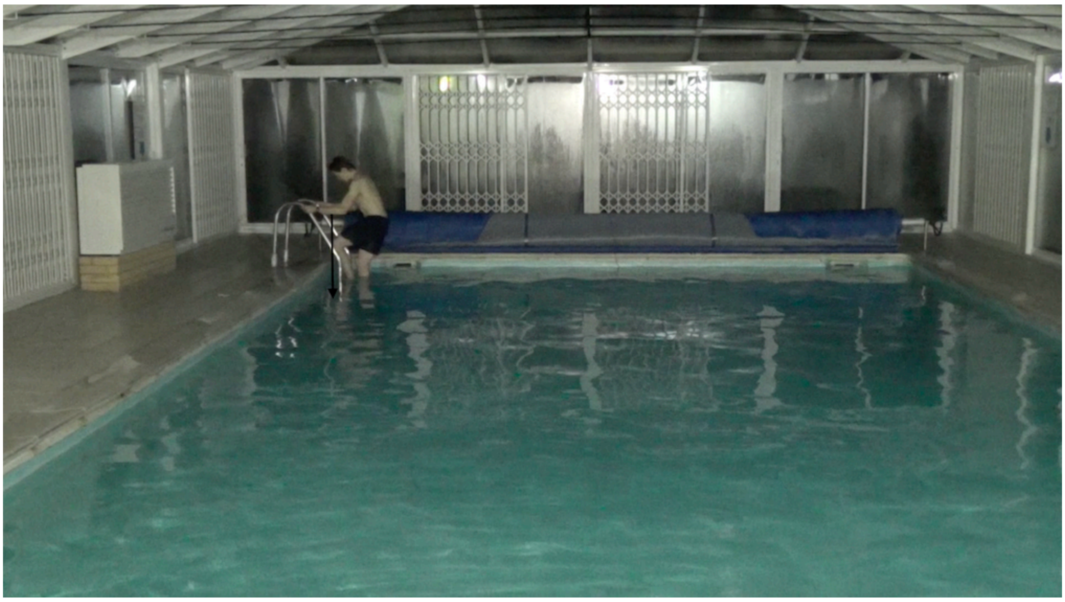


Image 71 Video clip of a man climbing down into a swimming pool

SWIMMING-POOL

CORNER

BE+located.at.x

MAN [c]

CLIMB-DOWN

(r) MOVE.figure+from.x+to.y

(l) HOLD.entity

A man is there by a swimming pool. [He] climbs down holding [onto a handrail].

Example 72 Early BSL signer using Vertical Path information in an In/Out event

The second strategy was the same as described by Slobin & Hoiting (1994) in NGT, Galvan & Taub (2003) in ASL and Sallandre et al, (2018) in LSF; signers used serial Path verbs to express boundary crossing (see Example 76, below, for a description of Image 75). BSL boundary-crossing Depicting verbs of Motion also featured the arc movement (see Example 76, below) described by Slobin & Hoiting (1994) in NGT and ASL. This arc movement was used in both enter and exit events, differing from the findings of Tang (2003) for HKSL.

Image 73 Video clip of a woman cycling out of an archway

ARCHWAY

WOMAN

CYCLE

MOVE.vehicle+from.x+to.y+past.self

A woman cycles past from x to y [out of?] an archway.

Example 74 Early BSL signer omitting boundary crossing

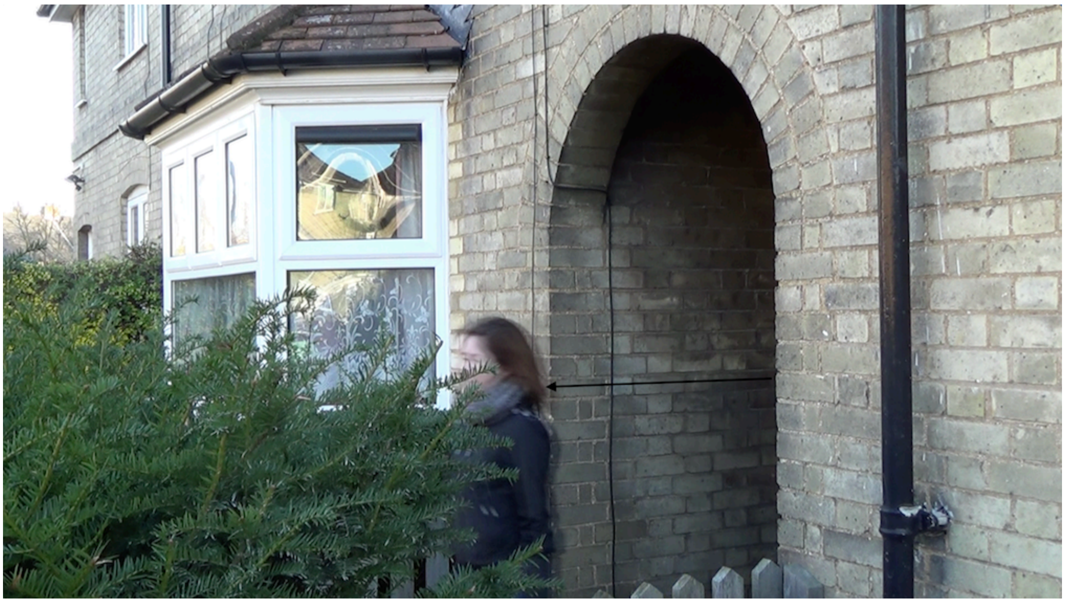
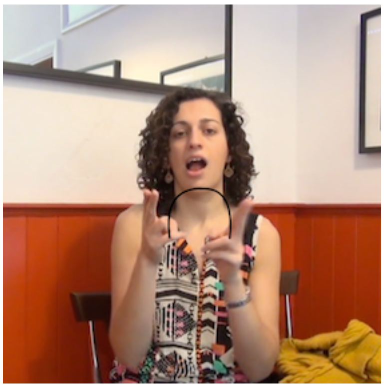


Image 75 Video clip of a woman walking out of an archway



ARCHWAY

WOMAN

MOVE.figure+from.x+to.y+manner.walk

(r) MOVE.figure+from.y+to.z+via.a

(l) BE.entity+located.at.a

A woman walks out of an archway.

Example 76 Early BSL signer using serial verbs and an arc movement in the description of a boundary-crossing event

The preferences of early BSL signers in boundary-crossing events suggest that in some instances BSL behaves as predicted by Slobin & Hoiting (1994) in their description of complex verb-framed languages (based on ASL and NGT). However, the majority of In/Out descriptions did not use a Boundary expression, but instead implied boundary crossing through foregrounding Ground and then using another Path type that suggested the Figure was crossing a boundary. It is possible that this strategy is more common in the type of boundary crossing elicited in this study. Slobin & Hoiting (1994) note that ascend/descend Motion events are not complex events and can be expressed without serial Path verbs. Therefore, maybe for In/Out events with vertical movement, signers are not obliged to express the complex Path information of boundary crossing. Additionally, as the In/Out events in this study involved entering water, it may be that this was not as salient as other types of boundary crossing (such as entering an enclosure). If the vertical movement had been into/out of an enclosure (such as a treehouse) then the strategy may have been to use complex verb-framed strategies. In around half of instances where the In/Out events involved a Figure entering/exiting an enclosure (an archway), signers did use the complex verb-framed strategy of serialised Path verbs. However, signers equally frequently described the Ground and then used another Path type to imply boundary crossing. This strategy differs from the one described by Slobin & Hoiting. However, the events used to elicit In/Out descriptions may have influenced the likelihood of using complex verb-framed strategies. Signers were more likely to include a Boundary Path type when Figures were running, walking, stepping or jumping into/out of an archway. However, when Figures were cycling into/out of an archway, they were more likely to use the strategy of implying Boundary crossing with another verb type. I would suggest that the saliency of this Instrumental Manner (in this instance, cycling) may override the preference for complex verb-framed expressions.

As predicted by hypothesis 1, there was no significant difference between English and BSL in the inclusion of Manner information. However, there was a significant difference in the packaging of Manner information, with English speakers using satellite-only Manner constructions more frequently than signers, although these constructions were still rare and only made up 3.3% of English utterances. I would argue that this is because BSL operates as a complex verb-framed language and therefore users disprefer providing either Path or Manner information in just a satellite. English, however, as an S-language does not show this dispreference. The majority of instances of satellite-only Manner in English were in events featuring cycling where deictic Path information was encoded in the verb and Instrumental Manner in a satellite (for example, 'a girl on a bike is coming towards me' or 'a man comes out of an archway on a bike').

Both languages included Path information in the majority of utterances (96% of BSL utterances and 94.2% of English utterances) and Manner information in the majority of utterances (96.7% of BSL utterances and 91.4% of English utterances). Both languages also showed a tendency to omit Path only when Manner was more salient (such as in the 'floating' events which could be construed as Motion activities rather than Motion events). As English has been considered an S-language, the regular inclusion of both Path and Manner information is predicted by its typological group. The regular inclusion of both Path and Manner in BSL does not fit with the findings for other V-languages (such as French in Soroli & Hickmann, 2010), but this preference is predicted by the findings of Slobin & Hoiting (1994) who suggest the typological group of complex verb-framed languages, which include both a Manner verb and a Path verb. Indeed, BSL signers used serial verb constructions in 56.9% of utterances. Where serial verbs were not used, signers frequently used Manner+Path verbs to provide information from both components. Similar to the finding of Tang

(2003) in HKSL, Manner could only be conflated in Depicting verbs of Motion in BSL when the V-handshape (designating a 'legged entity') was used.

There was no significant difference between early BSL signers and monolingual English speakers on differentiation between any of the dyads. English is an S-language, and therefore preferentially includes Path and Manner as well as Motion, Figure and Ground information. BSL may, as the discussion above suggests, be considered a complex verb-framed language and therefore also regularly includes Path and Manner as well as Motion, Figure and Ground information. Therefore, differences between languages in Figure, Ground, Path or Manner dyads would not be predicted. However, as verbs in sign languages can be inflected for aspect (such as intensity or durativity) or other Manner information (such as speed) one might have expected differences between early BSL signers and monolingual English speakers in Manner detail dyads. However, verb inflection appeared to be optional, with early BSL signers only marking a distinction between Manner detail dyads on 59.6% of occasions. Monolingual English speakers also marked this distinction in 52.6% of occurrences. Hypothesis 1 predicted that Path Detail would be marked differently in English and BSL. Talmy (2003) suggests that sign languages, unlike spoken languages, are able to use greater spatial gradience and provide specific Contour information (such as tracing an exact meandering Path). Although these differences were found in some signers' descriptions, it appeared that marking Contour differences in BSL is optional. For example, two Path Detail dyads had Figures walking up ramps of different steepnesses, but not all signers marked these differences (see Example 78 and Example 79 describing the two different ramp steepnesses in Image 77, below). Similarly, signers could choose to show the exact Contour of a meandering Path, but only did so optionally (see Example 81 and Example 82 describing the meandering Paths in Image 80, below). The two Path Detail dyads where Contour differences were not optional were descriptions of rotational direction (clockwise/anticlockwise) where Contour information was never omitted by early BSL signers. Early signers marked a distinction in 54.2% of Path Detail dyads. However, over half of the distinctions were in dyads with rotational direction. Monolingual English speakers also differentiated between Path Detail dyads in 41% of utterances and, again, over half of these distinctions were in dyads with rotational direction. Inclusion of Contour information in English and BSL is more similar than previously predicted (Talmy, 2003). However, it is important to note that participants were being asked to describe the video clips so they could later be selected from an array. Therefore, English speakers (and, indeed, early BSL signers) were being maximally informative in their descriptions and their everyday language for Motion events may be less descriptive than the results here suggest.

