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Using conversational data to determine lexical frequency in British Sign Language: The influence of text type.

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Abstract

This paper presents findings from an objective lexical frequency study in British Sign Language (BSL) based on 24,823 tokens collected as part of the BSL Corpus Project. The BSL study is only the fourth objective frequency study involving sign languages to be reported and is also the first study for any sign language to be based on entirely on spontaneous conversational data. When compared to previous frequency studies (both spoken and signed), some similarities can be observed although differences that may be attributed to text type are also recorded. When compared with subjective frequency ratings collected for BSL, a positive relationship is reported (similar to what has been observed for spoken languages). This is in contrast to a previous study which suggested a much weaker relationship between the two; however, this conclusion was based on a frequency count derived from narratives. These differences highlight the importance of using frequency measures derived from natural and spontaneous data, an opinion that has been emphasised in the spoken language literature.

1. Introduction

The effects of lexical frequency (i.e., how often a word occurs in a language) have broad consequences for grammaticalisation, language processing, sociolinguistic variation and change as well as first and second language acquisition (Bybee, 2002; Ellis, 2002) with such effects being well attested in studies of spoken language for over 60 years (e.g., Howes and Solomon, 1951). The lack of adequate frequency information for sign languages has created a significant barrier to the progress of research on these languages, with only three studies of objective frequency measures conducted to date: on American Sign Language (ASL), Australian Sign Language (Auslan), and New Zealand Sign Language (NZSL). As information regarding objective lexical frequency in British Sign Language (BSL) has not been readily available, researchers have sought to address this gap by collecting subjective frequency ratings for 300 BSL lexical signs from 20 deaf signers (Vinson et al., 2008). The current paper presents the findings from the first study of BSL on objective measures of lexical frequency based on 24,823 sign tokens collected as part of the BSL Corpus Project (Schembri et al., 2011). The BSL study is also the first frequency study for any sign language to be based entirely on spontaneous conversational data. The results from this study underline the importance of text type when investigating lexical frequency in sign languages. Differences in the frequency of specific lexical items and sign categories across the sign language studies discussed here appear to be largely due to the type of texts contained within each dataset. Additionally, when we compare the subjective frequency ratings collected by Vinson et al. (2008) to the frequency of the same lexical items in the spontaneous conversational data reported here, we find that the link between subjective frequency ratings and objective frequency in BSL may be stronger than suggested by Johnston (2012). In Johnston's study, the same subjective frequency ratings were compared to a lexical frequency count consisting of a high proportion of narrative data collected from the closely related sign language variety, Auslan.

2. Background

2.1. Why is frequency important?

The need to consider lexical frequency has been emphasised by many researchers working within several sub-disciplines in linguistics. For example, proponents of a usage-based approach to language acquisition have underlined the crucial role that lexical frequency plays in the development of a child's understanding of syntactic structure and in forming grammatical generalisations (Kidd et al., 2010; Langacker, 2009). Researchers investigating language in use have described how frequently used words tend to be phonetically reduced over time (Bybee, 2002; Bybee and Scheibman, 1999; Diessel, 2007; Dinkin, 2007;

File-Muriel, 2010; Guy, 2007; Philips, 1984) and how frequency interacts with grammaticalisation processes (Bybee, 2006; Bybee and Hopper, 2001). Within the field of language processing, online studies have repeatedly stressed that people's unconscious understanding of lexical frequency, formed from their past language experiences, is a major factor affecting the learning, recognition, comprehension and production of both words (e.g., Balota and Chumbley, 1984; Forster and Chambers, 1973; Gregg, 1976; Hall, 1954; Howes, 1954; Howes and Solomon, 1951; Savin, 1963) and sentences (Juliano and Tanenhaus, 1993; Jurafsky, 1996; Trueswell, 1996). Within applied contexts, lexical frequency is also important for lexicographers (McEnery and Xiao, 2011) and for those involved in curriculum design for second language learners (Nation, 2001). In sum, information about lexical frequency is vital for understanding the usage, processing and acquisition of the lexicon of any language,

Frequency data are typically obtained from studies of written or spoken language corpora[1] which have become increasingly available since the 1960s (e.g., Brown's Corpus of American English). With the advent of modern computing technology, it is now possible to obtain reliable frequency lists from extremely large corpora, such as the British National Corpus (100 million words) or monitor corpora such as the Bank of English (650 million words as of 2012). Frequency lists produced as a result of these corpora (e.g., Francis and Kucera, 1982; Leech et al., 2001) have in turn been used by researchers across the language sciences, as in the studies noted above.

