Modification of indicating verbs in British Sign Language: A corpus-based study

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ABSTRACT

Indicating verbs can be directed towards locations in space associated with their arguments. The primary debate about these verbs is whether this directionality is akin to grammatical agreement or whether it represents a fusion of both morphemic and gestural elements. To move the debate forward, more empirical evidence is needed. We consider linguistic and social factors in 1436 indicating verb tokens from the BSL Corpus. Results reveal that modification is not obligatory and that patient modification is conditioned by several factors such as constructed action. We argue that our results provide some support for the claim that indicating verbs represent a fusion of morphemic and gestural elements.

Keywords: agreement, directional, person, constructed action, role shift, gesture, deixis

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1. INTRODUCTION

The use of signing space has been described as where we see 'the most profound modality effects on grammatical organization in sign language' (Meier 2012: 587). Signers regularly make use of the space around their bodies in meaningful ways that appear to share some properties with the uses of space seen in co-speech gesture (e.g. Perniss & Özyürek 2015). The use of space in sign languages and the most appropriate theoretical account of this phenomenon have, however, been subject to considerable controversy in the sign language linguistics literature (e.g. Lillo-Martin and Meier 2011 and commentaries in the same issue). Here, we focus our attention on how signers indicate arguments within a clause by modifying the production of a specific class of verb signs (we use the term 'indicating verbs' to refer to this class of verbs). There are two main theoretical accounts of this aspect of the grammar of sign languages. The first, widely adopted by those working within a generative linguistics framework, analyzes such modification as grammatical agreement. The second, originating within a cognitive/functional linguistics framework, alternatively suggests that these verbs represent a fusion of morphemes with deictic gestural elements (Liddell, 2003), in a model built on Langacker's (1987, 1991) notion of Cognitive Grammar which sees speech, sign, and gesture as all part of a broader notion of 'language' (Liddell 2011) Although the debate has moved forward considerably since the latter perspective was introduced by Liddell (2000), the discussion has only recently begun to benefit from empirical insights gained by looking at large datasets such as corpora[1] (e.g. de Beuzeville et al. 2009). Corpus-based studies not only provide a greater understanding of the overall frequency of indicating verb modification in spontaneous settings but also allow us to statistically verify which factors (whether linguistic or social) may condition the use of space in this subset of verbs. Here we report on data from the conversational component of the British Sign Language (BSL) Corpus (Schembri et al. 2014) with an examination of social factors involved in modification, something that has not previously been attempted on such a large scale.

In the following section, we first briefly describe indicating verbs in BSL before introducing the debate regarding the typological nature of the modification of these verbs in sign languages generally (whether this modification can be considered agreement marking or blends of morphemic and deictic gestural elements). We outline the research questions and methodology in Sections 3 and 4, respectively. The results are presented in Section 5 and discussed in Section 6. In Section 7, we conclude that our data appear to provide more support

for a gestural analysis of directionality in indicating verbs (i.e. for the account claiming these signs contain deictic gestural elements).

2. LITERATURE REVIEW

2.1. VERBS IN SIGN LANGUAGES

Indicating verbs are a class of verbs that move in space between (and/or are oriented towards/away from) the locations of physically present referents and/or locations associated with absent referents. They have been attested in the vast majority of sign languages documented to date (e.g. Mathur & Rathmann 2010). Examples of two different types of indicating verbs in BSL, glossed here as GIVE and MOVE, are provided in Figure 1.[2]

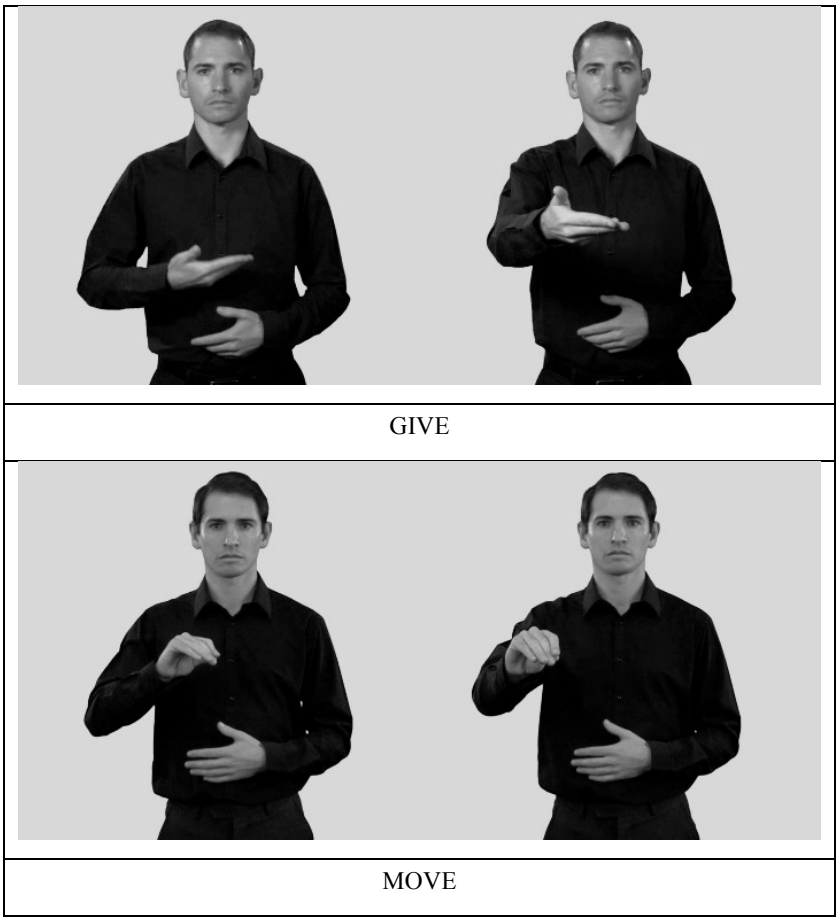


FIGURE 1. BSL GIVE and MOVE

Figure 1 illustrates the citation forms for GIVE and MOVE which begin at a location near the signer's chest and end in the space immediately in front of the signer. However, the beginning and end locations of these signs may be meaningful. For GIVE, these locations can be associated with the agent (i.e. who is giving) and the patient (i.e. who is receiving). In this case, the direction of movement in GIVE in Figure 1 can be interpreted as meaning 'I give you something' (the location immediately in front of the signer is often, although not always, understood as a reference to second person). Consequently, the direction of movement (or in some cases, the orientation of the hand) can be reversed to convey the opposite meaning – e.g., '(You) give (me something)'[3]. MOVE is also classed as a type of indicating verb (Johnston & Schembri 2007; Liddell 2003) although it differs from GIVE in that it appears to mark locative arguments as opposed to animate or nonlocative inanimate arguments. The movement of the hands in MOVE can therefore be interpreted as 'X moved from one location to another location' where the beginning and end points of the movement are understood as representing changes in the spatial location of the referent, from source to goal.

Indicating verbs vary in how they may be directionally modified to reflect agent and patient arguments (although an extensive analysis of these verb types and their modification patterns has yet to be conducted for BSL). For example, some verbs appear to be partly anchored to the body and are modified for only one argument within a clause. One such example is the BSL verb SAY which begins near the signer's mouth and ends at the location associated with the patient argument (e.g. the person who is being told something). In this sign, the beginning location is fixed, even when the agent argument within a clause is a second or third person referent as in 1. We may refer to these as 'single indicating verbs', as opposed to 'double indicating verbs' like GIVE.

(1) PT$^{\rightarrow 2}$ SAY$^{\rightarrow 3}$ YESTERDAY
You told him yesterday

The two types of indicating verbs mentioned previously (e.g. GIVE and MOVE) are widely known in the sign language linguistics literature as agreement and spatial verbs respectively and form,

together with plain verbs,[4] a tripartite division of verb types as first proposed by Padden (1983, 1988).[5] This division is motivated by the observation that these verbs appear to mark different types of arguments (animate versus locative) and that agreement verbs can be modified for person and number (Padden 1983). In this paper, and from this point onwards, we focus on the subtype of indicating verbs that are more widely known as agreement verbs. These verbs can be described as verbs that mark transfer and take animate or nonlocative inanimate arguments. Indicating verbs that are modified for purely locative arguments (i.e. arguments which are clearly only locative, e.g. MOVE as in Figure 1) will not be included in the analysis reported in this the paper.

In the following paragraphs, we discuss some of the arguments for the two different analyses of these verbs: the agreement analysis and the morphemic-gestural analysis. For a more detailed description of this debate, we refer the reader to Lillo-Martin and Meier (2011) and commentaries in the same issue.

2.2. DIRECTIONAL MODIFICATION AS GRAMMATICAL AGREEMENT

The first analysis of indicating verbs was presented for American Sign Language (ASL) by Padden (1983), building on earlier work by Friedman (1975), Fischer and Gough (1978) and Meier (1982). For both Padden (1983) and Meier (1982), directional modification in these verbs is interpreted as marking grammatical agreement for person similar to Romance languages, such as Italian. For instance, in 2 – 4, the Italian verb *parlare* 'speak' varies in form depending on whether the subject is first, second, or third person (it also varies according to whether the subject is singular or plural, though we are not focusing on number here).

(2) Io parl-**o** Italiano
I speak Italian

(3) Tu parl-**i** Italiano
You speak Italian

(4) Lui/lei parl-**a** Italiano.
He/she speaks Italian

Agreement, as defined by Corbett (2006), refers to the presence of co-variance between a constituent acting as a controller and a target constituent which serves to express grammatical relationships. In 2 - 4, the controller is the subject noun phrase and the target is the verb (the form that varies according to the controller). In 2, the controller is a first person singular pronoun and the suffix on the verb (-o) reflects this property. In other words, the verb takes a suffix to agree with formal properties (i.e. person and number) of the subject noun phrase.

In earlier analyses of indicating verbs in sign languages, the spatial loci associated with the beginning and end of the verb (e.g. in BSL GIVE) were analyzed as a type of inflectional morpheme similar to the suffixes we observe in the Italian examples (Padden 1983). These spatial loci, having previously been set up in the discourse, are understood as being associated with the subject and object of the verb. Base forms of agreement verbs are therefore modified to correspond with these loci.[6] Later analyses argue that the directionality (or the path movement) itself is the inflectional morpheme rather than a location in space (e.g. Aronoff et al. 2005). In these analyses, according to Corbett's (2006) definition, the claim would be that there is a formal property of the controller noun phrase (i.e. person) that is associated with these loci in the signing space (or the path movements towards them), and modifications of the target verb sign thus express agreement for person in the same way as the Italian examples in 2 - 4.