Image 77 Dyad showing a shallow and steep Path Contour

(r) TREE
(r)MOVE.figure+from.x+to.y+manner.walk

(l) RAMP

(l) RAMP+be.located

[A man] walks down a shallow ramp.

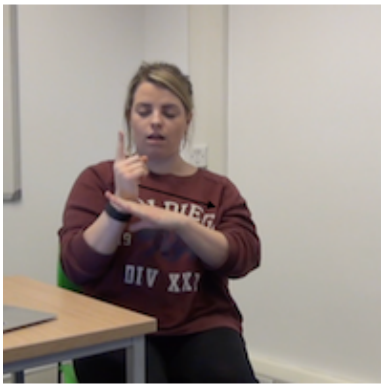
(r) TREE

MOVE.figure+from.x+to.y+manner.walk

(l) RAMP

[A man] walks down a steep ramp.

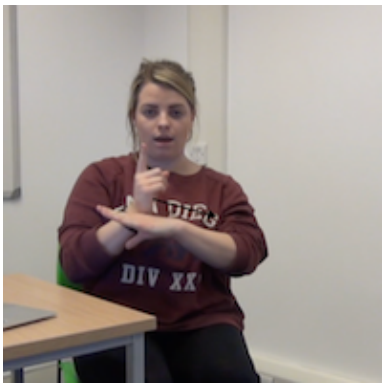
Example 78 Early BSL signer marking Contour information by showing different Path steepnesses



(r) MOVE.figure+from.x+to.y

(l) RAMP

[A man walks] down a ramp.



(r) MOVE.figure+from.x+to.y

(l) RAMP

[A man walks] down a ramp.

Example 79 Early BSL signer not distinguishing between different Path steepnesses

Image 80 Dyad showing a woman walking two different meandering Paths past some shops

MOVE.figure+from.x+to.y+past.self+contour.a

[A woman walks] past from x to y on a meandering path like this.

MOVE.figure+from.x+to.y+past.self+contour.b

[A woman walks] past from x to y on a meandering path like this.

Example 81 Early BSL signer marking Contour information by showing different meandering Paths

MOVE.figure+from.x+to.y+past.self+contour.a+manner.walk

[A woman] walks past from x to y on a meandering path.

MOVE.figure+from.x+to.y+past.self+contour.a+manner.walk

[A woman] walks past from x to y on a meandering path.

Example 82 Early BSL signer not distinguishing between different meandering Paths

The evidence presented above supports some of hypothesis 1. Although English and BSL differ in packaging of Motion event information, they both regularly include Ground, Figure, Path and Manner information. Both languages also optionally included Manner Detail information and Path Detail information (such as Contour information). However, inclusion of Contour information was not consistently included in either language, except in rotational direction descriptions where Direction information in BSL was also always included due to the use of Depicting verbs of Motion. The use of Depicting verbs of Motion in BSL increased the number of Directional Path types overall compared to English. The preferences for foregrounding Ground and Figure, using double verbs and describing boundary-crossing events with serial Path verbs suggest that BSL is a complex verb-framed language (as described for NGT and ASL by Slobin & Hoiting, 1994).

5.1.2 Hypothesis 2

I will now discuss the results relating to hypothesis 2, which was as follows:

2. Both early signers and late signers will regularly include all four basic components of Motion events (Motion, Figure, Ground and Path) as well as Manner information in their Motion event descriptions. However, early signers will provide fuller Path detail than late signers through the use of BSL Depicting verbs of Motion (which are capable of combining more parts of Path than English verbs, including Vector, Deixis, Conformation, Direction and Contour). Late signers will be influenced by their early English and so will only include Path information that is regularly included in English.

As predicted by hypothesis 2, BSL group did not have a significant effect on Figure inclusion. However, deaf early BSL signers significantly preferred to express Figure information outside the target Motion event clause while hearing late signers preferred to include Figure within the target Motion event clause. In this way, of the four groups, deaf early BSL signers most reflected the behaviour of signers in other sign languages (see Tang, 2003; Taub et al, 2009) and speakers in V-languages (see Slobin, 2004, 2006). Conversely, hearing late signers behaved more similarly to English speakers (see section 5.1.1, above). However, unlike as predicted in hypothesis 2, hearing late signers included Ground information more frequently than other groups (and more than monolingual English speakers). I would suggest that this is because this group was composed of trainee interpreters who, because of being trained to be as explicit as possible (in their formative BSL lessons and/or during interpreter training), may have been more hesitant to omit components, even if omission is acceptable in the target language. There was also a difference between groups in the packaging of Ground information, with deaf early BSL signers showing a greater preference for expressing Ground information in a separate clause than other groups. Again, deaf early BSL signers are acting most similarly to signers in other sign languages (Tang, 2003; Taub et al, 2009) and speakers of V-languages (Slobin, 2004, 2006) by foregrounding Ground and Figure in a separate clause prior to the target Motion event clause.

Related to Ground, some signers in every group conflated Ground information with Motion and Path as part of a Depicting verb of Motion (50 descriptions in total). This type of Depicting verb of Motion was only used when a Figure was going up or down the stairs. Even when Ground and Path were not conflated in this way, the direction of Path on stairs (up/down) and the direction of Ground signing (STAIRS up/down) were found to be related, with signers significantly preferring to sign Ground to match Path. I would argue that this indicates that even when signers produce Ground in a separate clause, they are conceptualising it in relation to the movement of the Figure. Therefore, although signers frequently map out Ground information prior to producing the Motion description, it is not a neutral depiction of the scene but is influenced by the Path information they will go on to express. This suggests, then, that the mental encoding of the close relationship between Ground and Path may not differ from English (or other languages) where Ground is systematically tightly packaged in the target Motion event clause.

There was a difference between groups on the omission of Path information, with hearing early BSL signers significantly more likely to omit Path information than other groups. This difference was not predicted by hypothesis 2. In their willingness to omit Path information (in 6.8% of utterances), hearing early BSL signers behaved more similarly to English speakers (who omitted Path information in 5.7% of utterances) than to deaf early BSL signers (who omitted Path information in just 1.2% of utterances). It could be that the effect of bilingualism in the hearing early BSL signers, in addition to their exposure to English in daily life, caused conceptual transfer from English. However, hearing late signers did not show this particular English preference in their signing (omitting Path information in just 1.6% of utterances). This could be because as late learners they are more aware of the differences for Path omission in English and BSL (perhaps having been explicitly instructed on it) and are therefore able to avoid this transfer. Relatedly, although there were not significant differences between groups on the use of Path types in most events, there was a difference in In/Out event types with hearing late signers using Directional Path more than all the other groups. I would suggest, again, that hearing late signers are aware of the different preferences in BSL and English and are avoiding the English strategies for describing boundary crossing (use of a Boundary expression) by using Directional Path, even in instances where early BSL signers would use a Boundary Path expression. Indeed, one could view this as a form of hypercorrection, similar to that reported by Brown (2000) in the acquisition of first language Motion event preferences where child learners go through a stage of overextending an adult pattern they had not previously used.

As predicted by hypothesis 2, there was no significant difference between BSL groups on the inclusion of Manner information. However, deaf early BSL signers preferred the use of verb plus satellite constructions when expressing Manner compared to other groups and hearing late signers significantly dispreferred this construction. The Manner satellites used by deaf early BSL signers added adverbial detail to the target Motion events. In the majority of instances (94.2%) where deaf early BSL signers used verb plus satellite constructions, the additional Manner information in the satellite was to specify speed. They would often also mark this information on the verb itself through the use of NMFs or movement speed. Hearing late signers used the verb plus satellite construction the least out of all groups (in 1.9% of utterances), even less than monolingual English speakers (in 17.7% of utterances). Instead, they preferred verb-only Manner more than any other group. I would suggest, again, that this is hypercorrection by hearing late signers, who are conscious of the serial verbs in BSL and, therefore, consider Manner satellites to be impermissible. Consequently, additional Manner information by hearing late signers was either omitted or marked on the verb (see Example 84, below, for a comparison of a deaf early BSL signer and hearing late signer describing the Motion event in Image 83).

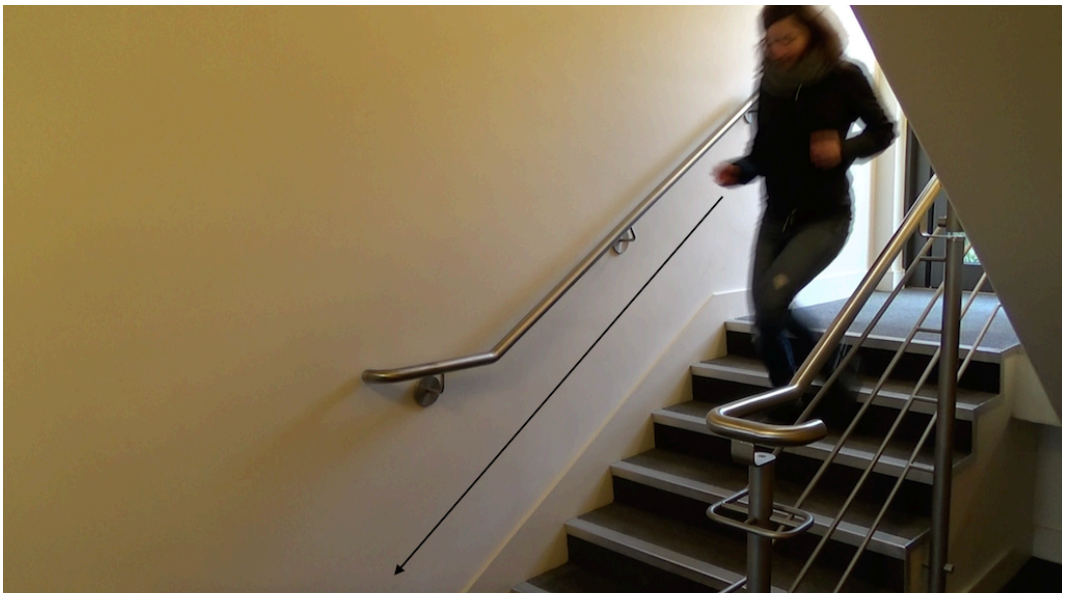


Image 83 Video clip of a woman running quickly down the stairs

a) Deaf early BSL signer using a Manner satellite showing speed

WOMAN

STAIRS

MOVE.figure+from.x+to.y

FAST

RUN+nmf.intense

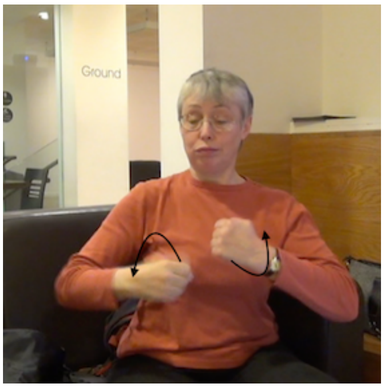
A woman runs quickly down the stairs.

b) Hearing late signer using a Manner verb without a Manner satellite

STAIRS

WOMAN

MOVE.figure+from.x+to.y



RUN+nmf.intense

A woman runs quickly down the stairs.