Recent research examining frequency measures obtained from different corpora have revealed that it is the type of data that make up a corpus, as opposed to its size, that plays a key role in obtaining reliable frequency

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[1] We use the word 'corpus' to mean a large, representative, accessible and machine-readable dataset of language recordings (McEnery and Wilson, 2001).

measures. Brysbaert and New (2009) conducted a detailed comparison of the relationship between different frequency measures and lexical decision latencies, inspired in part by the continuing usage of the relatively small and (now) dated frequency norms from Kučera and Francis (1967). Whilst increasing corpus size led to improved performance, only marginal gains were observed beyond a certain point. Instead the source of word frequency measures plays an important role, with text derived from speech, internet discussion groups or subtitles from TV and film predicting performance far better than more traditional written sources such as books, journals and other such publications. Additionally, Brysbaert and New (2009) argue that data derived from natural and spontaneous circumstances accounts for lexical decision times better than prepared texts.

2.2. Objective lexical frequency in sign languages

There have only been three studies on lexical frequency in sign languages using objective measures, primarily because sign language corpora are still in their infancy. The first project to investigate the distribution of lexical items in a sign language was by McKee and Kennedy (2006) which, drawing on a dataset of 100,000 sign tokens in the Wellington Corpus of NZSL from 80 NZSL signers, remains the largest objective frequency study to date. This was followed by a second, much smaller study by Morford and MacFarlane (2003) who conducted a distributional analysis of 4111 sign tokens in ASL collected from commercially available videotapes of 27 deaf signing individuals. The most recent study, based on 63,436 sign tokens taken from the Auslan Archive of 109 Auslan signers (Johnston, 2012), presented a cross-linguistic analysis of sign frequency by drawing upon the findings of the previous two studies. Of these three studies, only the Auslan study is based on dataset that was created to be a machine-readable corpus.[2] All studies drew from similar text types for their analysis. This included data from spontaneous conversation and narrative data, and data involving more formal registers (i.e., interviews and committee meetings). The Auslan objective frequency study also included data from narrative retellings and descriptions of a cartoon.[3]

The proportion of text types within these three datasets appears to vary (or is unclear). Morford and MacFarlane (2003) report that the nature of their ASL data is predominantly spontaneous with casual text types (representing natural conversation) accounting for most of the data (47.9%) followed by formal texts (33.2%) and narratives (19.0%). A similar division made by Johnston (2012) reveals that the Auslan dataset consists of primarily narrative data (41.1%), followed by formal texts (38.8%) and casual texts (20.1%). McKee and Kennedy (2006) do not provide specific information regarding the proportion of text types within their NZSL dataset.

In all three studies, pointing signs were amongst the most frequent signs. As is the case for sign languages in general, pointing signs have a range of functions including use as first, second, and third person pronouns, determiners, and

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[2] The Auslan Archive – as with the BSL Corpus and other sign language corpora - cannot yet be considered a true language corpus as further lexical annotation is required to make it fully machine-readable. The important point here is that the Auslan Archive and BSL Corpus are intended to become language corpora.
[3] The Auslan study differs from NZSL and ASL study in two ways: (1) as noted above, it uses a dataset that is intended to be a language corpus – i.e., a large, representative, machine-readable dataset, and (2) it uses a system of glossing conventions for type/token matching that yields more reliable counts of sign types and thus lexical frequency, including the use of ID glossing tied to a lexical database (Johnston, 2010).

locatives.[4] All three studies also report a relatively low number of function signs compared to lexical frequency studies of English where the frequency of individual function words is higher than that observed in any of the sign language studies discussed here (Leech et al., 2001). However, the three studies suggest that this is not surprising if one considers how sign languages are structured. That is, grammatical functions that are typically marked by functors in English (such as prepositions *in, on,* or *by,* or the conjunctions *but,* or *if*) may instead be marked by modifying signs in space or signalled by non-manual features. All three studies demonstrate that their respective sign languages are lexically dense, with a relatively high ratio of content signs compared to function signs. The NZSL and Auslan study also demonstrate that a small number of signs account for a significant proportion of their data. As pointed out by Johnston (2012), the observation that a small number of types represent a large proportion of the text is consistent with findings in spoken language frequency studies (e.g., Leech et al., 2001).