Various arguments have been made in support of person marking on these verbs. Meier (1990) and Lillo-Martin and Meier (2011) suggest that there are grounds for a distinction between first and nonfirst person pronominal forms, but not between second and third person. They argue that this first/nonfirst distinction can also be applied to agreement verbs when one considers that a number of idiosyncratic forms exist only for first person object (e.g. CONVINCE in ASL which is produced in neutral space for nonfirst person object forms but at the signer's neck for first person object forms). Furthermore, the presence of an indicating verb in a clause appears to have consequences for syntactic structure such as changes in word order (Fischer 1975; Quadros 1999; Quadros & Lillo-Martin 2010) and the licensing of null arguments (Lillo-Martin 1986) which, as argued by Lillo-Martin and Meier (2011), are characteristic of the morpho-syntactic properties of agreement systems in spoken languages (e.g. languages with rich agreement systems also permit null arguments).[7]

However, many researchers (e.g. Lillo-Martin & Meier 2011) acknowledge that some characteristics of sign language agreement systems make them typologically unique. For example, only some verbs are modified spatially – plain verbs are body anchored and cannot be modified to show direction. Additionally, unlike spoken language agreement systems studied to date where there is a strong tendency for verbs to agree with the subject, subject agreement appears to be optional in sign languages (Meier 1982; Padden 1983). Instead, object agreement appears to take a primary role and is claimed to be obligatory in ASL (Lillo-Martin & Meier 2011; Meier 1982), British Sign Language (Morgan et al. 2006), and Brazilian Sign Language (Quadros & Lillo-Martin 2007). In other sign languages it has been claimed that neither subject nor object agreement is obligatory. For example, Lam (2003, cited in Tang et al. 2008) claims that neither subject nor object agreement in Hong Kong Sign Language is required. Additionally, they claim that verbs may appear unmodified in citation form unless the subject is second person (in which case subject agreement is obligatory) or the object is first person (in which case object agreement is obligatory). However, in all of these cases, it is not clear on what grounds obligatoriness or optionality is claimed.

2.3. DIRECTIONALITY AS A FUSION OF MORPHEMIC AND GESTURAL ELEMENTS

An alternative analysis of these verbs posits that directionality is a fusion of morphemic and deictic gestural elements (Liddell 1990; Liddell 1995; Liddell 2000; Liddell 2003). Within such an analysis, directionality may be analyzed instead as a reference-tracking device through the incorporation of deictic pointing gesture(s) into the verb. Liddell (2003) argues that this type of behavior is similar to the way a nonsigner might point to location(s) associated with a referent while speaking simultaneously (cf. Kendon 2004), though the construction overall is still of course a grammatical one.

Several arguments have been made in support of this view. One argument is that the location towards which a verb is directed appears to be determined by properties of the referent (Liddell 1990; Liddell 2000). In 5 below, the indicating verb ASK moves towards a nonaddressed referent on the signer's right who is physically present. In this case, the location towards which the verb is directed does not depend on any semantic or formal property of the controller noun phrase (as

per Corbett's (2006) agreement definition) but rather on the physical location of the referent. These characteristics have been used to argue that sign languages do not, in fact, exhibit agreement at all (Corbett 2006).

(5) PT$^{\rightarrow 1}$ ASK$^{\rightarrow 3}$
I'll ask her

Secondly, some verbs which are directed towards specific parts of the body can vary in height depending on the physical dimensions of the referent. For example, the ASL sign ASK moves towards the head of a physically present referent. Liddell (2003) argues that, if the addressee were very tall, then the height of the verb would be modified to reflect this physical characteristic. This would be true even if the referent were not physically present. Such behavior suggests that signers are pointing to imagined referents as if they were present. Thirdly, Liddell (2000) argues that if we are to analyze the spatial locations associated with the beginning and end of these verbs as inflectional affixes then we are confronted with a listability problem. There is an infinite number of locations that a signer can point to with these verbs. Thus, creating a list of these forms would be an impossible task, and no model of sign language morphophonology has as yet successfully addressed this problem (although see Wilbur (2013) for a critique of Liddell's listability problem).

2.4. WEIGHING UP THE ARGUMENTS

The arguments put forward about the nature of indicating verbs have been subject to much debate. Some earlier proponents of the agreement analysis have subsequently revised their perspective so as to acknowledge the inherent pointing nature of these verbs. For example, many accept that the actual location that a signer may point to is external to the language and that these verbs must interface closely with a system of deictic gesture (Lillo-Martin & Meier 2011; Mathur & Rathmann 2010). Some of these authors argue that the form of the verb contains abstract indices (which they term as 'referential loci') with the actual spatial location being derived from a grammar-gesture interface. Under such a perspective, the listability problem that Liddell (2000) raises is less of an issue. Alternatively, Aronoff et al. (2005) have argued that agreement need not refer to grammatical categories and listable morphemes and that sign

language agreement is similar to literal alliterative agreement systems in which the target alliterates features of the controller (in this case, the spatial location associated with the noun or pronoun). Additionally, Lillo-Martin and Meier (2011) and Meier and Lillo-Martin (2013) have revised their analysis, arguing instead that directional modification is 'person-marking' at least, and this is the reason it shares some of the features associated with agreement systems (i.e. person and number) in spoken languages.

The debate regarding the status of directionality in indicating verbs is far from resolved. One of the major issues here is that those working in different theoretical traditions make different assumptions about the relationship between speech, sign, and gesture. Many who accept an agreement analysis work within a generative framework where language and gesture are considered separate systems. The morphemic-gestural analysis typically takes a cognitive/functional framework (where gesture may be seen as a part of language) as its starting point. Additional recent work in this tradition includes Rankin (2013) and Ferrara and Johnston (2014) (for an alternative analysis within a cognitive grammar approach which argues that directional verbs do not represent a fusion of morphemic and gestural elements, see Wilcox and Occhino (2016)). An additional issue is the apparent lack of naturalistic data upon which these arguments have been based. Both sides thus far appear to draw mainly on observation, native signer intuitions or experimental data. Very few studies have been conducted where conclusions have been drawn from a large naturalistic language sample. Such studies have the potential to clarify the factors that underlie directionality and reveal relevant new facts about the use of these verbs.

One such study has been conducted based on 2448 indicating verb tokens in narrative data from the Auslan (Australian Sign Language) Corpus (de Beuzeville et al. 2009). This study reported that only 41% of indicating verbs were clearly modified and that high frequency verbs and verbs co-occurring with constructed action (i.e. the use of articulators such as the head, face or the body to mimetically represent a referent's actions, utterances or feelings) were significantly more likely to be modified. The researchers also reported, based on a subset of their data, that object modification was not always present where expected; thus little support was found in the Auslan data for claims that object marking might be obligatory. The authors conclude that their findings

appear to support the analysis proposed by Liddell (2000). The fact that verbs favor modification during periods of constructed action suggests that directionality in indicating verbs may involve some degree of enactment and that signers use them to point to referents whether present or imagined. The relatively low rate of modification also suggests that directionality is not highly grammaticalized and this may be linked to the relative youth of sign languages (no contemporary sign language appears to have a documented continuous history of use longer than three centuries, cf. Woll et al. (2001)).

Studies based on corpora clearly have the potential to give us a clearer picture of what is happening when a verb is modified. However, a detailed analysis based on a range of both internal and external factors linked to modification has yet to be conducted. Such internal factors would include participant role ('person')[8], number, animacy, the presence or absence of an argument within a clause, the verb's position in a clause, the type of clause the verb occurs in, and a verb's overall frequency. External factors linked to modification may include social factors such as the signer's age and language background. Although the Auslan study did not look at social factors, factors such as age have been suggested as important. For example, Engberg-Pedersen (1993) claims that younger signers use modified forms more frequently than older signers in Danish Sign Language and differences in patterns of modification in relation to the body across generations has also been demonstrated using elicited data in a study involving Israeli Sign Language and Al-Sayyid Bedouin Sign Language (Meir 2012; Padden et al. 2010).

3. RESEARCH QUESTIONS

Given previous claims in the sign linguistics literature, we hope to address the following questions: What factors, language internal and external, are associated with directional modification in the class of indicating verbs in BSL conversation? Do we find factors similar to those found in the de Beuzeville et al. (2009) study of Auslan narratives, such as the presence of constructed action and lexical frequency, to be of importance in predicting modification in BSL conversation? Additionally, what roles do other linguistic factors not yet studied in corpus data, such as person, number, animacy, and coreference, play in directional modification? Do syntactic factors such as position in clause or clause type play a role? What role do social factors, such as

age and language background, play? Importantly, we hope to interpret our findings within the context of the two possible analyses discussed above. If an agreement analysis is appropriate, we might expect to find person to be the primary predictor of modification in these verbs, for example, and that marking of arguments is obligatory or at least highly frequent. However, if we find that other factors, constructed action in particular, play a role then this may point away from an agreement and towards a deictic gesture analysis.

4. METHODOLOGY

4.1. BSL CORPUS PROJECT

The study reported here draws on data collected as part of the BSL Corpus Project (Schembri et al. 2014), a large-scale project aiming to produce the first online, open-access corpus of BSL. The BSL Corpus features digital video data collected from 249 deaf signers from eight urban centres around the United Kingdom and partial annotations of these video data. The design and the methodology of the BSL Corpus are outlined in detail in Schembri et al. (2013). For this study, we focus on spontaneous conversation data collected as part of the BSL Corpus Project. The signing produced in this subset of the data is most likely to be indicative of BSL as it is produced in more a naturalistic setting, because participants were free to talk to each other about any topic they wished, without the researchers being present. We analyzed a subsection of the BSL Corpus conversation data: 101 signers from 4 cities in England (25 each from Birmingham, Bristol, and London, and 26 from Manchester) as these regions represent the annotation work that was completed at the time of this study. A 500-sign sample from each of these 101 signers was annotated using identifying glosses (or 'ID glosses')[9] (cf. Fenlon et al. 2014b). In Table 1, the distribution of participants according to several social categories is provided.

	Gender		**Age**				**Ethnicity**		**Language background**		**Total**
	Male	*Female*	*18-35*	*36-50*	*51-64*	*65+*	*White*	*Other*	*Deaf*	*Hearing*	
Birmingham	16	9	7	9	5	4	22	3	11	14	25
Manchester	12	14	6	5	8	7	24	2	7	19	26

London	13	12	6	8	7	4	21	4	13	12	25
Bristol	12	13	3	9	8	5	23	2	16	9	25
	53	**48**	**22**	**31**	**28**	**20**	**90**	**11**	**47**	**54**	**101**

TABLE 1. Distribution of participants according to social categories.