Example 84 Deaf early BSL signer and hearing late signer describing the same Motion event

It was expected that deaf and hearing early BSL signers would show preferences most similar to complex verb-framed languages (Slobin & Hoiting, 1994) with more utterances containing double verbs and greater use of Depicting verbs of Motion than deaf and hearing late signers. There was a significant difference between BSL groups on the use of single or double verbs, with deaf early signers (but not hearing early signers) showing a stronger preference for double verbs compared to other groups. Again, deaf early signers are behaving most similarly to signers in other sign languages and acting as predicted by Slobin & Hoiting (1994)'s description of complex verb-framed languages. Similarly, deaf early signers used significantly more

Depicting verbs of Motion than other BSL groups. However, hearing early signers used significantly fewer Depicting verbs of Motion overall compared to other groups. Again, these differences between deaf and hearing early signers could be attributed to conceptual transfer from English due to the effect of bilingualism and daily use of English.

There was also a significant difference between the groups on handshape used for person Depicting verbs of Motion, with hearing late signers using the G-UP handshape (index finger pointing up from a closed fist) significantly more than other groups. They used G-UP handshapes in instances where other groups used V-DOWN handshapes (see Example 86, below, for an early BSL signer and hearing late signer using different handshapes in describing Image 85). An explanation comes from Supalla (1982), who reports that in the acquisition of ASL Depicting verbs of Motion, children showed difficulty integrating Path and Manner in a Depicting verb. It could be that the use of a G-UP handshape allows hearing late signers to avoid expressing Path and Manner together in a Depicting verb.

Image 85 Video clip of a woman walking into an archway

a) Deaf early BSL signer using V-DOWN handshape in description

ARCHWAY

WOMAN

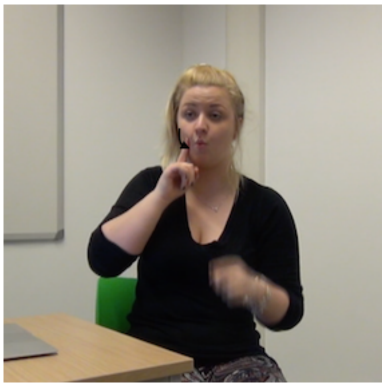
MOVE.figure+from.x+to.y+manner.walk

THROUGH

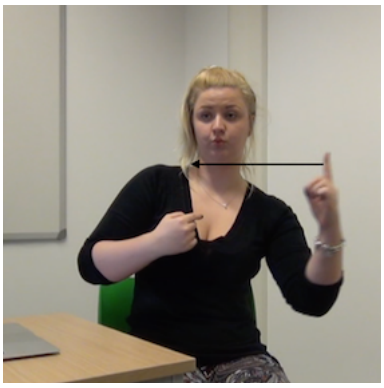
A woman walks through an archway.

b) Hearing late signer using G-UP handshape in description

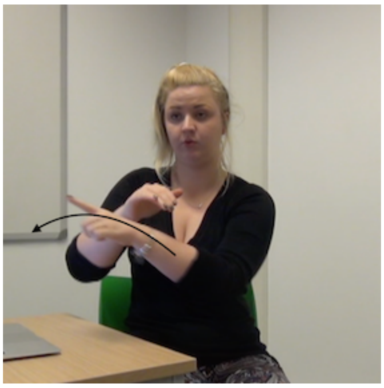
ARCHWAY



WOMAN



MOVE.figure+from.x+to.y+past.self



(r) BE.entity+located.at.x

(l) MOVE.figure+from.a+to.b+via.x

A woman goes into an archway.

Example 86 Depicting verb of Motion handshapes used by deaf early BSL signer and hearing late signer

As discussed in section 4.1.5.3.2, some signers in every group inflected supposed Plain verbs (like RUN, CYCLE and SWIM) with Path information, although this was still rare (in <5% of instances of Plain verbs). There was no significant difference between groups on the tendency to use Path-inflected supposed Plain verbs. However, there were differences in the occasions these verbs were used. SWIM was the most frequently inflected by early BSL signers (7 instances), whereas CYCLE was for late signers (24 instances). As well as differing frequency between groups for inflecting supposed Plain verbs, the situations in which inflections occurred differed. Deaf early BSL signers only ever inflected supposed Plain verbs for Path information alongside a Depicting verb. They also only ever did so for events featuring rotational direction (see Example 87, below, for an example). Hearing early BSL signers also generally followed this pattern, apart from one signer who used the verb CYCLE inflected with Path three times to show forward movement without an accompanying Depicting verb of Motion (see Example 88, below, for an example).

SWIM+manner.frontcrawl+rotate.clockwise

[He is] swimming clockwise.

Example 87 Plain verb inflected for rotational direction by deaf early BSL signer

CYCLE+from.x+to.y

[She is] cycling forward.

Example 88 Plain verb inflected for spatial information by hearing early BSL signer

Deaf and hearing late signers did not show the preferences outlined above (for inflecting supposed Plain verbs only alongside a Depicting verb of Motion and for mostly doing so with rotational direction). Only 4 out of 29 instances of spatial inflection of supposed Plain verbs by late signers involved rotational direction. Unlike early signers, late signers inflected supposed Plain verbs for

Path in 10 instances when expressing boundary crossing (see Example 89, below, for an example). There were also 11 instances of the use of a supposed Plain verb inflected for Path without an accompanying Depicting verb. These findings suggest that some spatial inflection is possible on these supposed Plain verbs (as this was present in every BSL group), perhaps suggesting that CYCLE, SWIM and RUN are Indicating rather than Plain verbs. There were differences between groups in how they inflected these verbs, with early signers preferring to do so alongside a Depicting verb of Motion whereas late signers appeared to consider the Depicting verb of Motion optional. Equally, early signers restricted the situations in which they inflected these verbs for Path information, doing so mainly in rotational direction events. As mentioned earlier in section 5.1.1, marking of rotational direction information in BSL is always included and perhaps the inflection of these verbs is treated as a bootstrap of this feature. The use of a Path-inflected Manner verb in boundary crossing events by late signers appears to violate the boundary-crossing constraint found in V-languages. I would suggest that this is a case of conceptual transfer from English, where an utterance such as 'he cycles into the archway' is acceptable and commonplace.

ARCHWAY

MAN

CYCLE+from.x+to.y

A man cycles forward [into] an archway.

Example 89 Hearing late signer using Path-inflected Plain verb without an accompanying Depicting verb of Motion in a boundary-crossing event

Looking at the differentiation between dyad types, there was no significant difference between any of the BSL groups on any of the dyads. As there was also no difference between early signers and monolingual English speakers, this is not an unexpected result. Indeed, all BSL groups were exposed to English from an early age as well as acquiring BSL (either as a child or an adult). Conceptual transfer in Motion event preferences has been shown from a language acquired early to a language acquired late (Alonso, 2011; Hendriks & Hickmann, 2015; Hijazo-Gascón, 2015; Sharpen, 2016). Backwards transfer has also been shown from a language acquired late to a language acquired early (Aveledo & Athanasopoulos, 2015; Brown & Gullberg, 2010a, 2010b; Bylund & Athanasopoulos, 2015; Daller, 2011). With English being the dominant language of the country and (to differing degrees) the language used most frequently in work and social settings by participants, it may be that all groups show some conceptual transfer from English, as all have some knowledge of English. As Filipović (2011) argues, bilinguals may fall back on the patterns that are acceptable in both languages and/or the patterns of the language used most frequently. In this way, perhaps English influenced all participants' BSL signing to some extent (although as the current study did not assess the English fluency of BSL groups, it is not possible to be sure of how much influence English could have on the signing of each individual). It may be that deaf early signers, who showed stronger preferences for complex verb-framed packaging than other signers, are less influenced by English. Unlike late signers, deaf early signers learned BSL before English. Also, unlike hearing early signers, they are not constantly exposed to spoken English.

The results discussed above have supported some of the predictions of hypothesis 2. BSL groups did show generally similar preferences for including Motion, Figure, Ground, Path and Manner information in their descriptions. Furthermore, it was expected that deaf early BSL signers would show the strongest complex verb-framed preferences and that hearing late signers would show English-like patterns due to conceptual transfer. Indeed, deaf early signers did show stronger preferences than other groups for the complex verb-framed constructions not regularly found in English; they more strongly preferred to express Figure and Ground information outside the target Motion event clause, they used serial verb constructions more frequently than other groups and they produced Depicting verbs of Motion more often than other groups. However, the ways in which hearing late signers differed was not predicted by hypothesis 2 and there were some unexpected results. Hearing late signers included Ground information more frequently than other groups (and more than monolingual English speakers). I argue that this is due to their hesitance to omit components (even when acceptable in the target language) due to their formative BSL lessons and/or interpreter training. There were instances where hearing late signers showed potential conceptual transfer from English, such as including Figure information more frequently in the target Motion event clause. Similarly, they showed a dispreference for verb plus satellite Manner constructions (opposite to deaf early signers). Hearing late signers also exhibited hypercorrection, such as overextending Directional Path types in instances where other signers used Boundary Path expressions. They also used the G-UP handshape in Depicting verbs more frequently than other groups, often using it where other groups would use a V-DOWN handshape. I argue that this is a strategy to avoid having to conflate Path and Manner in a Depicting verb, as only Depicting verbs of Motion with V-handshapes can take Manner information in BSL. Both hearing and deaf late signers showed a greater likelihood for inflecting Plain verbs with Path and did so in boundary-crossing events, a feature not found in early BSL signing. I argued, above, that this was due to conceptual transfer from English. There were further unpredicted instances of potential conceptual transfer in hearing early signers who showed a stronger preference for omitting Path information than other BSL groups and also used fewer Depicting verbs of Motion overall than other groups. In this way, hearing early signers differed unexpectedly from deaf early signers and also from late signers. I have suggested that the difference between deaf and hearing early signers may be due to hearing early signers being surrounded by spoken English, unlike deaf early signers, increasing the likelihood of transfer. The difference between hearing early signers and deaf/hearing late signers could be due to the age and circumstances of BSL acquisition. Late signers may have had more explicit instruction in the structure and preferences of BSL as adults and, therefore, intentionally attempt to suppress transfer from English. Hearing early signers, who acquired English and BSL simultaneously as children, may be less aware of these differing preferences in the two languages (having never been explicitly taught them). Therefore, hearing early signers may be less likely to emphasise BSL preferences (such as the use of Depicting verbs of Motion) in their signing.

5.1.3 Hypotheses 3 & 4

I will now discuss the results relating to hypothesis 3 and 4, which were as follows:

3. If one's early language can influence focus of attention to components of Motion events important to descriptions in that language then early BSL signers will perform better than English monolinguals at the recognition memory task (because, being a spatial language, BSL entails a higher level of detail in descriptions than English).
4. If a language acquired as an adult can influence focus of attention to components of Motion events important to description in that language then late signers will perform better than English monolinguals at the recognition memory task (because, being a spatial language, BSL entails a higher level of detail in descriptions than English).

No predictors (including BSL knowledge and hearing status) were found to be significant in relation to the recognition task or Correct/Guess/False Alarm responses on the recognition task. Similarly, no predictors were found to be significant in relation to recognition scores on the different Motion event components (Figure, Ground, Path, Manner, Path Detail and Manner Detail).

The premise of hypotheses 3 and 4 lay in the suggestion that English and BSL would differ in their inclusion of Motion event components. However, the results in section 5.1.1 and 5.1.2, above, reveal that there was very little difference between the languages or groups on the inclusion of Motion event components (even with regard to Path Detail) in this Motion event description task and that all groups differentiated between dyads to a similar extent. Therefore, even if it were the case that one's early language (as stated in hypothesis 3) or late language (as stated in hypothesis 4) influenced the focus of attention to components of Motion events, one would not expect to find a difference between the groups in this study as there were no overall group differences in linguistic differentiation.