In the ASL and Auslan studies, each sign token was additionally grouped according to sign category: whether it represented a core lexical sign, a pointing sign, a gesture, a classifier sign[5], a fingerspelled sequence, or a name sign (the ASL study includes an additional category for number signs as well). In these studies, signs from the core lexicon represented approximately two thirds of the data followed by the second largest category, pointing signs. (Information regarding the distribution of sign category is not fully reported in the NZSL study

[4] Note that we use the term 'person' here for ease of description of participant roles, although the extent to which sign languages exhibit grammatical person marking is a matter of some debate (Cormier, 2012).

[5] Johnston (2012) uses the term *depicting signs* to refer to classifier signs. Note that we agree that the analysis of these signs as including classifier morphemes is problematic (Cormier et al., 2012b; Schembri, 2003), but we have adopted this terminology for ease of comparison with the existing sign language literature.

although core lexical signs also appear to account for the bulk of their data.) These two studies also highlighted, as has been observed with spoken language frequency data (Johansson, 1985), the influence of text type on frequency. Pointing signs were most frequent in casual conversation when compared to narratives and formal texts and classifier signs were most frequent in narratives when compared to formal texts and casual conversation.

Some sign language studies have begun to use the results from the few sign language frequency studies reported here to demonstrate that frequency is a relevant factor conditioning sociophonetic variation. In one study looking at signs produced at the forehead in Auslan and New Zealand Sign Language, using frequency data obtained from McKee and Kennedy (2006), high frequency verbs produced in citation form on the forehead (e.g., KNOW) were more likely to be lowered (e.g., produced on the cheek) than low frequency verbs (Schembri et al., 2009). Additionally, preliminary results from a frequency analysis for BSL (Cormier et al., 2011) have already been applied to a study investigating handshape variation in signs using the '1' handshape which suggested that highly frequent signs using the 1 handshape tend to favour variation (Fenlon et al., 2013). It is clear that future studies investigating sign language use can begin to benefit from the information provided by the objective frequency studies involving sign languages reported here.

2.3. Subjective frequency ratings of British Sign Language signs

As objective frequency data for sign languages have traditionally not been readily available, researchers have attempted to address this problem by estimating frequency via other means. In some earlier work, it has even been argued that subjective ratings of frequency actually outperform objective measures, for example in predicting lexical decision latencies in English (Balota et al., 2004; Balota et al., 2001). With this issue in mind, sign language researchers have collected subjective frequency ratings in order to enable psycholinguists to control for lexical frequency in language processing experiments (Mayberry et al., in press; Vinson et al., 2008).[6] The subjective frequency ratings reported in Vinson et al. have since been used as a control in such experiments (e.g., Thompson et al., 2012; Thompson et al., 2010).

In Vinson et al. (2008), twenty deaf participants, the majority of which reported BSL as their preferred everyday language, were asked to watch 300 BSL signs produced in isolation and indicate on a scale of 1-7 how often they saw the sign (1 being 'I have never seen the sign before' and 7 being 'I see this sign everyday'). Items rated as most frequent were all concepts suspected to be used in everyday conversation (e.g., WORK (M = 6.90), EAT (M = 6.80), and WHAT (M = 6.80)) and items rated as least frequent included signs that were likely to be known only in a specific region such as BASINGSTOKE (M = 1.95).