In the following sections, we discuss the methodology of the current study and our motivations for including the range of internal and external factors that we studied.

4.2. PARTICIPANTS

A total of 101 deaf participants were included in the study, representing a nonrandom (i.e. judgment) sample of the British deaf community with attention to a number of social factors including language background, age, gender, and social class. In terms of language background, approximately half (46.5%, n = 47) were native signers (i.e. they had at least one signing parent who was deaf). Of the remaining number (53.5%, n = 54), 51 reported having learnt to sign before 7 years old and 3 reported having learnt to sign between the ages of 8-12. Research has demonstrated that the age of sign language exposure has a considerable effect on sign language proficiency in adulthood (Emmorey 2002; Mayberry 2010); therefore, we might expect to see variation in directional modification reflecting a signer's age of BSL acquisition.

Age-related variation is documented for spoken language at the morphosyntactic level (e.g. Cheshire & Fox 2009). For sign languages, variation according to age has been identified at the lexical level (Stamp et al. 2014) and at the phonological level (Schembri et al. 2009). Since few signers are born to signing parents,[10] large centralized deaf schools appear to play a primary role in transmitting the language from generation to generation. Variation in educational policy within such schools therefore has the potential to impact upon patterns of use. Recruitment in the BSL Corpus Project was designed to reflect this variation by ensuring that participant selection was evenly spread across four age groups (ranging from 16 to 94 years of age). These age groups were partly motivated by changes in language policy in deaf education during the twentieth century (e.g. from education that emphasized the exclusive acquisition of speech and listening skills to increasing acceptance of sign language in the classroom; see Woll & Ladd 2011 for an overview).

Morpho-syntactic variation due to region is well reported for spoken languages (e.g. Cheshire 2003; Cornips & Corrigan 2005; Harris 1984), and region has been found to be important at the phonological and lexical levels (Bayley et al. 2002; Eichmann & Rosenstock 2014; Fenlon et al. 2013; Schembri et al. 2009; Stamp et al. 2014) and in fingerspelling (Sutton-Spence et al. 1990) in sign languages. However, very few studies focusing on sign languages have produced evidence for morphosyntactic variation according to region. The participant sample we selected drew from four regions: Birmingham, Bristol, London, and Manchester. Signers from each region were chosen to take part in the corpus because they were believed to be representative of the signing used in that region. Lastly, since both ethnicity (Fought 2002; McCaskill et al. 2011) and gender (e.g. Rickford et al. 1995; Schembri et al. 2009) are also important variables to consider when investigating sociolinguistic variation in spoken and signed languages; these factors were also included in our analysis.

4.3. DATA CODING

For each of the 101 participants, approximately the first 500 signs produced in the conversational data were annotated and assigned an ID gloss. We identified within this set of 500 signs all tokens that were used as predicating elements in each case regardless of how they may be used in other contexts. However, not all predicative tokens were indicating verbs (e.g. some were plain verbs or other types of predicates). Only indicating verbs with at least one nonlocative argument were included in the study. This resulted in a set of verbs numbering 1612 tokens - approximately 16 tokens of indicating verbs from each participant (although this was later reduced to 1436 tokens, see below). The data was coded by the first author and two research assistants; all of whom are native/fluent signers of BSL. Since annotation was dependent (to an extent) on the coder's interpretation of the utterance, it was also necessary to assess reliability once coding was completed. Approximately 13% of the data (representing 212 tokens across 10 participants) was checked for all the categories described in this section (e.g. animacy, person, number, modification, etc.) by the third author, a fluent user of BSL, who indicated whether she agreed with the coding assigned or not. This produced an agreement level of 95% (i.e. only 5% were tokens that the third author would have coded differently).

For each indicating verb token, we also identified the boundaries of the clause the verb was situated within. Our definition of a clause was taken from the Auslan Corpus annotation guidelines (Johnston 2016). Such a unit is identified with reference to a predicating element (in this case, the verb), arguments of the predicate, and adjuncts associated with the predicating element or its arguments (Johnston 2016; Van Valin & LaPolla 1997). Examples of clauses from the BSL Corpus are provided in 6 - 10. Note that we also referred to prosodic cues as further justification for grouping signs together as clauses; descriptions of sign languages have outlined how prosodic structure is often closely aligned with syntactic structure in sign languages (e.g. Sandler 2010).

(6) [PT:PRO1SG TEACH$^{1\rightarrow X}$ PARENTS]
I taught my parents (to sign).

(7) [WHO GIVE$^{X\rightarrow Y}$ TICKET GIVE$^{X\rightarrow Y}$]
Who did you give the ticket to?

(8) [OVERTIME FATHER MOTHER THINK DISCUSS$^{X\leftrightarrow Y}$]
Over time, my father and mother thought about it and discussed it.

(9) [PT:POSS3SG FATHER ASK$^{X\rightarrow 1}$][GO-TO WEST-HAM]
His father asked me to go to West Ham with him.

(10) [IF FS:MIDDLESBROUGH TOP][MEAN HARD TAKE]
If Middlesbrough were at the top, it would be hard for me to get tickets.

For example, in 6, TEACH has been identified as a predicating element and PT:PRO1SG (a first person singular pronoun) and PARENTS are identified as arguments of the verb. This is marked as a single clause. As a rule, we typically identify one main verb (or predicating element) to a clause. However, a clause could contain more than one verb. This was the case if a verb was doubled as in 7, if the clause contained serial verbs as in 8, or if there was an embedded clause structure as in 9. In order to assist with identifying coreference, the clause immediately preceding the clause with the indicating verb token was also annotated. Following segmentation, we identified the agent and the patient of the clause.[11] For example, in 6, the agent of TEACH is represented by PT:PRO1SG and PARENTS is the patient. For each clause, the agent, the patient and other semantic roles were identified. It was also noted whether the agent and patient (or other

roles) were overtly expressed as noun phrases within the clause. For example, in 7 above, the beneficiary of the verb GIVE is described as nonovertly expressed.

Once the agent and patient were identified, we also coded each argument for a range of linguistic features. These were person, number, animacy, and coreference. All arguments were coded for whether they represented first, second, or third person – that is, whether they involved reference to the self, addressed participant(s) or nonaddressed participant(s). Arguments for which person was difficult to establish were marked as indeterminate for person. For number, arguments were categorized as singular, plural or indeterminate. It should be noted that it was frequently difficult to determine whether an argument should be treated as plural because there was often little distinction made in form (e.g. points to plural referents in our dataset were often points to a single location). Meaning can be ambiguous as well, particularly with nonspecific referents (e.g. it was often difficult to tell if a sign like WOMAN referred to just one woman or several women or if it was generic). Such tokens were labeled as indeterminate for plurality whether due to form or meaning or both. For animacy, arguments were categorized as animate-human, animate-animals/groups, inanimate, or indeterminate. Animate-human arguments are human beings (individuals or multiple people). The category of 'animate-animals/groups' includes nonhuman animates such as animals; it also includes groups/organisations displaying some degree of group identity such as the deaf community, a school, a football club, and so on. Inanimate arguments are referents that are not an animate being, such as a pen, table, window, or newspaper. Arguments which could not be placed in any of these categories were labeled indeterminate for animacy. This included tokens for which it was difficult to determine if the verb indicated an animate/inanimate or locative argument (e.g. LOOK could be modified so that it is oriented towards a specific object situated at a specific location, but it is not always clear whether the looked at referent was the object 'look at x' or the location 'look there' as the form in each case would be identical). We also established if the arguments in the target clause were coreferential with the preceding clause (identified using the criteria set out above). An argument was determined as coreferential if it matched an argument in the preceding clause; conversely, an argument was considered as noncoreferential if it did not match an argument in the preceding clause. We also indicated whether the verb's argument was coreferential with a noun, a pronoun, or a null argument in the previous clause. We also considered coreference across conversational

partners (e.g. if the preceding clause was produced by the conversational partner, we looked at the clause they produced to determine coreference).

In addition, we created a category 'person:agent/patient' to enable us to inspect the relationship between the agent and the patient with respect to person. This is important because the statistical analysis focuses on the agent and patient separately without any consideration of the relationship between the two. We wanted to explore for example whether we can expect to see modification for the agent when the construction in question involves a first person agent and a nonfirst (i.e. second and third person combined) person patient. Alternatively, can we expect to see modification for the patient when the construction involves a nonfirst person agent and a first person patient? To investigate this, each verb token was coded for the following categories: first person agent to nonfirst person patient, nonfirst person agent to first person patient, and nonfirst person agent to nonfirst person patient.

Given previous work that argued for the role of indicating verbs in syntax (Fischer 1975; Quadros 1999; Quadros & Lillo-Martin 2010), we also considered syntactic factors such as clause type, verb position, and whether the agent or patient arguments were overtly expressed as a noun phrase or not.[12] For clause type, we considered 'simple clauses' versus 'complex clauses', based in part on the Auslan Annotation Guidelines (Johnston 2016). A simple clause is one that does not enter into a dependency relationship with other neighboring clauses but stands on its own as in 6. Complex clauses are clauses that share some kind of relationship with neighbouring clauses such as the matrix and subordinate clauses in 9 and independent and dependent clauses as in 10. In addition to clause type, we also indicated the verb's position in the clause, given previous claims that in clauses involving agreement verbs, the verb occurs in final position after arguments have been established in space (e.g. Fischer 1975). To see if this is reflected in our data, we coded whether the verb token was clause-final, nonfinal, or a verb-only clause. Clauses that were joined with neighboring clauses were considered a single unit when deciding verb position (e.g. in 9, the verb ASK would be labeled nonfinal).

For each indicating verb token, modification was coded for both the agent and the patient. Verbs were judged as unmodified, modified, congruent, or indeterminate. Signs judged as unmodified

did not differ from citation form (the citation form typically involves movement from a location near/touching the signer towards a location directly in front of the signer). Signs judged as congruent were signs in which it was impossible to tell whether such signs were modified or not because the locations associated with the arguments in question were identical to the locations associated with the citation form of the verb. Signs judged as modified were signs that differed from the citation form. In Figure 2, the three categories with respect to the agent and the patient are illustrated using the BSL sign GIVE. Note that the initial location (when considering agent modification) and the final location (when considering patient modification) of the unmodified and congruent versions are identical to each other; they only differ in that, for a sign to be coded as congruent, either the context relates to actions involving a first person agent and second person patient, or the signer explicitly established the argument(s) directly in front of him/herself along the sagittal axis previously in discourse. Signs judged as indeterminate were those in which it could not be determined whether the sign was identical to citation form (moving directly forward in front of the signer) or different from citation form (and thus modified). This issue occurred most often due to the seating arrangement of the participants (i.e. participants were filmed from an angle which, at times, slightly obscured whether a sign had shifted in space).