Although language and group did not show a relationship with score on the Motion event recognition task, a significant positive relationship was found between choosing the correct clip out of a dyad in the Motion event recognition task and later differentiating between the clips in that dyad during the description task. This relationship could be considered two ways:

- Explanation One: Noticing the difference between clips in the recognition memory task made participants more likely to differentiate between them linguistically because they were aware of the component that had been changed. This explanation would require self-awareness from participants. If their attention were first drawn to components when comparing clips in the recognition memory task, then this would be reflected in their confidence ratings. They would notice the component difference and then know whether they had successfully chosen the right clip or guessed. Therefore, this explanation would predict a positive correlation between confidence rating and picking the correct clip.
- Explanation Two: Participants were more likely to make the correct choice on some clips in the recognition memory task because they paid more attention to certain components based on their individual linguistic preferences (because the thinking-for-speaking hypothesis would suggest that participants were using language to mentally encode the video clips the first time they viewed them). The individual linguistic preferences of the participants were then revealed in the description task.

I would argue that the latter explanation is more likely because the model revealed that level of confidence was not significantly associated with differentiation in description. Indeed, participants overall did not show high levels of self-awareness in their own recognition ability (as the former explanation would require). That is to say, a participant might show high confidence in having recognised the component difference between clips, but this confidence did not necessarily correlate with them including the component in their linguistic description or mean that they were correct in their choice in the recognition task. Similarly, participants might score themselves low on confidence but select the correct clip in a dyad and then later also describe that difference. If the latter explanation for this correlation is accepted then the current study provides potential evidence for the thinking-for-speaking hypothesis. The results suggest that what is readily encoded in language by the individual (regardless of which language) is also more easily distinguished in recognition.

This finding is also interesting as it raises the possibility that individual differences in linguistic description may influence attention and memory. Studies previously have only investigated differences between languages without taking into account the possibility of individual variation in use of that language. If one subscribes to the notion that the way in which people conceptualise events is related to something as fundamental as language then it also follows that people could be influenced by their own linguistic preferences. Indeed, Slobin (2006) argues that thinking-for-speaking is developed through individuals' online thinking about which components of an event to include in descriptions. Although there are certainly overall differences between languages on what is readily linguistically encoded, there are also individual preferences for specificity/generality and terseness/wordiness. Up until now, the focus has been on the overarching differences between languages but, by ignoring individual linguistic differences within the same language, one could be missing the full extent of thinking-for-speaking. Much as bodily relativity is unique to a person's corporeal experience of the world (for example, through handedness or habitual preferences, see section 2.3.3.1), perhaps individual linguistic preferences similarly shape areas of cognition.

In relation to hypotheses 3 and 4, I failed to reject the null hypothesis that English and BSL (early or late) participants are the same in their memory for components of Motion events. Language and group also did not influence ability in the memory and attention task battery. However, the results discussed above raise the possibility that there is a link between linguistic description and memory, relevant to the thinking-for-speaking hypothesis. The results also suggest that individual differences in linguistic description may influence attention and memory for components of Motion events. This opens an avenue for greater exploration in the area of thinking-for-speaking.

5.1.4 Memory and Attention Task Battery

As discussed in section 3.8, if BSL knowledge (early, late or none) or Hearing status (deaf/hearing) showed a relationship to scores in the memory and attention task battery then (depending on the relationship) one could conclude that auditory deprivation or knowledge of a visuospatial language influenced these seemingly non-linguistic cognitive abilities. However, neither BSL knowledge nor hearing status were found to be significant predictors for scores in any of the memory and attention tasks. The results in this study did not replicate those of Emmorey et al (1998) who reported that ASL signers showed an advantage at a rotations task. However, Emmorey et al's rotations task took place on a horizontal plane, the same plane that is used as part of the spatial referencing system in sign languages (where signers have to mentally rotate scenes 180 degrees in sign comprehension, see section 2.3.1.2). The Rotations task in this study took place on the vertical plane. Rotation in this plane is not part of the spatial referencing system in BSL or other sign languages. Therefore, I would suggest that signers showed no advantage in this Rotations task because vertical rotation, unlike horizontal rotation, is not present in their language and this skill has not been bolstered through linguistic experience.

The only significant predictor for any of the memory and attention tasks was Age, with a negative correlation between years of age and scores on the Spatial Span task, Feature Match task and Rotations task. These results reflect well-established findings (Brown, 2016; Glisky, 2007; Pak, Czaja, Sharit, Rogers & Fisk, 2006) that short-term memory, attention and spatial processing skills decrease with age. However, it is of note that Age was not related to score in all the memory and attention tasks. Scores in the Interlocking Polygons task (which measured visuospatial processing and reasoning) and Paired Associates Learning task (which measured spatial and object memory) were not related to age. As this study was conducted with a limited sample (*N* = 50), it is not possible to draw any firm conclusions from these findings.

5.2 Limitations

As mentioned in section 1.3, difficulties arise in BSL research in the area of recruitment. With BSL users making up less than 1% of the UK population, this study was not able to recruit as many participants as originally intended. Deaf early signers and late signers were reached through snowball sampling and opportunity sampling at deaf social clubs (in Cambridgeshire, Coventry and Birmingham). Numbers in the two deaf groups were lower than the other groups as many potential participants did not meet recruitment criteria (for example, on age, age of acquisition or use of BSL as opposed to some other signing system like Sign Supported English). Therefore, the results from this current study must be viewed with the understanding that sample sizes are smaller than in other similar studies involving spoken languages. Another limitation was that this study did not measure English fluency for any of the groups. Therefore, although it was assumed that all groups were fluent in English (due to, for example, all participants replying to emails in written English), this fluency was not confirmed. A test of English fluency would have given suggestions of English-to-BSL transfer more credence. Equally, the level of fluency could have been examined as a factor in English-to-BSL transfer. Relatedly, use of hearing aids by deaf groups was not recorded. Therefore, it is not possible to be certain about the extent to which deaf participants are exposed to spoken English. Further limitations are present when comparing hearing early BSL signers and deaf early BSL signers. Although for the current study both groups have been considered early signers, the deaf early BSL signers showed variation in the age at which they acquired BSL, whether they had deaf or hearing parents and how many other BSL signers there were in their childhood home (Appendix 5). All the hearing early BSL signers acquired BSL from birth in the home from deaf parents. This is a limitation because studies have shown that there are differences in performance at grammaticality judgment tasks in BSL between deaf individuals who acquired BSL from birth in deaf families and those who acquired BSL in early childhood in hearing families (for example, Cormier et al, 2012). Difficulties in recruiting enough participants meant that there were not enough individuals to form two separate groups (deaf signers who had acquired BSL from birth in deaf families and deaf signers who had acquired BSL before age seven in hearing families). Future research in this area could compare Motion event description between these two groups to discover if there are significant differences.

A larger limitation, which will also be considered in section 5.4, is that all BSL groups were familiar with English and BSL (and presumed to be bilingual to some degree) while the English speakers were all monolingual. Ideally, the English speakers would have also been bilingual in a language with S-language Motion event preferences (for example, German or Dutch). However, the UK English-German/Dutch bilingual population is also extremely small and, unlike with the deaf community, more disparate with less opportunity for snowball sampling. Therefore, for ease of recruitment, English monolinguals were used. If results had been found that indicated an advantage for any BSL signing groups in the recognition task or the memory and attention task battery, it would have been difficult to attribute this with certainty to knowledge of BSL as it could also have been due to bilingualism. As there were no differences between groups on the recognition task or the memory and attention task battery, this did not present a major issue for the current study. However, another issue arose from the BSL groups' knowledge of English, as explored above in section 5.1.1. All the hypotheses of the current study assumed differences between English and BSL based on previous sign language research. However, all groups included similar information in their Motion event descriptions. Where BSL groups included similar Motion event information to English monolinguals, I could not dismiss the possibility that English was influencing BSL signers. It is impossible to recruit monolingual BSL signers, because all signers are exposed to English (as the majority language) at school.

5.3 Implications

The major implications of the current study relate to the linguistic description of Motion events (in English and BSL) and the memory for Motion event components. Below I will discuss the most significant contributions to knowledge in the study and the generalisability of the study's findings.

The study revealed that English and BSL do not differ in the inclusion of Motion event components with both regularly including Motion, Figure, Ground, Path and Manner information. However, the packaging of information did differ. English speakers produced descriptions that matched with S-language preferences. Early signers, meanwhile, showed preferences (such as use of serial verbs) that indicate BSL is a complex verb-framed language. It supports previous findings that sign languages are complex verb-framed (Galvan & Taub, 2003; Slobin & Hoiting, 1994; Tai & Su, 2013). Once again, Talmy's typology of V-language and S-language cannot fully account for the findings in BSL. The frequent use of serial verbs (with one encoding Manner and another encoding Path) and the use of Manner+Path verbs (one verb encoding both Manner and Path information) indicate that BSL signers do not give greater prominence to either component. Indeed, the results suggest that BSL is a serial verb language and fits within Slobin (2004)'s suggested category of equipollently-framed languages. It is important to note, however, that this study only dealt with self-agentive Motion and did not include any events with Cause. Talmy's typology is based on the typical conflation for Co-events (that is, both Manner and Cause) and it may be that BSL would show more typical V-language preferences in caused Motion events than in the self-agentive Motion events examined in this study.

Another finding relates to the optionality of marking Contour information in BSL. This study elicited three types of Contour: Path steepness (along a steep/shallow ramp), meandering Path (a non-linear route taken across a road/climbing wall) and rotational Path (around a tree). Although Talmy (2003) suggests that signers are capable of marking finer spatial gradience in their descriptions, this study reveals that marking this information is not obligatory. In fact, English speakers were as likely as BSL signers to include the various types of Contour information. The only instance where Contour information was regularly included in both languages was rotational direction. This suggests that rotational direction information may be universally salient.

Despite a surprising similarity in the inclusion of Contour information by both BSL signers and English speakers, there were notable differences in the other Path information included. Talmy (2000b, 2003) suggests that languages differ in their preferences for including Vector (the main Path schema), Deixis (how the Path relates to the viewer), Conformation (how the Path relates to the Ground), Contour and Direction in their Motion event descriptions. The findings in this study support this proposition. BSL signers showed a preference for conflating Vector, Deixis and Direction in Depicting verbs.

However, English speakers preferred Conformation Path information. These differing preferences were particularly noticeable in boundary-crossing events where BSL signers frequently omitted the Boundary Path type (Conformation) and preferred to use a Directional Path type (conflating Vector, Deixis and Direction in a Depicting verb). The variation in the Path information included in the various Path events also supports the suggestion of Croft et al. (2010) that languages should be typologised by event rather than overall preferences. The results in the current study suggest that BSL and English did differ in the information provided across different event types, despite both overall preferring to include both Manner and Path information in the target clause.

Although English and BSL did differ in the Path information included across most event types, both languages showed a strong preference for encoding Vertical Path information, even where other strategies were available (for example, Boundary or Goal Paths). I would argue that these preferences suggest the possibility of a cross-linguistic salience for Vertical Paths (as suggested for Chinese and English by Ji, 2009). As discussed previously, when children are acquiring a reference system, they show early competency with vertical locative relations (for example, in English 'on' or 'under') as these do not require a complete understanding of either an absolute or relative system (Johnston & Slobin, 1979). I suggest that this ease of interpreting vertical relations carries over into adulthood and creates a preference for describing the vertical nature of a Path over other details (such as boundary crossing or Source/Goal information).