Given that Auslan and BSL are closely related historically (and some consider them to be dialects of a single language; Johnston, 2003), Johnston (2012) compared the BSL subjective frequency ratings collected in Vinson et al. (2008) to his Auslan frequency data and concluded that subjective frequency ratings may not be closely correlated with objective frequency. Of the 300 lexical signs selected in Vinson et al. (2008), 157 occurred in the Auslan data, 26 (8.7%) of which occurred in the top 100 ranked fully lexical signs and 57 (19%) in the top 300. Additionally, 127 of the 157 signs returned a high subjective frequency rating in Vinson et al. (i.e., a rating of 5 or higher) but only 18 (14.2%) of these highly frequent signs appeared in the top 100 and only 39 (29.9%) occurred in the top 300 in the Auslan data. Johnston (2012) noted that these results reflect

[6] Vinson et al., (2008) refer to their ratings as measures of familiarity although instructions put to participants were actually framed in terms of subjective frequency (as in Balota et al., 2001). We use the term 'subjective frequency' here to refer to the familiarity ratings collected by Vinson et al. (2008)

only a comparison between the 300 lexical items selected in the BSL subjective frequency study and the core lexical signs occurring in his data. If one considers all the other sign types that occur naturally in everyday conversation (e.g., gestures, classifier signs, pointing signs) then the relationship between subjective and objective frequency for fully lexical signs may be further weakened.

Johnston's findings above suggests, as a precursor to our comparison of BSL frequency data with BSL subjective frequency ratings below, that the relationship between subjective and objective frequency may not be as straightforward as previously thought. However, as acknowledged by Johnston, these findings are based on a comparison between two different languages (albeit closely related) and Auslan frequency data derived from a corpus consisting of a variety of text types but with a larger proportion of prepared and elicited narratives. Therefore, it is essential to compare these ratings with corpora consisting of appropriate text types (e.g., spontaneous conversation) from BSL particularly as the importance of text type has been emphasised for spoken/written corpora (Brysbaert and New, 2009).

3. Research questions

Previous lexical frequency studies involving sign languages have used texts from a variety of registers. Given that this is the first objective frequency study to focus on conversational data in sign language, the current study addresses the following questions:

- What sign types and sign categories occur most and least frequently in BSL conversations?
- How does this frequency information for BSL generally compare with lexical frequency of a) other sign languages? b) spoken/written languages?
- What is the relationship between lexical frequency and text type in BSL and

how does this compare to other sign language studies of lexical frequency?

- How does this objective frequency information in conversational BSL compare with subjective frequency ratings for BSL signs obtained by Vinson et al. (2008)? Do we observe a similar relationship between the two like that reported in Balota et al. (2004)?

4. Method

In this section, we describe the methodological approach in our objective frequency study which is based on 24,823 tokens taken from the BSL Corpus (Schembri et al., 2011). We begin with a brief description of the BSL Corpus data before describing the annotation practices relevant to the current study. In particular, this involves recognising that the sign language lexicon is comprised of different sign types (e.g., core lexical signs and fingerspelled sequences) which must be appropriately categorised to ensure that a thorough and consistent count is conducted. We also describe problematic issues in categorising tokens in some detail here. Finally, we conclude this section with a brief description as to how the frequency data was extracted from the BSL Corpus and analysed.

4.1. BSL data

The study that we report here is based on data from a digital video corpus of BSL (Schembri et al., 2011) consisting of spontaneous and elicited BSL collected from deaf native and near-native signers. The set of participants is 'stratified' (using a non-random quota sampling technique) for gender, region, age, and age of BSL acquisition with 249 signers from 8 key regions across the UK (Belfast, Birmingham, Bristol, Cardiff, Glasgow, London, Manchester and Newcastle). Participants were filmed in pairs taking part in four language-based activities which included participation in a spontaneous conversation lasting 30 minutes. Some of the dataset was partly annotated using ELAN software and all of the video data have been made available online for researchers and/or the wider sign language community (www.bslcorpusproject.org/data). For a detailed description of the methodology of the BSL Corpus Project, see Schembri et al. (in press).