Agent of GIVE (typically the starting location of the verb)		
		
Unmodified for agent	Modified for agent	Congruent for agent
Verb begins at a location near the signer and either does not correspond to a location set up for the agent or no location was established prior to the	Verb begins at a location other than near the signer (e.g. away from the signer)	Verb begins at a location near the signer (as in citation form) which matches the location of the agent (e.g. referent is the signer)

verb's articulation		
Patient of GIVE (typically the end location of the verb)		
		
Unmodified for patient	Modified for patient	Congruent for patient
Verb ends at a location in front of / away from the signer on the sagittal axis and either does not correspond to a location set up for the patient or no location was established prior to the verb's articulation	Verb ends at a location other than the one in front of the signer along the sagittal axis (e.g. to the left)	Verb ends at a location in front of / away from the signer (as in citation form) which matches the location for the referent (e.g. referent is the addressee)

FIGURE 2. Citation form of GIVE and three categories of unmodified, modified, and congruent for agent and patient

Because a systematic study of the modification potential of all BSL indicating verb signs had not been undertaken at the time the study began, all indicating verbs were coded as potentially modifiable for agent and patient (i.e. we assumed all verbs in our data were lexically specified for modification). This was the case even if the beginning of the verb was a single indicating verb, anchored to the body (e.g. the BSL sign SAY which begins at the signer's lips). Following coding, signs that were consistently unmodified for either agent or patient were changed from 'unmodified' to 'not applicable' for either agent or patient modification. Verbs that were excluded on the basis of never being modified in our data were CONTROL, OBJECT, OFFER, DEPEND4. Some verbs, such as LOOK, PUSH, THANK, ACCEPT, and CHECK, were only modified for

one argument in our data (these verbs were never modified for agent). In these cases, we changed all the coded data for agent modification from 'unmodified' to 'not applicable' so that they would be excluded from the analysis. Thus, we determined which forms acted as indicating verbs on the basis of the data from the corpus itself.

Following de Beuzeville et al. (2009), we also expected that lexical frequency could be a factor predicting directional modification in BSL (cf. Bybee, 2006 for frequency effects in spoken languages). That is, more frequent indicating verbs may show greater variability in form and allow for more spatial modifications. To include lexical frequency as a factor in our analysis, verbs that were within the top ten most frequent signs in our dataset of 1612 tokens were classed as high frequency verbs with all others classed as low frequency verbs. Verbs that were marked as high frequency (SAY, LOOK, LOOK2, MEET, GIVE, PAY, DISCUSS, GIVE-INFORMATION, ASK, TEACH) represented 56% (n = 909 tokens) of 1612 tokens.

Lastly, we also coded for presence and absence of constructed action (elements of enactment) (Metzger 1995). A distinction can also be made between overt displays of constructed action (e.g. involving the whole body) and minimal displays of constructed action (e.g. involving the use of facial expression or eye gaze alone). For the purpose of this study, we define constructed action broadly, as the use of one or more articulators (e.g. head, face, eyegaze, body, arms, and/or hands) to mimetically represent a referent's actions, utterances or feelings (Cormier et al. 2015c). Following this definition, we coded constructed action as either present or absent. An example of the use of constructed action with the lexical verb LEARN is provided in Figure 3. In this example, the articulators involved in this use of constructed action are the eyes, facial expression, the head, and the torso, and the signer is representing herself in the past (when she attended school while young and learnt to sign from her peers). Her facial expression and mouth action convey the sense of surprise and wonder she experienced as she learned BSL for the first time from her deaf peers at school.

FIGURE 3. Constructed action with the lexical sign LEARN

For the statistical analysis, we used the variable rule program Rbrul (Johnson 2009) to quantitatively determine the effect of several factors (i.e. the linguistic and social factors) on a binary linguistic variable (i.e. whether the target was modified or unmodified) using a mixed effects model, with participant and lexical item as random effects and all other independent variables as fixed effects. Rbrul reports its results using both factor weights and log odds. A factor weight between .50 and 1.00, or a positive log odd result, means that this particular factor 'favors' the use of the modified indicating verb (i.e. modification is more likely to occur), while a weight between 0 and .50, or a negative log odd result, indicates that it 'disfavors' the modified form (i.e. modification is less likely to occur) (Tagliamonte 2006). Although we discuss results in term of favoring or disfavoring modification, factor weights and log odds should be considered in relation to other factor weights and log odds within each category (e.g., a higher factor weight for first person and a lower factor weight for third person means first person strongly favors modification when compared to third person). Additionally, although we use a positive/negative log odd value and a cut-off point of .50 to interpret results as either favoring or disfavoring modification, a log odd close to 0 or a factor weight close to .50 may be interpreted as being relatively neutral with respect to modification. Again, what is important is its relative position with respect to the other values within a given category. Rbrul also tests the significance of each factor's effect on the use of modification, and the relative strength of the influence of each factor when compared to other factors. As Rbrul requires a binary dependent variable, we had to re-organize the categories described above for determining modification (modified,

unmodified, congruent, indeterminate). Since it is impossible to decide if congruent tokens were either modified or unmodified, we treated all congruent tokens as modified (i.e. modified and congruent were collapsed into a single category) in the first instance. We also conducted a second analysis with congruent tokens excluded for comparison. It was expected that we could be more confident that a given factor had a significant effect on modification if it appeared to be significant in both analyses. Factors that were only significant in one type of analysis may have a significant effect on modification but this significance would be dependent on how these congruent tokens are to be interpreted. Finally, since the categories of person and 'person:agent/patient' are closely related with one another, person was run separately from the main analyses each time (since Rbrul assumes that all factors are independent).

Lastly, our statistical analysis was based on a reduced dataset of 1436 tokens from the 1612 tokens. The reduced number reflects the fact that we only focus on tokens within our dataset in which all the factors mentioned in this section could be coded for and therefore we can accurately assess how these factors may or may not be competing with one another. Therefore, 176 tokens were excluded from the analysis on the basis that not all factors we focus on here were applicable to them. The majority of these tokens (n = 159) were verbs that took only one argument and therefore for which the category of person:agent/patient was not applicable (i.e. the statistical analysis could not take these tokens into account).

In summary, the following linguistic factors were included in our analysis for agent and patient modification: person, person:agent/patient, number, coreference, animacy, lexical frequency, presence vs. absence of constructed action, overtly expressed (i.e. by means of a noun phrase) versus nonovertly expressed arguments, verb position in clause, and clause type. The following social factors were included in our analysis for both agent and patient modification: region, gender, age, ethnicity, and language background.

5. RESULTS

Our analysis focuses on 1436 tokens, representing 81 verb types. A table listing all the indicating verbs in the statistical analysis according to frequency is provided in the appendix, along with

information on whether a verb could be modified for the agent or the patient.[13] The top 10 and top 50 verbs account for a significant proportion of the overall dataset: 57.0% and 93.6% respectively. In the following sections, we provide an overview of the rate of modification for our 1436 tokens[14] as well as the results of our statistical analysis.

5.1. RATE OF MODIFICATION FOR AGENT AND PATIENT

In Table 2, the rate of modification for agent and patient is provided according to the following modification categories: modified, unmodified, congruent, and indeterminate. As some verbs within our set of 1436 ultimately did not appear to be modified for agent or patient (e.g. LOOK was never modified for the agent in our data and therefore was excluded from the analysis regarding agent modification), they were excluded from the analysis. This meant that for an analysis of agent modification, 1019 tokens were included. For patient modification, we analysed 1278 tokens.

	Agent		Patient	
Modified	291	27%	731	52%
Congruent	401	38%	186	13%
Unmodified	327	31%	361	26%
Indeterminate	47	4%	137	10%
Total	1019	100%	1278	100%

TABLE 2. Rate of modification for both agent and patient

Table 2 shows that 27% of our tokens were clearly modified for agent. Tokens classed as congruent represented the largest category, 38%. If one assumes that the congruent tokens are all actually modified, then grouping these together results in a maximum of 65% of our tokens being modified for agent. Table 2 also shows that more tokens were clearly modified for the patient than for the agent (52% compared to 27%). Verbs classed as congruent came to 13%. Again, if both the modified and congruent categories are combined, adopting a generous definition of modified verbs, then up to 65% of our dataset could be considered modified for patient arguments. In the following sections, the factors concerning agent and patient modification are reported.

5.2. FACTORS INFLUENCING AGENT MODIFICATION

MODIFIED/CONGRUENT VS. UNMODIFIED

In Table 3, the factors influencing agent modification are shown. As Rbrul requires a binary dependent variable, we collapsed the subcategories of modified verb and congruent verbs into a single category representing all forms of modification. As mentioned above, due to a high degree of interaction with 'person:agent/patient', the results concerning person which are also presented in Table 3 were obtained from a separate analysis (indicated by a carat ^).

	Tokens	% modified	Log-odds	Factor weights
Person:agent/patient (p <0.001)				
First to Non-First	373	95.2	2.304	0.909
Non-First to First	278	66.5	0.145	0.536
Indeterminate	61	37.7	-0.872	0.295
Non-First to Non-First	307	42.0	-1.577	0.171
Coreference (p <0.01)				
Indeterminate	36	72.2	0.695	0.667
Coreference (null argument)	218	78.4	0.489	0.620
No coreference	515	65.4	-0.204	0.449
Coreference (pronoun)	192	68.2	-0.486	0.381
Coreference (noun)	58	46.6	-0.494	0.379
Verb position (p <0.05)				
Final	293	79.2	0.314	0.578
Verb-only	138	80.4	0.066	0.517
Non-final	588	59.4	-0.380	0.406
Constructed action (p <0.05)				
Constructed action	645	72.7	0.394	0.597

No constructed action	325	61.2	0.198	0.549
Indeterminate	49	49.0	-0.592	0.356
^Person (p <0.001)				
First	380	95.0	2.431	0.919
Third	528	51.9	-0.697	0.332
Second	94	52.1	-0.743	0.322
Indeterminate	17	47.1	-0.992	0.271

TABLE 3. Significant factors influencing agent modification in indicating verbs (with 'congruent' as 'modified')

In Table 3, five factor groups were found to be significant in predicting agent modification: person:agent/patient ($p < 0.001$), coreference ($p < 0.01$), verb position ($p < 0.05$), constructed action ($p < 0.05$) and person ($p < 0.001$). For person:agent/patient, the strongest factor (moving from a first person agent to a nonfirst patient) strongly favored agent modification (2.304) while moving from a nonfirst agent to first person patient slightly favored agent modification (0.145). Indeterminate tokens and moving from a nonfirst agent to a nonfirst patient both disfavored agent modification (-0.872 and -1.577 respectively). The second strongest factor was coreference. Tokens indeterminate for coreference favored agent modification (0.695) followed by tokens that were coreferential with a null argument in the previous clause (0.489). Tokens that were coreferential with a noun or a pronoun in the previous clause were most likely to disfavor agent modification (-0.494 and -0.486 respectively) compared to tokens that were not coreferential at all (-0.204). The next significant factor was verb position in clause. Here, verb final favored agent modification (0.314) while verb-only clauses appeared to be neutral (0.066). In contrast, nonfinal verbs disfavored agent modification (-0.380). The next most significant factor was constructed action. Here verbs with constructed action were more likely to occur with modification (0.394) than verbs that did not display any evidence of constructed action (0.198). Verbs that were indeterminate (i.e. we could not determine if there was evidence of constructed action) disfavored agent modification (-0.592). Finally, in a separate analysis, person was also significant with first person agents favoring agent modification (2.431) while indeterminate

tokens, second person agents, and third person agents all disfavored agent modification (-0.697, -0.743, -0.992 respectively).