Relatedly, Pourcel (2004) suggests that Path is cross-linguistically salient and that Manner is only more salient when it is particularly striking. She divides Manner into Default Manner (for example, walking or running), Forced Manner (for example, hopping or limping) and Instrumental Manner (for example, cycling or driving). She suggests that when Figures are carrying out

Default Manner, the cross-linguistic preference is to pay attention to Path. Manner only becomes as salient as Path when the Figure is carrying out Forced or Instrumental Manner. Some of the findings in this study indicate that Instrumental Manner may indeed influence the saliency of Manner compared to Path. For example, BSL signers were more likely to omit boundary crossing when a Figure was on a bicycle. This is opposed to the predictions of the boundary-crossing constraint, where it is proposed that Manner would be omitted in favour of describing the boundary crossing. However, I would suggest that the saliency of the Instrumental Manner made them place the focus on Manner rather than Path. Similarly, although satellite-only Manner constructions were rare in English, they mostly occurred when participants were describing cycling events (for example, 'a girl on a bike is coming towards me'). This use of an unusual construction in English suggests that participants might indeed have found Instrumental Manner more salient than other Manner types, supporting Pourcel's suggestions.

This study hoped to examine the differences between groups of signers (deaf early, hearing early, deaf late and hearing late) in their Motion event descriptions. The findings outlined below will form the basis of a report that will be distributed to interpreting agencies and teaching organisations to increase the understanding of Motion event descriptions in BSL. All groups showed similar preferences for including and packaging Motion, Figure, Ground, Path and Manner information in their descriptions, but there were some areas where they diverged. Firstly, looking at second language acquisition, hearing late signers (who were trainee interpreters) differed from other groups in a number of different ways: they included Ground information more frequently and included Figure information more frequently in the target Motion event clause. In these preferences, hearing late signers used English preferences in their BSL, indicating cross-modality transfer. They also showed preferences not found in English. When using Depicting verbs, they used the

G-UP handshape more frequently than other groups, often using it where other signers used a V-DOWN handshape. A G-UP handshape cannot include Manner information, while a V-DOWN handshape can. I propose that the use of G-UP handshape is a strategy to avoid conflating Manner and Path in the Depicting verb. One explanation could be because conflating Manner and Path is not possible in English and this is another instance of transfer. However, hearing late signers showed Manner and Path conflation in verbs in other instances (such as in the use of CLIMB-UP or JUMP-DOWN). They frequently used these Manner+Path verbs alongside a Depicting verb of Motion showing only Path. Therefore, I suggest that hearing late signers use a G-UP handshape to avoid including Manner information in a Depicting verb of Motion because they are aware that BSL uses serial verbs (perhaps being explicitly taught this structure) and they try to include Path in a separate verb whenever the option is available.

Both hearing and deaf late signers showed a greater likelihood for inflecting Plain verbs (like CYCLE and RUN) with Path and did so in boundary crossing events, a feature not found in early BSL signing. I would suggest that this is again due to conceptual transfer from English, where use of a Manner verb in a boundary-crossing event is standard. I also suggest that hearing early BSL signers show indications of transfer from English, with their stronger preference for omitting Path information and use of fewer Depicting verbs of Motion than other groups. The key finding in the comparison of BSL groups was that deaf early signers showed the strongest preferences for complex verb-framed constructions. Participants in this group acquired BSL early as their first language and, unlike hearing early signers, are not constantly exposed to spoken English. Therefore, they should be considered the group that is least influenced by English Motion event preferences.

The possibility that frequency of exposure to English might alter the BSL signing of bilinguals is of interest. Although this phenomenon has been reported frequently in Motion event preferences with sequential bilinguals, whose early language was influenced by backwards transfer from a language acquired late (Aveledo & Athanasopoulos, 2015; Brown & Gullberg, 2010b; Daller, 2011), it has been less frequently reported in simultaneous bilinguals. Filipović (2011) found that English-Spanish bilinguals behaved more like Spanish monolinguals than English monolinguals when carrying out a Motion event recognition task. She suggests two possible reasons for this behaviour. Firstly, she suggests that using one language more frequently can influence the preferences in both languages. Certainly in the current study the hearing early BSL signers were exposed to English more frequently in their daily life, with it being the majority language of the country. This may be seen as evidence for the role of exposure in changing the linguistic preferences of bilinguals in their lesser-used language. However, Filipović also suggests that bilinguals may fall back on the patterns that are acceptable in both languages. In order to test whether this is the case, one would need to elicit descriptions in both languages (English and BSL) to see if there were shared preferences across modalities. This could also reveal whether the English of the English-BSL bilinguals differed from the English of monolinguals due to transfer from BSL to English.

Moving on to whether language (BSL or English) affected memory for Motion event components, this study did not find evidence to support or reject this suggestion. BSL and English participants showed extremely similar preferences for differentiating between components in the dyads and also showed similar abilities at the recognition task. However, a link was discovered between what was described linguistically and what was recognised in the memory task. This result provides some evidence in favour of the thinking-for-speaking hypothesis. Additionally, this finding raises the question of whether individual linguistic differences could also influence attention and memory. I will discuss this potential area of exploration, and others, in 5.4 Future Research, below.

The implications discussed above must be considered alongside the limitations previously presented. The current study was conducted with a small group of BSL signers and English speakers and took place under experimental conditions. Therefore, although the results suggest possibilities about the differences between sign languages and spoken languages in the description of and memory for Motion events, it is not possible to generalise these findings to all contexts. For example, signers who acquired BSL at different ages or under different circumstances might exhibit different preferences, the participants in this study might describe Motion events differently under different conditions (such as during an informal conversation with a friend) and other signed languages could show different preferences to those revealed in this study. Although this study cannot be generalised beyond the context in which it was conducted, it does add to the current body of knowledge about how signed and spoken languages differ and raises some suggestions for future research.

5.4 Future Research

The current study suggests a number of different areas for future research. Below, I list eight for further exploration:

- Cross-modal saliences: The results of this study indicate that there are certain parts of Path that are equally salient across modalities. Vertical motion was marked consistently in English and BSL, as was Contour information in rotational direction events. Further research into whether other languages across both modalities obligatorily mark Vertical and circular Contour information would create understanding of whether there is a cross-modal salience for these Path types.

- Cross-modality transfer: Treffers-Daller & Sakel (2012) suggest that it is important to study transfer in sign languages in order to gain a fuller knowledge of the phenomenon overall. The current study reports on potential forward (from early English to late BSL) and bilingual conceptual transfer (from early English to early BSL). A fuller picture of how languages in two modalities interact would be formed by research into the English descriptions of Motion events by BSL bilinguals. Further studies in this area would create a greater understanding of how cross-modality transfer occurs and in which areas.
- Comparison of sign language and co-speech gesture: The current study initially intended to compare the Motion event components contained in co-speech gesture (alongside those contained in speech) with the Motion event components contained in BSL. However, none of the participants produced co-speech gesture (potentially because of the set-up of the experiment with the participants sitting behind a desk). Future research could compare the inclusion and packaging of Motion event components in co-speech gesture and a sign language (such as BSL). Of particular interest would be whether additional parts of Path can be included in co-speech gesture when it is not possible to include them in speech.
- Development of Depicting verbs of Motion: Although hearing late signers in this study were at a high level of proficiency (trainee interpreters), they did not match early BSL signers in their use of Depicting verbs of Motion. Not only did they overextend the use of Directional Path types in Depicting verbs of Motion, but they also preferred the use of G-UP handshapes where other signers used V-DOWN handshapes. Although there are studies that report on the late acquisition of Depicting verb handshapes in locative constructions (see Marshall & Morgan, 2014), there is limited research on late acquisition of

Depicting verbs of Motion. Future research could explore the late development of Depicting verbs of Motion, especially with regard to handshape choice and conflation of Path and Manner information.

- Grammatical preferences and physical limitations: BSL signers in this study occasionally had to describe events where their physical limitations interfered with their grammatical preferences. For example, when having to describe a Figure jumping away from a tree they had to alter their perspective; they could not produce the scene from a viewer perspective due to the physical awkwardness and likelihood to block their interlocutor's view. BSL signers in this study had two strategies for dealing with such an event (changing to a character perspective or dropping Ground information). Further research could be done into how signers deal with other events that force conflict between perspective preference and physical limitations.
- V-languages and complex verb-framed languages: This study compared English monolinguals and BSL signers (all also familiar with English). English is considered an S-language and BSL was presumed to be either a V-language or complex verb-framed language (see Slobin & Hoiting, 1994; Talmy, 2003). It was expected that if BSL were a V-language then there would be differences between it and English in the information included. However, it was discovered that BSL is a complex verb-framed language and that it does not differ significantly from English in the inclusion of various Motion event components. S-languages and complex verb-framed languages are expected to regularly include Motion, Figure, Ground, Path and Manner components, therefore it was unlikely that differences in inclusion would be found between these two languages. Additionally, as all BSL signers were also fluent in an S-language (English), it is not possible to detect whether the similar

inclusion of Motion event components is due to complex verb-framed languages including the same types of information as S-languages (though with different packaging) or due to cross-modal influence of an S-language on signers. However, comparison of co-occurring languages, where one is a signed complex verb-framed language and one is a V-language, could be expected to reveal larger differences (for example, French and LSF or Turkish and TİD) as V-languages are less likely to regularly include Manner information. If this study was carried out in languages with larger typological differences then one could clarify issues of conceptual transfer. For example, regular inclusion of Manner in the target Motion event clause is highly unlikely to be due to influence from a V-language. More significantly, repeating the current study with a V-language and a signed complex verb-framed language might result in measurable differences in the recognition task. To ensure that any results would be attributable to knowledge of a complex verb-framed language, as opposed to bilingualism, ideally non-signers would be bilingual in two spoken V-languages.

- Interpreting BSL Motion events: The Motion event descriptions collected in this study could be used as stimuli for future studies looking at BSL-English translation. As it is possible to see the exact Motion events being described, one could compare how accurately an interpreted description matches the original Motion event. One would also be able to investigate the strategies interpreters have for moving information from a spatial language to a spoken language, including how elements are altered or omitted.
- Individual differences and thinking-for-speaking: The final area of potential research is into individual linguistic differences and the possible influence on attention and memory. Results from the current

study suggest that there is a link between what participants preferred to differentiate between in description and what they were able to differentiate between in the recognition task. More research into how individual linguistic differences might influence mental encoding of events would contribute to the thinking-for-speaking hypothesis. Future research in this area should regularly include measures of individual differences to allow for a fuller understanding of how, even within a language group, preferences and memory vary.

6 CONCLUSION

This thesis sought to provide a better understanding of how Motion event descriptions differ between English and BSL as well as how linguistic differences might influence memory (as explained in Chapter 1). Firstly, by comparing English monolinguals and early BSL signers I intended to investigate how English and BSL fitted into Motion event typologies. Secondly, by investigating the Motion event descriptions of early signers and late signers I hoped to give a fuller understanding of how these groups differ. Thirdly, in conducting a recognition memory task I hoped to contribute to debates around Linguistic Relativity by bringing in evidence from across two modalities.

I reviewed previous research into Motion events in both spoken and signed languages in Chapter 2. I discussed the proposed language typologies for Motion events and raised the suggestion that sign languages may be complex verb-framed languages. During the review I also noted how studies had reported on difficulties acquiring new Motion event preferences in a language acquired late and on conceptual transfer between languages. I then discussed previous research on Linguistic Relativity and suggested that this study might provide evidence for the thinking-for-speaking hypothesis.

The current study investigated the questions raised in Chapter 2 through a series of behavioural experiments (fully explained in Chapter 3) with participants in five groups: monolingual English speakers, deaf early BSL signers, hearing early BSL signers, deaf late BSL signers and hearing late BSL signers. Participants watched a series of Motion event video clips before carrying out a battery of memory and attention tasks. After this, they took part in a Motion event recognition task where they were asked to select which clip they had seen previously from pairs of similar clips. Finally, the participants described all 72 Motion event clips (in English for monolinguals and BSL for all other groups).

Results from linguistic analyses (reported in full in Chapter 4) revealed that English and BSL are similar in the Motion event components included in descriptions. However, packaging differed between the languages, with English descriptions fitting the typology of an S-language (with strong preferences for Manner verbs and Path satellites) and BSL fitting the typology of a complex verb-framed language (with evidence of serial verb constructions and a preference for including both Path and Manner in the target Motion event clause). With the similarities between English and BSL on the information included, I have suggested that some information is cross-modally salient, such as vertical Motion and circular Contours. Looking at the four BSL groups, there was very little difference in which Motion event components were included in descriptions. However, the groups diverged in how they packaged components. Hearing late signers showed some packaging that mirrored English preferences (such as including Figure in the target Motion event clause) and I raised the possibility that these signers exhibited cross-modality conceptual transfer. Hearing late signers also exhibited some preferences that appeared to be an overextension of BSL features (such as more frequent use of a Direction Depicting verb of Motion compared to other groups). Deaf early BSL signers, meanwhile, showed the strongest complex verb-framed preferences and I argued that they are the most representative of BSL without conceptual transfer from English. This is due to them learning BSL as their first language at an early age and, unlike hearing early signers, being outside the influence of spoken English.

Results from the behavioural experiments (reported in full in Chapter 4) indicated that language played no role in success in the memory and attention tasks or the Motion event recognition task. I suggested that the similarity of English and BSL descriptions undermined the ability of the recognition task to show memory differences. However, results suggested that there was a link between language and recognition memory; marking a difference between components in linguistic description was correlated with correctly selecting that component clip in the recognition task. I argued that this provides evidence for a relationship between linguistic encoding and memory at an individual level rather than at a language group level. I proposed that if the overall language groups had been more distinct then there may have been significant differences in recognition task scores.

As explored in Chapter 5, this doctoral research has contributed to the understanding of how English speakers and different BSL groups vary in their inclusion and packaging of Motion event components. Having all five groups describe the same video clips has allowed for direct comparison of how they package the same information. This has given a valuable insight into what different groups consider necessary information and the strategies they have for expressing Motion event components. The results of this study have provided valuable knowledge for how interpreters, and other signers acquiring BSL, can more accurately match early BSL signers in their descriptions of Motion events. It has highlighted areas where hearing late signers deviate from the target language provided by deaf early BSL signers. The work has also provided some evidence for the thinking-for-speaking hypothesis, indicating that there could be a link between linguistic encoding of Motion event components and memory for those components. Although no overall language differences were found, there were individual differences that raise the possibility that personal linguistic preferences might have a role in shaping memories.

This study has raised more questions in the area of Motion events and sign languages. I have suggested that further research is needed across modalities, especially to compare how spoken V-languages and signed complex verb-framed languages differ in their Motion event descriptions. Conducting such research would create a clearer picture of which Motion event information is cross-modally salient. It would also provide a better understanding of conceptual transfer across modalities. Using the Motion event recognition task in this study with a V-language and a complex verb-framed language might also reveal language group differences in memory. Findings in the recognition task have also opened up avenues of exploration for how individual linguistic preferences might influence attention and memory.

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8 APPENDICES

APPENDIX 1 GUIDE TO SIGN NOTATION

Examples of signing will be provided in this thesis through photographs. All meaningful movement and handshape change in the signs is indicated through the notation on the photographs. The movement required to move from one sign to the next is not included as this is not a meaningful element. The notation for movement has been made deliberately simple and does not indicate elements such as speed of movement. Below is a simple guide to the notation used.

1. The path and direction of hands in moving signs are indicated by arrows. Any hand that moves will have an associated arrow. If there is not an arrow associated with one of the hands, that hand is static. Photographs of the sign may indicate the hand at the beginning, middle or end of a movement. The arrow shows the path from start to finish.

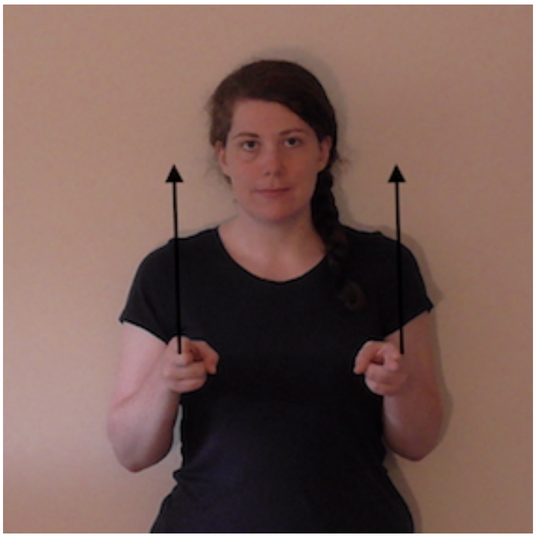

Image 1.1 Two-handed sign moving upwards

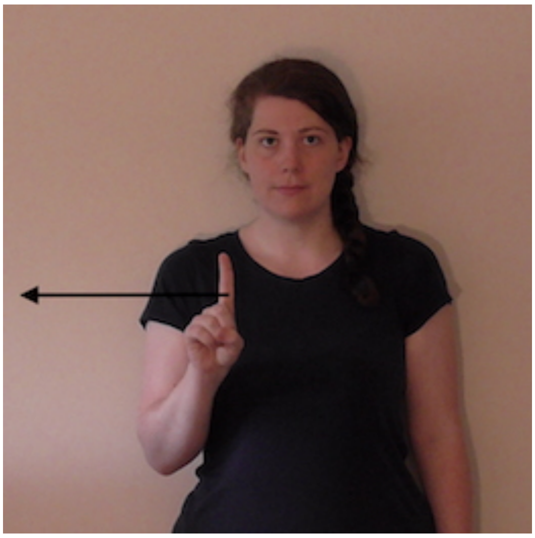

Image 1.2 One-handed sign moving to the signer's right

2. Shape outlines drawn by the hands are indicated with lines. If both hands are in contact with the line shape then each hand produces half of the object in symmetry. If one hand is in contact with the line shape, it is produced by just one hand.

Image 1.3 Signer outlining a circle with hands

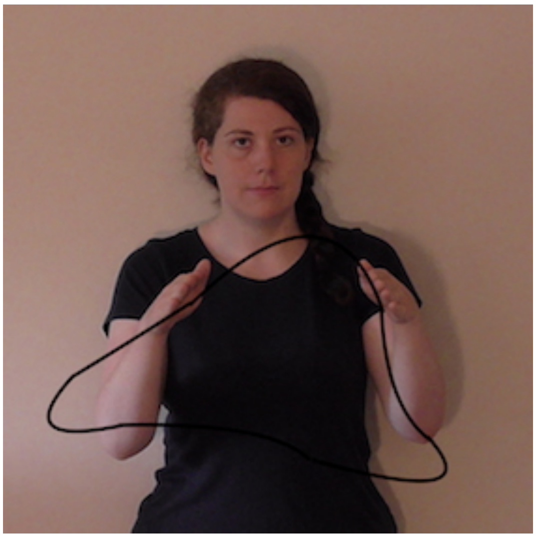

Image 1.4 Signer outlining an abstract shape with hands

3. Hands twisting forwards or sideways during a movement are indicated by a larger arrow.

Image 1.5 Handshape twisting forwards

4. Handshape changes are shown by a photograph of each handshape with the movement between the handshapes indicated with a dashed arrow.

Image 1.6 Handshape change

Glosses

[c]: end of a clause

(r): sign is made on the right hand

(l): sign is made on the left hand

.figure/vehicle/entity: the handshape used describes a figure/vehicle/entity

HOLD: the handling of an entity is being described

BE: indicates a point or the placing of a Depicting verb in a location

+located.at.x: describes the location being shown

MOVE: indicates a Depicting verb of Motion is moving in the sign space

+from.x: indicates a movement from a location

+to.x: indicates a movement to a location

+past.x: indicates a movement past a location

+towards.self: indicates a movement towards the signer

+away.from.self: indicates a movement away from the signer

+past.self: indicates a movement past the signer

+via.x: indicates a movement happening in relation to a location

+contour.x: indicates a contour is being mapped out

+rotate.anticlockwise: indicates a circular anticlockwise movement

+rotate.clockwise: indicates a circular clockwise movement

+manner.: indicates extra manner information is being added (for example, .jump or .backstroke)

+nmf.: indicates non-manual feature is added (for example, .intense)

An example of a gloss:

MOVE.figure+from.x+to.y+contour.a+manner.walk

This would indicate a Depicting verb showing a figure walking from one location to another on a specific contour.

APPENDIX 2 HANDSHAPES USED IN BSL DEPICTING SIGNS

Below are the Depicting verb handshapes used by participants in this study. Their handshape names are taken from the Dictionary of British Sign Language/English. The handshapes listed below can be used in any orientation but are all shown in the same orientation below for ease of comparison. An indication of the handshape and the orientation will be written as Handshape-Orientation (e.g. G-UP or B-LATERAL)

Table 2.1 Depicting verb handshapes relevant to the current study

Handshape Name	Image	Frequent Use
B		Flat objects and vehicles (e.g. magazine or car)
C		Cylindrical objects (e.g. a bannister or cup)
G		Thin objects and people (e.g. pencil or person)

O		Small cylindrical objects (e.g. fishing-rod)
V		Legged entities (e.g. person)
Y		Aeroplane
5		Large curved objects (e.g. bush)

All of the handshapes listed above may be produced in different orientations. Below, in Table 2.2, is a list of orientations relevant to the current study with images showing examples with the G-handshape.

Table 2.2 Orientations of Depicting verbs relevant to the current study

Orientation	Image	Description
Horizontal		If all fingers were extended, palm would face downwards
Up		If all fingers were extended, they would point upwards
Down		If all fingers were extended, they would point downwards
Lateral		If thumb was extended, it would point upwards

APPENDIX 3 MOTION EVENT DYADS AND FILLERS

Table 3.1 Stimuli set of Motion event video clip dyads

Clip Name	Figure	Ground	Path	Manner	Path Detail	Manner Detail
F1	Man/Woman	Climbing Wall	Left	Climb	None	None
F2	Woman/Man	Swimming Pool	Towards	Swim	None	None
F3	Man/Woman	Park	Towards	Jump	None	None
F4	Woman/Man	Archway	Out	Walk	None	None
F5	Man/Woman	Stairs	Down	Step	None	None
F6	Woman/Man	Archway	Out	Step	None	None
G1	Man	Park/Street	Towards	Cycle	None	None
G2	Woman	Street/Park	Away	Walk	None	None
G3	Man	Archway 1/2	In	Cycle	None	None
G4	Woman	Climbing Wall 1/2	Up	Climb	None	None
G5	Man	Street 1/2	Away	Cycle	None	None
G6	Woman	Park 1/2	Around	Run	None	None
P1	Man	Climbing Wall	Up/Down	Climb	None	None
P2	Woman	Stairs	Down/Up	Walk	None	None
P3	Man	Swimming Pool	In/Out	Climb	None	None
P4	Woman	Archway	Out/In	Cycle	None	None
P5	Man	Street	Left/Right	Run	None	None
P6	Woman	Park	Right/Left	Step	None	None
M1	Man	Stairs	Down	Walk/Run	None	None
M2	Woman	Archway	In	Run/Walk	None	None
M3	Man	Stairs	Up	Jump/Step	None	None
M4	Woman	Swimming Pool	In	Step/Jump	None	None
M5	Man	Swimming Pool	Right	Swim/Float	None	None
M6	Woman	Swimming Pool	Away	Float/Swim	None	None

PD1	Man	Park	Left	Walk	Shallow/Steep	None
PD2	Woman	Park	Right	Run	Steep/Shallow	None
PD3	Man	Climbing Wall	Right	Climb	Route 1/2	None
PD4	Woman	Street	Left	Walk	Route 1/2	None
PD5	Man	Swimming Pool	Around	Swim	Clockwise/ Anticlockwise	None
PD6	Woman	Park	Around	Cycle	Anticlockwise/ Clockwise	None
MD1	Man	Archway	Out	Run	None	Fast/ Slow
MD2	Woman	Stairs	Down	Run	None	Slow/ Fast
MD3	Man	Swimming Pool	Away	Swim	None	Breaststroke/ Frontcrawl
MD4	Woman	Park	Towards	Cycle	None	Style 1/2
MD5	Man	Stairs	Up	Run	None	Bound/ Sneak
MD6	Woman	Park	Around	Walk	None	Sneak/ Bound

Below, in Images 3.1 – 3.6 are stills from a dyad in each component type.