MODIFIED VS. UNMODIFIED (CONGRUENT EXCLUDED)

An alternative analysis for agent modification was also conducted in which 'congruent' tokens were excluded. The results for this analysis are presented in Table 4.

	Tokens	% modified	Log-odds	Factor weights
Person:agent/patient (p <0.001)				
Non-First to First	271	65.7	2.192	0.899
First to Non-First	58	69.0	0.141	0.535
Indeterminate	51	25.5	-0.378	0.407
Non-First to Non-First	238	25.2	-1.955	0.124
Coreference (p <0.05)				
Indeterminate	27	63.0	1.153	0.760
Coreference (null argument)	103	54.4	0.356	0.588
No coreference	345	48.4	0.048	0.512
Coreference (pronoun)	97	37.1	-0.592	0.356
Coreference (noun)	46	32.6	-0.966	0.276
Verb position (p <0.05)				
Final	152	59.9	0.430	0.606
Verb-only	69	60.9	0.022	0.505
Non-final	397	39.8	-0.452	0.389

TABLE 4. Significant factors influencing agent modification in indicating verbs (with 'congruent' tokens excluded)

In contrast to the first analysis reported in Table 3, when congruent tokens are excluded as in the second analysis, constructed action and person are no longer significant factors. Coreference and

verb position are significant in both analyses in similar ways (e.g. final and verb-only clauses favor agent modification in both analyses). For person:agent/patient (the strongest factor predicting modification), nonfirst agents to first person patients strongly favor agent modification (2.192). In contrast, first person agents to nonfirst patients show a tendency towards agent modification (0.141). Additionally, nonfirst agents to nonfirst patients strongly disfavor agent modification (-1.955) as do tokens that are indeterminate (-0.378). The difference in the category of person:agent/patient can be explained with reference to how congruent tokens align with first person forms (see Section 6.2). The remaining linguistic categories (number, present/absent agents, clause type, frequency, animacy) as well as all the social categories (language background, region, age, ethnicity, and gender) did not play a significant role in agent modification in either analysis of our data.

5.3. FACTORS INFLUENCING PATIENT MODIFICATION

MODIFIED/CONGRUENT VS. UNMODIFIED

In contrast to factors influencing agent modification, more factors appear to be at play when we look at patient modification, when collapsing modified and congruent tokens together versus unmodified tokens. The relevant factors are outlined in Table 5. Significant factors mentioned in this table are also listed in order of importance.

	Tokens	% modified	Log-odds	Factor weights
Constructed action (p <0.001)				
Indeterminate	56	78.6	0.238	0.559
CA	785	77.7	0.228	0.557
No CA	437	61.8	-0.466	0.386
Person:agent/patient (p <0.001)				
Non-First to First	269	80.7	0.461	0.613
First to Non-First	540	75.9	0.213	0.553
Indeterminate	67	64.2	-0.206	0.449
Non-first to Non-first	402	63.2	-0.468	0.385

Animacy (p <0.001)				
Animates-animals/groups	124	72.6	0.283	0.570
Indeterminate	144	76.4	0.207	0.551
Animates-human	802	75.9	0.183	0.546
Inanimates	208	55.3	-0.673	0.338
Coreference (p <0.05)				
Coreference (null agent/patient)	253	83.0	0.401	0.599
Coreference (noun)	84	77.4	0.397	0.598
Coreference (pronoun)	132	77.3	-0.014	0.497
No coreference	739	67.7	-0.345	0.415
Indeterminate	70	67.1	-0.440	0.392
Verb position (p <0.05)				
Verb-only	184	83.7	0.304	0.575
Final	368	80.7	0.039	0.510
Non-final	726	65.2	-0.343	0.415
^Person (p <0.05)				
Second	60	80.0	0.522	0.628
First	269	80.7	0.405	0.600
Third	920	69.9	-0.281	0.430
Indeterminate	29	55.2	-0.646	0.344

TABLE 5. Significant factors influencing patient modification (with 'congruent' tokens as 'modified')

Table 5 shows five factors found to be significant in predicting patient modification. In order of importance, they are constructed action ($p < 0.001$), person:agent/patient ($p < 0.001$), animacy ($p < 0.001$), coreference ($p < 0.05$), verb position ($p < 0.05$), and (in a separate analysis) person ($p < 0.05$). Within the category of constructed action (the most important factor), we see that tokens indeterminate for constructed action (0.238) and the presence of constructed action (0.228) favor

patient modification similarly, while tokens that did not have constructed action disfavored patient modification (-0.466). The next most important factor is person:agent/patient. Clauses with nonfirst person agents and first person patients favored modification for the patient (0.461) followed by clauses with first person agents to nonfirst person patients (0.213). Conversely, clauses with nonfirst agents and patients were most likely to disfavor patient modification followed by indeterminate tokens (-0.468 and -0.206 respectively). Animacy is the next most important factor. Here, animates-animals/groups, tokens indeterminate for animacy, and animates-human arguments all favor patient modification in that order (0.283, 0.207, 0.183 respectively) while inanimate arguments clearly disfavor patient modification (-0.673). This is followed by coreference: if the patient is coreferential with a null argument in the preceding clause then it was likely that we would see the verb modified for the patient (0.401). This was also the case (at a similar rate) if the patient was coreferential with a noun in the previous clause (0.397). Conversely, if the patient was coreferential with a pronoun (-0.014), there did not seem to be a tendency to favor or disfavor modification. However, tokens that were not coreferential (-0.345), or were indeterminate (-0.440) disfavored patient modification. Syntactic factors are also important. Verb-only clauses significantly favor patient modification (0.304) while verb-final clauses seem to be neutral with regards to modification (0.039). However, verbs in nonfinal position clearly disfavor patient modification (-0.343). Finally, in a separate analysis, person was also a strong factor. Second person patients and first person patients both favored patient modification (0.522 and 0.405 respectively) and third person patients as well as tokens indeterminate for person both disfavored modification for the patient (-0.281 and -0.646). All other linguistic and social factors (i.e. clause type, frequency, overt vs. nonovert arguments, age, region, gender, language background) were not found to be significant for patient modification.

MODIFIED VS. UNMODIFIED (CONGRUENT EXCLUDED)

When 'congruent' tokens are excluded from the analysis for patient, a similar set of results is obtained. These results are presented with factors in order of importance in Table 6.

	Tokens	% modified	Log-odds	Factor weights
Person:agent/patient (p <0.001)				

Non-First to First	269	78.1	0.736	0.676
First to Non-First	421	69.1	0.122	0.531
Indeterminate	54	55.6	-0.395	0.402
Non-First to Non-First	348	57.5	-0.463	0.386
Constructed action (p <0.001)				
CA	666	72.8	0.286	0.571
Indeterminate	43	72.1	0.126	0.532
No CA	383	56.1	-0.413	0.398
Animacy (p <0.001)				
Animates-animals/groups	98	65.3	0.322	0.580
Animates-human	708	71.9	0.293	0.573
Indeterminate	115	69.6	0.111	0.528
Inanimates	171	45.6	-0.726	0.326
***Person (p <0.001)**				
Second	56	78.6	0.824	0.695
First	269	78.1	0.757	0.681
Third	743	62.7	-0.604	0.353
Indeterminate	24	45.8	-0.976	0.274

TABLE 6. Significant factors influencing patient modification (with 'congruent' tokens excluded)

Overall, similar results to Table 5 are observed when congruent tokens are excluded. Person:agent/patient (the strongest factor) and person both pattern in similar ways to Table 5. Some minor differences can be seen within the categories of constructed action and animacy. For constructed action, the presence of constructed action (0.286) now favors modification more than indeterminate tokens (0.126) although both continue to favor modification overall. For animacy, animate-human arguments now favor modification more than tokens indeterminate for animacy (0.293 and 0.111 respectively) although both continue to favor modification overall. In contrast to Table 5 however, coreference and verb position are no longer significant. Additionally, the

remaining linguistic factors (clause type, overt versus nonovert arguments, and frequency) as well as all the social factors are not significant factors linked to modification for patient.

6. DISCUSSION

In this section, we review our results with reference to previous literature on verb modification in sign language. In short, our results reveal that modification is optional and conditioned by a number of factors. Our results also highlight that similar factors are implicated in agent and patient modification. When these results are interpreted in light of the debate referred to in Section 2 regarding the nature of these verbs, they appear to provide some support for the indicating verb analysis proposed by Liddell (2003) (i.e. the claim that these verbs involve a fusion of morphemic and deictic gestural elements).

6.1. MODIFICATION APPEARS TO BE OPTIONAL

The results provided in Table 2 indicate that modification for both agent and patient arguments is optional. Depending on what is considered to constitute modification, tokens clearly modified for the agent account for at least 27% of the overall dataset while tokens clearly modified for the patient account for at least 52%. If we combine the categories of modified and congruent, we observe a similar rate of modification for both agent (65%) and patient (65%). However, even when these categories are combined, we do not observe a rate of modification that suggests that this phenomenon is obligatory for either the agent or patient argument. In addition, recall that we determined which forms acted as indicating verbs on the basis of the data from the corpus itself and therefore excluded verbs that were never modified, including some verbs that previously have been assumed to be indicating verbs in BSL (e.g. TO-OBJECT). If we had included such verbs in our analysis (since it may be that these verbs can be modified but happened to be unmodified consistently within our dataset), then the overall rate of modification would have been even lower than what we report here. In Figure 4, we provide an example from our dataset demonstrating when modification for both the agent and the patient does not occur.