Image 3.1 Stills from a Figure dyad

Image 3.2 Stills from a Ground dyad

Image 3.3 Stills from a Path dyad

Image 3.4 Stills from a Manner dyad

Image 3.5 Stills from a Path Detail dyad

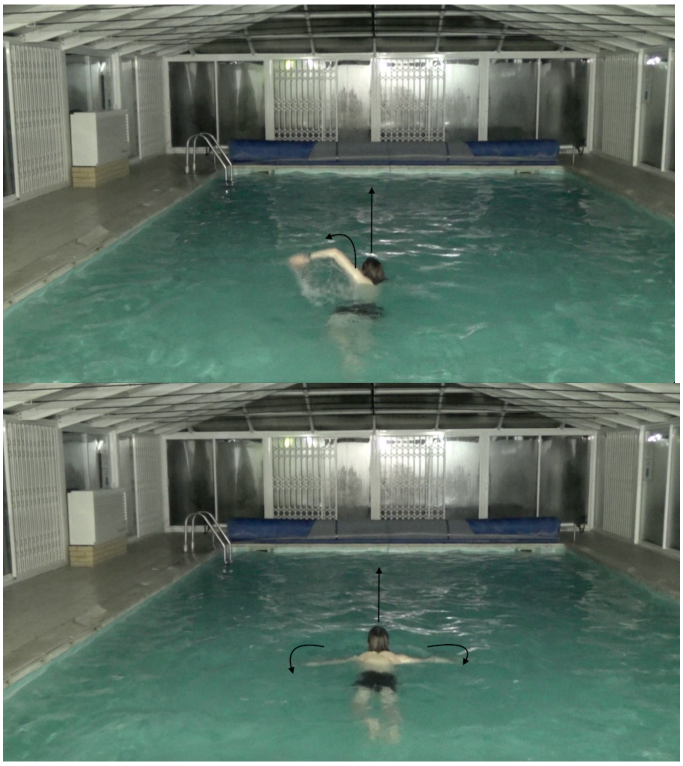

Image 3.6 Stills from a Manner Detail dyad

Table 3.2 Stimuli set of filler video clips

	Figure	Ground	Action
MF1	Man	Park	Throws a ball
MF2	Woman	Swimming Pool	Splashes water
MF3	Man	Park	Jogs on spot
MF4	Woman	Archway	Does jumping jacks
MF5	Man	Stairs	Does triceps dips
MF6	Woman	Street	Waves
NF1	Man	Swimming Pool	Sits on pool edge
NF2	Woman	Park	Lies on ground
NF3	Man	Street	Stands with phone
NF4	Woman	Stairs	Sits with book
NF5	Man	Archway	Looks at watch
NF6	Woman	Climbing Wall	Looks at wall

APPENDIX 4 PSEUDORANDOMISATION EXPLANATION

Stimulus presentation was counterbalanced among participants, as shown below, to control for order, practice and fatigue effects.

Video Clip Presentation

During the first presentation, participants were exposed to a total of 48 video clips, comprised of 36 Motion event video clips and 12 filler clips (see in Appendix 3, above). Half of participants saw Clip One of the dyads (for example, P1a) and half saw Clip Two (for example, P1b). Motion event clips were arranged into six blocks where all six classes of change are represented once per block (Table 4.1, below) to prevent clips from the same dyad type being presented sequentially. Each participant saw all of these blocks, but orders were varied. To prevent interference from first-order carryover effects, these blocks were presented in 6 unique orders, created by using a balanced 6x6 Latin Square (see Table 4.2 for all the possible orders). Order within each block was randomised for each participant. As half of participants saw Clip One and half Clip Two, this created 12 unique presentations.

Table 4.1 All stimuli clips divided into six blocks for the video clip presentation

Block	Video Clips							
A	P1	M2	F3	G4	PD5	MD6	MF1	NF1
B	P2	M3	F4	G5	PD6	MD1	MF2	NF2
C	P3	M4	F5	G6	PD1	MD2	MF3	NF3
D	P4	M5	F6	G7	PD2	MD3	MF4	NF4
E	P5	M6	F1	G8	PD3	MD4	MF5	NF5
F	P6	M1	F2	G9	PD4	MD5	MF6	NF6

Table 4.2 Six different presentation orders for the six blocks in the video clip presentation

	Blocks					
1	A	B	F	C	E	D
2	B	C	A	D	F	E
3	C	D	B	E	A	F
4	D	E	C	F	B	A
5	E	F	D	A	C	B
6	F	A	E	B	D	C

Video Clip Description

For the video clip description, all 72 Motion event video clips in the battery were shown individually to participants. The clips were arranged into 12 blocks with each of the 6 Motion events in each block (see Table 4.3, below). This was to prevent clips from the same dyad or same dyad type being presented back-to-back. Clips were randomised within each block for each participant.

Table 4.3 All stimuli clips divided into 12 blocks for the description task

Block	Clips					
1	P6b	M5a	F4b	G3a	PD2b	MD1a
2	P1a	M2b	F3a	G4b	PD5a	MD6b
3	P5b	M4a	F3b	G2a	PD1b	MD6a
4	P2a	M3b	F4a	G5b	PD6a	MD1a
5	P4b	M3a	F2b	G1a	PD6b	MD5a
6	P3a	M4b	F5a	G6b	PD1a	MD2b
7	P3b	M2a	F1b	G6a	PD5b	MD4a

8	P4a	M5b	F6a	G1b	PD2a	MD3b
9	P2b	M1a	F6b	G5a	PD4b	MD3a
10	P5a	M6b	F1a	G2b	PD3a	MD4b
11	P1b	M6a	F5b	G4a	PD3b	MD2a
12	P6a	M1b	F2a	G3b	PD4a	MD5b

Motion Event Recognition Task

Participants were shown all clips in a random order. As both companion clips in each dyad were presented simultaneously to select between, it was important to control for whether the target clip was presented on the left or the right of the screen. Therefore, two conditions were created (A and B), which had clips presented on opposite sides of the screen (so, for example, if clip P1a was on the left in condition A, it would be on the right in condition B).

Appendix 5 Background on Signing Participants

Participant Number	Hearing Status	Age	Age of BSL Acquisition	Family Members who Signed at Home	Interpreter Status
001	Deaf	28	3–4	Mother*, Sister	None
002	Deaf	46	5–6	Brother, Sister	None
003	Deaf	38	0†	Mother, Father	None
004	Deaf	52	5–6	Mother*	None
005	Deaf	30	0	Mother, Sister	None
006	Deaf	52	0	Mother, Father, Brother, Grandmother	None
007	Hearing	30	0	Mother, Father	Qualified
008	Hearing	52	0	Mother, Father	Qualified
009	Hearing	20	0	Mother, Father, Brother*	Qualified
010	Hearing	50	0	Mother, Father	Qualified
011	Hearing	55	0	Mother, Father, Sister*	None
012	Hearing	48	0	Mother, Father	None
013	Hearing	20	0	Mother, Father	None
014	Hearing	46	0	Mother, Father, Brother*, Sister*	Qualified
015	Hearing	19	0	Mother, Father, Sister*	Qualified
016	Hearing	48	0	Mother, Father, Sister*	Qualified
017	Hearing	28	0	Mother, Father	None

018	Hearing	48	0	Mother, Father	None
019	Deaf	48	>16	None	None
020	Deaf	50	>16	None	None
021	Deaf	53	>16	None	None
022	Deaf	60	>16	None	None
023	Deaf	46	>16	None	None
024	Deaf	53	>16	None	None
025	Deaf	53	>16	None	None
026	Hearing	31	>16	None	Training
027	Hearing	57	>16	None	Training
028	Hearing	34	>16	None	Training
029	Hearing	45	>16	None	Training
030	Hearing	19	>16	None	Training
031	Hearing	21	>16	None	Training
032	Hearing	21	>16	None	Training
033	Hearing	24	>16	None	Training
034	Hearing	35	>16	None	Training
035	Hearing	28	>16	None	Training
036	Hearing	31	>16	None	Training
037	Hearing	51	>16	None	Training

* Hearing individual

† 0 indicates acquired from birth

Appendix 6 Information Sheet & Consent Form

A Study of Early and Late BSL

We have translated this form (and all other written instructions) into BSL. If you are an early signer we will show you these translations alongside the written English.

You are being asked to take part in a research study. Research studies include only people who choose to take part. This document is an information sheet and consent form. Please read this information carefully and take your time making your decision. The nature of the study, risks and other important information about the study are listed below.

The person who is in charge of this research study is Rowena Bermingham. She is being guided in this research by Dr Henriëtte Hendriks.

The contact details of the lead researcher are:

Name: Rowena Bermingham   Email: [redacted]

This research is being sponsored by the Economic and Social Research Council and forms part of the research towards a PhD at Cambridge University.

This form tells you about this research study. The form explains:

- What will happen during this study and what you will need to do.
- How the information collected about you during this study will be used and with whom it may be shared.

Taking part in this research study is up to you. If you choose to be in the study, then you should sign this informed consent form. If you do not want to take part in this study, you should not sign this form.

Purpose of the study

The purpose of this study is to understand how English and BSL differ in their description of events and also how early signers and late signers differ in their use of BSL

Why am I being asked to take part?

We are asking you to take part in this study because you are either a native English speaker or early/late BSL signer.

Do I have to take part?

It is up to you to decide. We will describe the study in this information sheet. We will then ask you to sign a consent form to show you agreed to take part. You are free to withdraw at any time, without giving a reason.

What will happen during this study?

You will be asked to spend about one hour in this study, in one single session. During this session you will be asked to watch video clips before playing some non-language games on a computer. After this you will watch some more video clips and then carry out another non-language task. Finally you will take part in a language production task. You will be filmed during this task. We will ask you to sign a release form to be able to use these video files in future publications and presentations. Only the experimenter will have access to these recordings and they will be kept securely. Some research designs require that the full extent of the study not be explained prior to participation. Although we have described the general nature of the tasks that you will be asked to perform, the full intent of the study will not be explained to you until after the completion of the study. At that time, we will provide you with a full debriefing which will include an explanation of the hypotheses that were tested and other relevant background information pertaining to the study. You will also be given an opportunity to ask any questions you have about the hypotheses and the procedures used in the study. Please note that the tasks in this study are not a test of your personal intelligence, knowledge or abilities.

Confidentiality

The following data will be recorded:

- Audiovisual video clips
- Scores relating to language and non-language tasks

All data will be coded so that your anonymity will be protected in any research papers and presentations that result from this work. The procedures for handling, processing, storage and destruction of your data match Data Protection Act 1998. If you are happy for your video clips to be used in conference presentations and future publications, you will be asked to sign a video release form.

Total Number of Participants

40–70 individuals will take part in this study.

Benefits

You are unlikely to receive any direct benefits by taking part in this research study.

Risks or Discomfort

This research is considered to be minimal risk. That means that the risks associated with this study are the same as what you face every day. There are no known additional risks to those who take part in this study.

Compensation

You will be paid £7 if you complete all of the experiment.

Your Rights

You can refuse to sign this form. If you do not sign this form you will not be able to take part in this research study.

Privacy and Confidentiality

We will keep your records related to this study private and confidential. We may publish what we learn from this study. If we do, we will not include your name or any of your personal details.

Voluntary Participation / Withdrawal

You should only take part in this study if you want to volunteer. You should not feel that there is any pressure to take part in the study. You are free to participate in this research or withdraw at any time. You can withdraw from participation in this study at any point during the study session or afterwards, by telling the experimenter or emailing [redacted] and stating your name and that you no longer wish to be included in the study. You do not need to give any reason for your withdrawal.

How can I find out the results of this study?

If interested, you can find out the results of the study by contacting Rowena, after 01/07/17. She can be contacted by email on [redacted].

Record of Consent

Your signature below indicates that you have understood the information about this experiment and consent to your participation. Participation is voluntary and you may refuse to answer certain questions and withdraw from the study at any time with no penalty. This does not waive your legal rights. You will receive a copy of this consent form for your own record. If you have further questions related to this research, please contact the researcher.

Appendix 7 Background Questionnaire

Date of Birth (for example, 21/01/85)

___/___/___

Education

Please tick the highest qualification you have:

□ No formal qualifications

□ GCSE/O-levels (or equivalent)

□ A-levels (or equivalent)

□ Undergraduate degree (or equivalent)

□ Professional Qualification (higher than Undergraduate equivalent)

□ Postgraduate degree (masters/doctorate)

□ Other (please specify below)

____

Hearing level

□ I have never been told I have hearing loss

□ I have a hearing threshold above 55 decibels

□ I would prefer not to say/I do not know

□ Other (please specify below)

____

Do you have normal near-sight vision *OR* wear glasses/contact lenses to correct your vision to normal near-sight vision?

□ Yes

□ No

Languages (please tick *ALL* that apply to you)

□ I do not know any sign languages

□ I used/learned BSL (BSL) at home before the age of 7

□ I used/learned BSL (BSL) after the age of 16

□ I used/learned a language other than BSL or English before the age of 11 (please specify below)

Language 1: ____________________ Age: ____

Do you still know this language fluently? □ Yes □ No

Language 2: ____________________ Age: ____

Do you still know this language fluently? □ Yes □ No

Language 3: ____________________ Age: ____

Do you still know this language fluently? □ Yes □ No

Family Languages

In your family home when you were growing up, how many members of your family (not including yourself) used BSL as their main language?

□ 0

□ 1

□ 2

□ 3+

Who in your family used BSL as their main language (for example, mother/father/older sister)?

____

____

____

Appendix 8 Debriefing

Thank you for taking part in this study. As you were told before you started the study, we are looking at descriptions in English and BSL. We are comparing how these two languages describe events. We are also looking at if the way describing events in one's early language influences how one remembers events. The first set of non-language tasks that you took part in gave us a general measure of your recognition and spatial memory ability (the ability to recognise previously encountered objects and locations). The non-language task where you selected which video clips you had seen previously gave us a measure of your event recognition memory. What we are interested in is how your memory for these events relates to the way you later chose to describe them in the language task.

The questions we were asking in this study were as follows:

1. Do early signers include more detail when describing events than English speakers?
2. Do late signers include less detail about events when using BSL than early BSL signers?
3. Do early signers perform better than English speakers at a recognition task for video clips?
4. Do late signers perform better than English speakers at a recognition task for video clips?

It is vital that you do not share details of this study with anyone, particularly those who may take part in the study in the future. This is because it may influence their behaviour and change the results of the study. Thank you for keeping the aims and methods of this study private.

If you have any questions or concerns about this study or its procedures, please contact the project supervisor Dr Henriëtte Hendriks on [redacted].

Appendix 9 Photograph & Video Release Form

I hereby grant permission to the rights of my image, likeness and sound of my voice as recorded on audio or videotape without payment or any other consideration. I understand that my face will not be blurred or concealed on these videotapes. I understand that my image may be edited, copied, exhibited, published or distributed and waive the right to inspect or approve the finished product wherein my likeness appears. Additionally, I waive any right to royalties or other compensation arising or related to the use of my image or recording. I also understand that this material may be used in diverse educational settings within an unrestricted geographic area.

Photographic, audio or video recordings may be used for the following purposes:

- conference presentations
- educational presentations or courses
- informational presentations
- academic journals

By signing this release I understand this permission signifies that photographic or video recordings of me may be displayed in a public educational setting.

I will be consulted about the use of the photographs or video recording for any purpose other than those listed above. There is no time limit on the validity of this release nor is there any geographic limitation on where these materials may be distributed.

This release applies to photographic, audio or video recordings collected as part of this session on ___/___/___. By signing this form I acknowledge that I have completely read and fully understand the above release and agree to be bound thereby. I hereby release any and all claims against any person or organization utilizing this material for educational purposes.

APPENDIX 10 LIST OF PATH TYPES USED BY ALL GROUPS IN DIFFERENT PATH EVENT TYPES

Language	Hearing Status	Event Type	Vertical	Boundary	Deictic	Source	Goal	Source-Goal	Directional	Horizontal	Other	Total
L1 BSL	*Deaf*	Up/ Down	168 (98.3%)	3 (1.8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	171
	Hearing		254 (97.3%)	0 (0%)	0 (0%)	0 (0%)	1 (0.4%)	0 (0%)	5 (1.9%)	0 (0%)	1 (0.4%)	261
L2 BSL	*Deaf*		151 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	151
	Hearing		269 (96.4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	5 (1.8%)	0 (0%)	5 (1.8%)	279
English	*Hearing*		237 (91.9%)	1 (0.4%)	9 (3.5%)	0 (0%)	6 (2.3%)	2 (0.8%)	2 (0.8%)	1 (0.4%)	0 (0%)	258
L1 BSL	*Deaf*	Left/ Right	2 (2.6%)	0 (0%)	0 (0%)	2 (2.6%)	0 (0%)	0 (0%)	65 (85.5%)	0 (0%)	7 (9.2%)	76
	Hearing		0 (0%)	0 (0%)	0 (0%)	1 (0.8%)	0 (0%)	1 (0.8%)	104 (83.9%)	0 (0%)	18 (14.5%)	124
L2 BSL	*Deaf*		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	66 (97.1%)	0 (0%)	2 (2.9%)	68
	Hearing		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	132 (94.3%)	0 (0%)	8 (5.7%)	140
English	*Hearing*		0 (0%)	13 (10.2%)	1 (0.8%)	3 (2.4%)	4 (3.2%)	1 (0.8%)	87 (68.5%)	5 (3.9%)	13 (10.2%)	127
L1 BSL	*Deaf*	In/Out	29 (21.8%)	48 (36%)	0 (0%)	6 (4.5%)	1 (0.8%)	1 (0.8%)	4 (3%)	20 (15%)	24 (18%)	133
	Hearing		48 (24%)	64 (32%)	0 (0%)	6 (3%)	0 (0%)	0 (0%)	12 (6%)	2 (1%)	68 (34%)	200
L2 BSL	*Deaf*		26 (22.2%)	46 (39.3%)	0 (0%)	4 (3.4%)	2 (1.7%)	0 (0%)	1 (0.9%)	15 (12.8%)	23 (19.7%)	117
	Hearing		53 (24.9%)	47 (22%)	0 (0%)	0 (0%)	1 (0.5%)	0 (0%)	48 (22.5%)	3 (1.4%)	61 (28.6%)	213
English	*Hearing*		4 (1.9%)	180 (83.3%)	9 (4.2%)	8 (3.7%)	3 (1.4%)	1 (0.5%)	7 (3.2%)	0 (0%)	4 (1.9%)	216
L1 BSL	*Deaf*	Towards /Away	0 (0%)	4 (3.9%)	0 (0%)	1 (1%)	13 (12.5%)	0 (0%)	65 (62.5%)	18 (17.3%)	3 (2.9%)	104
	Hearing		0 (0%)	2 (1.3%)	0 (0%)	1 (0.7%)	16 (10.5%)	2 (1.3%)	67 (44.1%)	24 (15.8%)	40 (26.3%)	152
L2 BSL	*Deaf*		0 (0%)	3 (3.5%)	0 (0%)	2 (2.3%)	6 (6.9%)	0 (0%)	50 (57.5%)	23 (26.4%)	3 (3.5%)	87
	Hearing		0 (0%)	1 (0.5%)	0 (0%)	0 (0%)	5 (2.6%)	0 (0%)	138 (72.6%)	28 (14.7%)	18 (9.5%)	190
English	*Hearing*		0 (0%)	13 (6.7%)	12 (6.2%)	25 (13%)	80 (41.5%)	20 (10.4%)	12 (6.2%)	30 (15.5%)	1 (0.5%)	193
L1 BSL	*Deaf*	Around	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	48 (100%)	0 (0%)	0 (0%)	48
	Hearing		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	86 (95.6%)	0 (0%)	4 (4.4%)	90
L2 BSL	*Deaf*		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	47 (100%)	0 (0%)	0 (0%)	47
	Hearing		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	103 (100%)	0 (0%)	0 (0%)	103
English	*Hearing*		0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	105 (100%)	105

APPENDIX 11 LIST OF CANDIDATE MODELS

Response	Predictors	Significant Predictors	AIC	*p*	Normality (Shapiro-Wilk)	Adjusted R^2	*F*
Recognition Task	Paired Associates Age	Paired Associates	271.21	0.018	$W = 0.96$ $p = 0.08$	0.12	4.41
Recognition Task	Paired Associates	Paired Associates	269.52	0.03	$W = 0.95$ $p < 0.05$	0.08	5.25
Recognition Task	Hearing	Hearing	269.89	0.03	$W = 0.95$ $p < 0.05$	0.07	4.85
Manner Dyads	Paired Associates Age	Age	152.90	< 0.05	$W = 0.98$ $p = 0.71$	0.09	3.28
Correct	Feature Match Age	Feature Match Age	291.02	0.018	$W = 0.98$ $p = 0.53$	0.12	4.36
Guess	Age	Age	314.33	0.03	$W = 0.95$ $p < 0.05$	0.08	5.02
Spatial Span	Age	Age	140.73	< 0.001	$W = 0.93$ $p < 0.01$	0.21	8.00
Spatial Span	Hearing Age	Age	140.99	0.001	$W = 0.96$ $p = 0.14$	0.22	8.00
Feature Match	Age	Age	489.01	< 0.001	$W = 0.97$ $p = 0.36$	0.21	14.08
Rotations	Age	Age	515.16	0.02	$W = 0.96$ $p = 0.14$	0.087	5.68