			
PT:PRO3SG	TEASE	PT:DETPL	DOG
She (My dog) teases the other dogs			

FIGURE 4. TEASE unmodified for the agent and patient

In Figure 4, agent modification does not occur even when following a pronoun associating the agent with a location in front of the signer. In addition, TEASE is not modified for the patient (PT:DETPL DOG) which is associated with a location on the signer's left following the articulation of the verb. In fact, the location in space associated with the patient noun phrase is at odds with the final location of the verb TEASE. (If it were modified, the dominant hand (and/or the forearm) would be adjusted so that the fingertips were facing the location on the signer's left.) These results appear to differ from claims made in the sign language literature by Morgan et al. (2006) who have assumed that modification for the object is obligatory in BSL. These results also have implications for work by Lillo-Martin and Meier (2011) and Quadros and Lillo-Martin (2007) who make the same assumption about obligatory patient modification of indicating verbs in ASL and Brazilian Sign Language respectively. Interestingly, examples of optionality with regard to agreement marking in spoken languages can be found in the literature. Reid (1997), for example, outlines how gender agreement is optional in the Australian language Ngan'gityermerri. With regards to optionality in grammatical morphology more generally, Minashima (2001) shows how case marking in Japanese is often omitted in colloquial speech and its omission can be explained with reference to animacy and definiteness. That is, nouns which are low in animacy and low in definiteness frequently omit the accusative case marker in Japanese. Such work suggest that the optionality regarding agent and patient modification may be explained with reference to similar factors which we describe in the following sections. Importantly, while the finding that modification is not obligatory is insufficient grounds to conclude that modification is not an agreement phenomenon, it does contradict a widely-held assumption with regards to patient modification in the sign language literature.

The results in Table 2 suggest that patient modification might play a more important role than agent modification – this has also been suggested previously by Padden (1988) and others. In our data, there are more tokens of verbs clearly modified for patient (excluding the congruent category) when compared to agent (52% compared to 27%). However, there is also a larger proportion of verbs labeled as being congruent with their agent argument (37% compared to 13% with the same category for patient). The large difference between the two can be explained by the high incidence of first person agents in our data and the relationship between this form and a verb's citation form. It is generally the case that an indicating verb citation form begins on the body which is the same location as first person. As first person agents were frequent in our data, this has led to a high number of 'congruent' verbs in which is impossible to determine whether a verb is modified or not for agent. However, our findings for agent modification in terms of optionality are generally consistent with what others have claimed about subject agreement for ASL and several other sign languages – that is, that agent modification is optional, not obligatory.

6.2. LINGUISTIC AND SOCIAL FACTORS INVOLVED IN MODIFICATION

The statistical analysis revealed that several factors are associated with agent and patient modification in BSL. For agent modification, these factors are person, person:agent/patient, coreference, verb position, and constructed action. In an analysis excluding tokens congruent for agent modification, all these factors except for constructed action and person remained significant. For patient modification, factors similar to agent modification were important. These were person, person:agent/patient, constructed action, coreference, animacy, and verb position. In a second analysis excluding tokens congruent for patient modification, all these factors except coreference and verb position remained significant. In the following sections, we discuss these factors in detail and how they contribute to our current understanding regarding the nature of indicating verbs in sign languages. It should be noted that although we describe several important factors that have an influence on where and when modification occurs, other factors which may be more subtle may be at play here which the study has not been able to identify. Therefore, the factors we discuss below should not be considered an exhaustive description of patterns of modification in BSL.

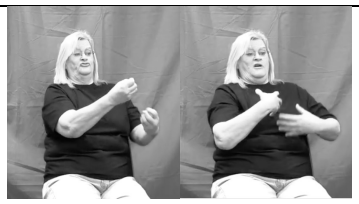
PERSON AND PERSON:AGENT/PATIENT

The results of the statistical analyses conducted for both agent and patient modification with regards to the categories of person and person:agent/patient consistently suggest that first person arguments can predict when a verb will be spatially modified in BSL. Generally, first person agents favor agent modification and first person patients favor patient modification. For agent modification, second and third person agents both disfavor modification. For patient modification, second person patients also favor patient modification while third person patients do not. The strong finding in Table 3 may be argued to be a reflection of the fact that with agent modification, congruent tokens can only have first person agents (i.e. the citation form of these verbs align with first person agents and therefore cannot be distinguished from modified forms). The fact that these congruent tokens have an effect on the result can be seen in Table 4 when congruent tokens are excluded from the analysis; here, person is no longer significant for agent modification. It seems, therefore, that the relationship between agent modification and person depends heavily on our interpretation of congruent tokens. Our findings concerning agent modification also differ from claims regarding Hong Kong Sign Language (Lam 2003, cited in Tang et al. 2008) where subject agreement is considered obligatory with second person subjects. However parallels can be made with the claim by the same authors that modification is obligatory for first person objects in HKSL (although we did not find that modification was obligatory for any arguments, regardless of person).

For patient modification, we suspect that the tendency for second and first person referents to favor modification may represent a distinction between present and nonpresent referents (i.e. physically present referents). That is, it is likely that a point to a second person patient refers to one's conversational partner and a point to a first person patient refers to the self. Given that our data involves conversation between only two participants, a point to a third person patient is very likely to be a point to a nonpresent referent represented by an 'empty' location in space as there is no physical referent present to act as a third person. If we view the person distinction as a distinction between present (i.e. first and second person) and nonpresent (i.e. third person) referents, then we might say that present referents strongly favor modification for the patient while nonpresent referents disfavor patient modification. It is also interesting to note that while Lam (2003, cited in Tang et al. 2008) observes that overt second person subjects and first person

objects are obligatory in HKSL, these arguments are also likely to be physically present referents which is consistent with our conclusions here. For BSL, only first person agents favor modification while both second and first person patients favor modification. This may reflect a distinction between present versus nonpresent referents but only with regards to patient modification in BSL.

The importance of first person (i.e. the signer) is further emphasized in the category of person:agent/patient which is often the strongest predictor for agent and patient modification. That is, it is whether either argument is first person that predicts when we will see modification for either the agent or the patient. For example, in Table 3, clauses with first person agents and nonfirst person patients strongly favor agent modification. Clauses with nonfirst person agents and first person patients slightly favor agent modification. Clauses that consist of nonfirst person agents and nonfirst person patients strongly disfavor agent modification. In Table 4, when congruent tokens are excluded, clauses with first person agents and nonfirst person patients appear neutral with respect to agent modification. However, this reduction in strength is expected since congruent tokens can only have first person agents so therefore, given that we treat congruent tokens as modified in Table 3, the strong preference for agent modification is reduced substantially once congruent tokens (401 in total) are excluded from the analysis (note that there are 373 clauses with first person agents to nonfirst patients in Table 3 but only 58 clauses of the same category in Table 4). What is notable, however, is that clauses with nonfirst person agents and with first person patients strongly favor agent modification (2.192) in Table 4 in comparison to other categories. This is demonstrated in Figure 5 where the verb GIVE-INFORMATION is modified for a third person agent and a first person patient.



GIVE-INFORMATION

FIRST SANDRA GIVE-INFORMATION YESTERDAY PT:PRO3SG

Sandra told me yesterday

FIGURE 5. GIVE-INFORMATION modified for a third person agent and first person patient

What appears to be an important predictor for agent modification here is whether the patient is first person since this indicates that the verb will likely be articulated in line with the signer's perspective. This is supported by the observation that clauses involving nonfirst agents and nonfirst patients (i.e. clauses that do not involve first person agents or patients) do not favor agent modification as in Figure 4. Here, neither argument is linked to the signer's perspective so we see less tendency towards modification. Similar results are reported for patient modification. As with the agent, verbs are more likely to be modified for the patient when the patient is first person as in Figure 5.[15] Clauses with first person agents and nonfirst patients appear to be neutral with respect to patient modification in comparison. When neither the agent nor the patient is first person (as in Figures 4 and 7), we do not observe a significant tendency towards patient modification. This suggests that modification generally reflects a signer's egocentric perspective of events.

When indicating verbs are described in the context of an agreement system, they are often said to encode grammatical person and syntactic roles (e.g. Meir et al. 2007). Our finding here suggests otherwise. Modification of indicating verbs is strongly associated with the signer's body and whether the signer's body is associated with an agent or patient argument. Second person shows only a tendency towards patient modification but we argue that this reflects the presence of a conversational partner (and this effect is not apparent with second person agents). Third person does not appear to favor modification at all. The patterns of modification can be explained with reference to perspective and the strong association of the body with the role of first person. This implies that signers are not simply modifying verbs in space to mark arguments but that they are imagining how an action is carried out from their perspective. Indicating verbs, therefore, may be best explained with reference to mental spaces (Janzen 2004; Liddell 2003). That is, modification of verbs reflects the signer's egocentric conceptualization of an event. We frequently see modification with first person arguments because first person is strongly associated with the body and signers frequently conceptualize events from this perspective. The

fact that directional modification may be interpreted within an egocentric framework has been suggested for other sign languages such as Auslan (Johnston 1991). The tendency for third person arguments to disfavor modification may also reflect a general tendency for third person to be the category that is least marked morphologically (e.g. Farrell 1990).

CONSTRUCTED ACTION

Constructed action is also an important factor associated with both agent and patient modification. For the agent, the presence of constructed action displays a stronger tendency for agent modification than the absence of constructed action although both favor modification for the agent overall. Note that when congruent tokens are excluded from the agent analysis, constructed action is no longer significant. Therefore, the result regarding constructed action with respect to agent modification should be interpreted with caution since this result relies on how congruent tokens are to be interpreted. Constructed action is however important in predicting patient modification. Here the presence of constructed action slightly favors patient modification while the absence of constructed action disfavors modification, whether congruent tokens are considered modified or not. Our results are similar to previous work in Auslan by de Beuzeville et al. (2009) who also found that constructed action plays an important role in predicting verb modification. These findings lend support to Liddell's (2000) analysis of these verbs as a fusion of morphemes and deictic gestures. During periods of constructed action, signers appear to be interacting with absent referents as if they were physically present within the signing space as in Figure 6 where LOOK2 is produced with constructed action. The fact that we observe an increased likelihood in modification during periods of constructed action suggests that signers may be pointing to imagined referents (see also Cormier et al. 2015b).


PT:PRO1SG	LOOK2
I looked at her	

FIGURE 6. LOOK2 with constructed action and modified for the patient

Taken together, the factors of person, person:agent/patient, and constructed action all suggest that signers are frequently conceptualizing referents in signing space and modifying verbs to reflect this conceptualization. It also appears that this tendency towards conceptualization is more common with first person arguments generally. These factors all align closely with Liddell's (2003) account of indicating verbs. Other factors are also at play but these factors are consistently amongst the strongest predictors with regards to verb modification.

VERB POSITION

Verb position is also an important predictor. Generally, verb final and verb-only clauses favor modification (or seem to be neutral in this respect) for the agent and patient while nonfinal verbs consistently disfavor modification. Note however that verb position is no longer significant for patient modification in Table 6 when congruent tokens are excluded. The fact that verbs in final position and verb-only clauses sometimes favor modification is consistent with similar reports for ASL (Friedman 1976). It may be related to claims for ASL by Fischer (1975) (where modified verbs are also reported to prefer final clause position) that referents often need to be established in signing space prior to the articulation of the modified verb. However, this does not appear to be the case in our data as clauses frequently omit arguments. An analysis of all verb final clauses (n = 389) reveals that 62% (n = 241) lack an overt patient (as in 14.) and 28% (n = 107) lack an overt agent and patient. When we consider clauses with a nonfinal verb (n= 852 clauses), 28% (n = 240) lack both an overt agent and patient argument, 23% (n = 196) lack only an overt agent and 27% (n = 232) lack only an overt patient. The general picture that emerges is that there is a frequent tendency for clauses to omit at least one argument. Note, however, that our statistical analysis did not find that directional modification was linked to the presence or absence of arguments. The significance of phrase-final position may be linked to the fact that this position plays a special role in many sign languages in both form and function (Crasborn et al. 2012). Wilbur (1999) has claimed that phrase-final position is prosodically heavy and this phonological fact interacts with the role of prominence. The finding that modified verbs favor phrase-final position may be associated with these claims.

ANIMACY

Animacy was also an important factor in our data but only for patient arguments. Here, human and other animate patient arguments generally favored modification over inanimate arguments. Animacy is well documented to have a range of effects on grammatical phenomena in many languages including agreement systems (Corbett 2006), differential object marking (Aissen 2003), the passive construction (Dingare 2001), dative alternations (Bresnan et al. 2007) and in the expression of core syntactic arguments (Øvrelid 2004). Thus, finding an effect of animacy in this study is not unexpected, and it may reflect the salience of humans and other animates in cognition (Yamamoto 1999). At first glance, our finding for BSL appears to support Rathmann and Mathur (2002) who claim that animacy is important for modification of indicating verbs in ASL and German Sign Language (DGS). However, they suggest that it is only verbs that have two animate arguments that may be modified for person at all (e.g. verbs like ASL HELP may be modified but verbs like ASL BUY cannot). Our results indicate that animacy may only be important in predicting patient modification in BSL. Additionally, there are clauses within our data involving animate agents and patients where the verb is unmodified for both arguments as in Figure 7. This suggests that while animate arguments tend to favor modification, verb modification for animate arguments is not obligatory in BSL.

LOOK-AFTER	BABY
She looks after her baby	

FIGURE 7. LOOK-AFTER unmodified for an animate third person agent and patient

COREFERENCE

Coreference is also an important factor for both agent and patient modification. Clauses that have agents that are coreferential with a null argument in the previous clause favor agent modification.

Clauses that have agents that are coreferential with a pronoun or a noun in the previous clause disfavor agent modification. Clauses with an agent that is not coreferential appear to be neutral with respect to agent modification. Slightly different results are seen when we look at patient modification with respect to coreference. While clauses with patients that are coreferential with a null argument favor patient modification, those that are coreferential with a noun in the previous clause slightly favor patient modification and those coreferential with a pronoun appear to be neutral in this respect. Clauses with patient arguments that are not coreferential disfavor patient modification. In Table 6, coreference is not an important factor suggesting that the extent to which coreference is an important factor depends on our interpretation of the congruent tokens. Note, however, that we determined coreference by only looking at the preceding clause so therefore it remains an open question whether an analysis which includes a wider scope for determining coreference would reveal a stronger relationship for patient modification. The importance of coreference that we have found overall suggests that the use of directionality in indicating verbs may be indicative of a reference tracking system (e.g. de Beuzeville et al. 2009; Liddell 1990). Specifically, our findings indicate that modification appears to be more likely in clauses following null arguments and therefore may be a communication strategy used by signers to maintain reference and to ensure transparency of meaning. Verbs that are articulated following clauses in which referents are explicitly stated (e.g. via the articulation of a noun or a pronoun) show less tendency towards verb modification. Other studies investigating reference tracking in sign languages have not focused on indicating verbs in detail and report different findings (e.g. Cormier et al. 2013; McKee et al. 2011; Perniss & Özyürek 2015; Wulf et al. 2002). These studies have suggested that more overt expressions (e.g. modified predicates, overt noun phrases) are generally likely to occur in contexts where the referent is being re-introduced than when they are being maintained in the discourse. Similar claims have been reported for spoken languages (e.g. Ariel 1994). Our study suggests that verb modification generally occurs when reference is being maintained and this tendency is strongest following clauses with null arguments. Therefore, it may be a referential strategy more likely to be used when referents are not being explicitly stated in the discourse (note that our overview of present vs. absent arguments in Section 6.2 indicates that many arguments are dropped in spontaneous discourse). A more detailed analysis of how reference tracking works in sign language with respect to indicating

verbs would help clarify the role of coreference in verb modification; we leave this for future research.

NONSIGNIFICANT FACTORS

The results above indicate similar factors at play with regards to agent and patient modification with subtle differences. It is much clearer that the remaining linguistic factors do not play a role in agent or patient modification. These factors are clause type, frequency, overt vs. nonovert arguments, and number. It also clear that all the social factors in our data – language background, age, gender, and ethnicity – do not appear to play a role at all in verb modification.

The lack of significant findings regarding age and frequency are interesting from the point of view of grammaticalization because they indicate that there is little evidence of language change in progress in BSL, unlike what is reported for emerging or younger sign languages (e.g. Padden et al. 2010). In de Beuzeville et al. (2009), it was suggested that the low rate of modification indicated that directionality was not highly grammaticalized in Auslan. However, while the the Auslan study found that high frequency verbs were significantly more modified than low frequency verbs, we did not find frequency to be significant in our analysis.[16] Furthermore, and unlike the Auslan study, we also included social factors to investigate this claim further but did not find any to be significant. Studies investigating phonological variation in sign language have found both lexical frequency and social factors significant and have used these to argue there is language change in progress. For example, Schembri et al. (2009), in investigating location variation in Auslan, report that the association with frequency and specific social factors (age, gender and region specifically) may be indicative of language change at the phonological level beginning with highly frequent verbs and led by women in urban centers. On the basis of our results concerning frequency and social factors, there appears to be no indication of any such change at the morpho-syntactic level with respect to verb modification. There are several reasons why we may be seeing little evidence of on-going grammaticalization process here. One possible explanation may involve the fact that sign languages (particularly in western urban communities) have an interrupted pattern of language transmission, which is likely to affect the development of morphological redundancy (Trudgill 2011). Deaf children are much more likely to learn to sign later in life when they encounter other deaf individuals than from a deaf signing parent. Even for

those born to deaf signing parent(s) (approximately 5-10% of the deaf community), the likelihood that the parent(s) are native signers themselves is low (i.e. deaf children with deaf parent(s) and also deaf grandparent(s) are very rare). Secondly, sign languages are young languages. It is suggested that BSL is likely to have emerged towards the end of the eighteenth century following the establishment of the first deaf school (and in the subsequent schools that opened across Britain). Given its relatively young age, we might not expect to see a highly grammaticalized system with respect to directional modification of indicating verbs (although see Aronoff et al. (2005) for an alternative view).

6.3. IMPLICATIONS

The findings reported in this study have important implications for the field of sign language research. Modification of these verbs is widely considered a highly grammaticalized agreement system (Aronoff et al. 2005; Emmorey 2002; Sandler & Lillo-Martin 2006; Sutton-Spence & Woll 1999). The current study is only the second known attempt to examine the use of directionality in indicating verbs with reference to a large dataset of semi-spontaneous signing (the first being a study based on the Auslan Corpus reported in de Beuzeville et al. 2009) and the first to study directionality in conversation. Both studies have indicated that modification of these verbs does not appear to be a highly grammaticalized agreement system. This has some important implications. For example, there is a danger in making assumptions about typical language use in the sign language population when investigating language use in other contexts. Researchers investigating the development of verb modification in native signing deaf children, for instance, have often assumed that object agreement in the adult/target language is obligatory – for example, in studies involving ASL, BSL, and Brazilian Sign Language (Meier 1982; Meier 2002; Morgan et al. 2006; Quadros & Lillo-Martin 2007). In each of these studies, omission of object modification by children was considered an error. Yet the adults interacting with the children and/or consulted for native signer judgments in these studies also sometimes omitted such supposedly "obligatory" modifications, using unmodified citation forms instead. Similarly, with second language acquisition, Thompson et al. (2009) studied eyegaze patterns with indicating verbs used by hearing learners of ASL but excluded tokens which lacked 'obligatory manual agreement'. The results from our study show that considering unmodified forms to be errors by learners (whether children or adults) is problematic. This is a point also raised by Chen

Pichler (2012) who notes: "Counting these [unmodified] forms as target-like not only reduces the number of obligatory contexts, but also calls into question the traditional, strict categorization of agreeing verbs as always requiring inflection" (p. 668).

7. CONCLUSION

In summary, our results indicate several factors at play which all have an effect on modification of indicating verbs. Some of these factors have been indicated previously by proponents of the agreement analysis and by those who support a gestural/morphemic analysis although it appears our results align more closely with the latter viewpoint. Firstly, our results highlight the importance of the signer's perspective of events when predicting whether modification will occur. Signers frequently modify verbs so that they align with their own perspective (whether in the role of the agent or patient). When the signer's body is associated with neither the agent nor the patient role, there is a significant tendency to disfavor modification. This behavior suggests that signers are conceptualizing events from an egocentric perspective and this is reflected in patterns of modification. This conclusion is further supported by the effect of constructed action on modification. Generally, the presence of constructed action exhibits the strongest tendency towards modification. This suggests that signers are imagining referents to be present in the signing space and will modify verbs so as to point at these imagined referents. These factors are the strongest factors in our analysis and align closely with Liddell's (2000) description of these verbs rather than an agreement system which requires systematic co-variance between a controller and target (Corbett, 2006). That said, some factors are consistent with what is found in agreement systems: the role of animacy is certainly something that agreement systems may share with indicating verbs (Corbett, 2006), but this influence is found across a range of grammatical phenomena. Additionally, the effect of verb position on modification appears to reflect previous claims in the literature from those working with an agreement account about interactions between verb modification and syntax (Quadros & Lillo-Martin 2010), although Liddell (2003) does not predict that there should be a lack of interaction. The effect of coreference appears to suggest that modification of indicating verbs in BSL is a reference tracking system, which also may be something that it shares with agreement systems (Corbett 2006). Finally, we find no evidence of an interaction with social factors or lexical frequency in our data and conclude that

there is little to suggest that the use of space is becoming grammaticalized in BSL as part of a language change in progress. The findings reported here make an important contribution to the ongoing debate regarding the underlying nature of the modification of these verbs and the importance of corpus data in this debate (as well as in sign language research generally). Previously, both sides of the debate have made claims based on small datasets, or elicited judgements. The present study adds to growing evidence from large datasets (e.g. de Beuzeville et al. 2009) to provide some support for Liddell's (2003) analysis of these verbs. That is, rather than an agreement system, these verbs appear to reflect a fusion of morphemic and deictic gestural elements (i.e. signers are pointing to imagined referents) that is closely entwined with the signer's perspective and sequences of constructed action (i.e. when the signer embodies the referent). Finally, the work described here has also implications for the field of linguistics generally. Verb modification and the factors that condition it play an important role in understanding the typological context of indicating verbs and their relationship to agreement systems and reference-tracking devices in spoken languages. In addition to this, the importance of constructed action and the strong tendency towards an egocentric perspective is of broader relevance to those working within a cognitive linguistic framework, particularly those with an interest in embodied communication. Lastly, the interplay between deictic gesture and sign languages we describe here will be of wider interest to those working in gesture studies and multimodal aspects of language use.

8. APPENDIX

Frequency of verb types in the corpus (glosses with an '*' are signs which were not applicable for agent modification according to our data, glosses followed by an '+' were not applicable for patient modification according to our data).

	ID-Gloss	Total	Frequency (%)	Cumulative frequency (%)
1	SAY	183	12.7	12.7
2	LOOK*	174	12.1	24.9
3	LOOK2	138	9.6	34.5
4	GIVE	56	3.9	38.4
5	MEET	49	3.4	41.8
6	GIVE-INFORMATION	48	3.3	45.1
7	ASK	45	3.1	48.3
8	PAY	45	3.1	51.4
9	TEACH	41	2.9	54.2
10	HELP	40	2.8	57.0
11	TOUCH	38	2.6	59.7
12	GRAB	33	2.3	62.0
13	TAKE	30	2.1	64.1
14	EXPLAIN	28	1.9	66.0
15	LINK	24	1.7	67.7
16	CHOOSE	22	1.5	69.2
17	BORROW	20	1.4	70.6
18	DISCUSS	20	1.4	72.0
19	SUE	20	1.4	73.4

20	ACCOMMODATION* *(e.g. stay, reside)*	16	1.1	74.5
21	LEAVE-IT-BE*	16	1.1	75.6
22	PAYMENT *(e.g. donate, pay)*	15	1.0	76.7
23	INFORM	14	1.0	77.6
24	LOOK-AFTER	14	1.0	78.6
25	PUSH*	14	1.0	79.6
26	VISIT	14	1.0	80.6
27	ACCEPT*	11	0.8	81.3
28	CHECK*	11	0.8	82.1
29	INATTENTION *(e.g. ignore)*	11	0.8	82.9
30	TEXT-TO	11	0.8	83.6
31	THANK*	11	0.8	84.4
32	ATTACK	10	0.7	85.1
33	AWARD*	10	0.7	85.8
34	CONCENTRATE*	9	0.6	86.4
35	SEND2	8	0.6	87.0
36	TEASE	8	0.6	87.5
37	BEAT	7	0.5	88.0
38	CALL	7	0.5	88.5
39	EXTRACT*	7	0.5	89.0
40	PICK-UP*	7	0.5	89.5
41	SHOUT*	7	0.5	90.0
42	FAVOUR*	6	0.4	90.4
43	FOLLOW*	6	0.4	90.8
44	HELP2	6	0.4	91.2
45	RENT	6	0.4	91.6

46	SEND	6	0.4	92.1
47	SHOW	6	0.4	92.5
48	UNFAMILIAR* (*e.g. do not recognise)*	6	0.4	92.9
49	COPY	5	0.3	93.2
50	GUN* *(e.g. shoot, shot)*	5	0.3	93.6
51	RECOGNISE	5	0.3	93.9
52	RESEARCH*	5	0.3	94.3
53	SUPPORT*	5	0.3	94.6
54	WARN*	5	0.3	95.0
55	BEAT-UP*	4	0.3	95.3
56	AGAINST *(e.g. compete, opposed)*	4	0.3	95.5
57	ATTENTION	4	0.3	95.8
58	EXCLUDE	4	0.3	96.1
59	PRAISE*	4	0.3	96.4
60	RESPONSE	4	0.3	96.7
61	SUSPECT	4	0.3	96.9
62	DELIVER	3	0.2	97.1
63	INFLUENCE	3	0.2	97.4
64	LEARN*	3	0.2	97.6
65	LOBBY*	3	0.2	97.8
66	OFFER	3	0.2	98.0
67	PULL*	3	0.2	98.2
68	QUIT*	3	0.2	98.4
69	REPLACE*	3	0.2	98.6
70	RESPECT*	3	0.2	98.8
71	AFFORD^{+}	2	0.1	99.0
72	DEBATE	2	0.1	99.1

73	EXCHANGE	2	0.1	99.2
74	EXPLAIN2*	2	0.1	99.4
75	GIVE-AWAY	2	0.1	99.5
76	SYMPATHY*	2	0.1	99.7
77	ARGUE	1	0.1	99.7
78	CHALLENGE	1	0.1	99.8
79	PLEASE-ONESELF^{+}	1	0.1	99.9
80	SWAP	1	0.1	99.9
81	TALK2^{+}	1	0.1	100.0

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[1] We use the term 'corpus' in the modern linguistic sense to refer to a large machine readable resource that is representative and can be consulted to obtain information about the frequency in which a particular phenomenon or construction occurs (see McEnery & Wilson 2001).

[2] As is conventional in the sign language literature, we use English glosses in small caps to represent signs in a sign language. Pointing signs (PT) and indicating verbs in examples are glossed with a superscript indicating the direction of pointing (e.g. 1, 2, or 3 for 'person').

[3] Many sign languages also have a class of verbs known as 'backwards' verbs, often verbs like TAKE, CHOOSE, INVITE, which move from patient to agent (for more see e.g. Brentari 1988). When giving examples and explaining how indicating verbs work generally, we focus on verbs that move (or are directed) from agent to patient, but our study does include backwards verbs and in those cases the movements/directions are reversed.

[4] Plain verbs are verbs that do not move in space to reflect subject/object or source/goal arguments. These tend to be verbs that are produced on the body.

[5] Note that Padden (1983) referred to agreement verbs as 'inflecting' verbs. She introduced the 'agreeing/agreement verb' terminology in 1988.

[6] Others have moved away from a person analysis entirely and instead analyse the locations associated with pronouns and agreeing verbs as variables ('loci') whose content derives from discourse (Cormier et al. 1999; Lillo-Martin & Klima 1990).

[7] The existence of null arguments is definitely not confined to highly inflecting languages, however, and can be found in languages without rich agreement systems, such as in Mandarin Chinese. It is also common in clauses in ASL and other sign languages that contain only plain verbs which cannot be modified directionally (McKee et al. 2011; Wulf et al. 2002).

[8] Although we refer to 'person' here, this is primarily for ease of exposition (e.g. 'first person' refers to the signer him/herself or to the role being assumed by the signer during constructed action) and should not be taken as reference to grammatical person.

[9] All signs in this study were assigned an ID gloss, which represents best practice when annotating a sign language corpus (Johnston 2010). An ID gloss is a unique label used to identify a particular lexeme and to represent all its phonological and morphological variants in the process of lemmatisation – the ID glosses used here correspond to those in BSL SignBank

(http://bslsignbank.ucl.ac.uk). ID glosses do not reflect the meaning of a sign across all contexts, nor do they give any indication of a token's grammatical function. For example, the ID gloss ACCOMMODATION is used for the sign which can mean 'accommodation', 'accommodate', 'stay', 'reside', 'resident' etc., regardless of whether the token in question is functioning as a verb or noun or whether it refers to a place, a person, the act of staying, etc. The numbers used in some ID glosses are for lexical variants with the same or similar meaning in BSL SignBank – for example, LOOK vs LOOK2 (for more on lemmatisation principles, see Fenlon et al. 2015). Meaning and grammatical function information are annotated separately from glosses in a corpus. Glosses for partly lexical signs (e.g. pointing signs, classifier constructions and buoys) follow conventions described in (Cormier et al. 2015a).

[10] The number of native signers in the UK is unknown, but it is largely thought that roughly 5-10% of deaf people are born into signing families, following similar proportions documented in other countries (Mitchell & Karchmer 2004).

[11] Our use of the terms 'agent' and 'patient' should be understood here as generalised semantic roles or proto-roles, corresponding roughly to A and P described by Haspelmath (2011). These also correspond roughly to Van Valin & La Polla's (1997) 'actor' (which may include agent, expeiencer, possessor, etc, depending on the verb) and 'undergoer' (which may include patient, theme recipient, etc, depending on the verb). This approach of using generalised or proto-roles is seen as increasingly important in comparative work in linguistic typology.

[12] Other syntactic factors we considered were verb doubling and serial verbs. However, verbs of these types were so infrequent that a meaningful statistical analysis could not be conducted.

[13] The citation form for each of these signs as well as English keywords (translation equivalents) and other information about each sign in BSL SignBank is available upon registration to researchers who request this level of access. Note that because SignBank is constantly growing and changing, some sign entries (including ID gloss and/or citation form) may be different from those shown here.

[14] The rate of modification for 1612 tokens (our original dataset) in percentages is almost identical to that presented in Table 2 based on 1436 tokens.

[15] Verbs that were unmodified for first person patients include SAY, TEACH, PUSH, HELP, ACCEPT, WARN, RESPONSE, EXPLAIN, INATTENTION, CHOOSE, TOUCH, CHALLENGE, and BORROW. Of these,

few are difficult/awkward to produce so that they mark a first person patient (one example is PUSH) and the majority of this unmodified set was tokens of the verb SAY (which like most of the other verbs is unproblematic for first person patients).

[16] It is not clear why lexical frequency significantly favored modification in Auslan but not BSL. One possible reason may be related to text type – that is, the Auslan data were mostly composed of narratives while the BSL data consist entirely of conversation – however, more analysis of both datasets would be needed to confirm this.