4.2. Annotation

For this study, lexical frequency was determined based on 24,823 sign tokens from the BSL Corpus conversation data. This total consists of approximately 500 signs each from 50 participants 'stratified' (non-randomly selected to fit quotas) for age, region (25 each from Birmingham and Bristol), gender, and age of BSL acquisition. All the annotation for this project was carried out using ELAN, a multimedia software package that allows the precise time alignment of annotations to corresponding media files (http://www.lat-mpi.eu/tools/elan/) and the subsequent export of data to Microsoft Excel for further quantitative and statistical analysis. To begin with, each file was segmented according to manual activity alone (we do not report here on the frequency of non-manual signs) and an appropriate gloss was assigned to each manual segment (see below for further description of glossing practices). Segmentation and glossing in each participant file continued until our target of 500 signs was reached and then we proceeded onto the next participant.

4.3. Sign categories

Before any study of lexical frequency in sign language can proceed, it is important to be clear on the nature of types one might encounter in a signed text and how they can be categorised. Indeed, Johnston (2012:4) cautions that 'without a clear notion of what constitutes a token and what types they may be instances of, there is no possibility of conducting a rigorous count.'

For the study reported here, we have categorised all 24,823 sign tokens according to the following groups: core native lexical signs, fingerspelled sequences, classifier signs, gestures, pointing signs, and buoys. For signs which could not be grouped into one of these 6 categories for any reason, these were categorised as 'other'. Each category is explained in more detail below.

Lexical signs represent signs belonging to the core native lexicon that adhere to a set of phonological constraints (Brentari and Padden, 2001). These signs, also known as 'frozen' signs, have a highly conventionalised form and meaning pairing across contexts that is often unpredictable from the potential meaning derived from their components (e.g., handshape, location, movement) (Johnston and Schembri, 2007). Each unique lexical sign was assigned its own identifying (or 'ID') gloss to be used with that lexical sign and all its phonological and morphological variants (Johnston, 2010). This ID gloss, an English word or phrase that often represented a 'best fit' with the sign's meaning(s), was entered into the project's lexical database along with a number of English translation equivalents ("keywords") reflecting the range of its meaning in BSL. This task was by far the most time consuming aspect of the study. As existing BSL dictionaries are unlikely to be to be completely representative of BSL's lexicon and have not been consistently lemmatised, it was necessary to build up a lexical database containing each unique lexical item we encountered in our study, including a video clip showing its form, its ID gloss and keywords.[7]

Fingerspelled forms represent a sequence of hand configurations that have a one-to-one correspondence with the letters of the English alphabet. Fingerspelled forms often violate phonological constraints associated with core native signs and are said to constitute what is known as the 'non-native lexicon' (Brentari and Padden, 2001). Fingerspelled forms were annotated with "FS:" followed by the English word that was fingerspelled (e.g., FS:TWININGS). Lexicalised fingerspelled signs that are considered part of the core lexicon (e.g., the BSL signs MOTHER and GOVERNMENT are based on the initial manual letter of the corresponding English word) were annotated as lexical signs and not as fingerspelled forms. As this distinction between lexicalised fingerspelled signs and fingerspelled forms can be difficult to maintain, we developed guidelines largely based on the principles of nativisation of fingerspelling outlined in Cormier et al. (2008) to determine whether a given token could be accorded lexical status.

Classifier signs are complex lexical items in which each of the units of handshape, orientation, location, and movement may have their own meaning (Cormier et al., 2012b). Classifier signs (or 'depicting signs' (Liddell, 2003)), together with pointing signs, make up the non-core native lexicon and differ from lexical signs where the units of handshape, orientation, location and movement are often meaningless. For this study, we include four types of classifier signs: motion, size and shape, handling, and locating classifier constructions. Motion classifier constructions depict the movement of an entity; size and shape signs

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[7] The BSL lexical database created during this study has grown into a database consisting of approximately 2,500 signs (supplemented in part with signs from Brien, 1992) which at the time of writing is being transformed into BSL SignBank, an online BSL dictionary (Cormier et al., 2012a). BSL SignBank will be the first sign language dictionary to be constructed from the start based on a sign language corpus.

represent the size and shape of entities, most often with a tracing movement but sometimes with a hold; handling classifier signs depict the handling of an object; and locating signs represent the location of entities, often by a short movement at a location or a hold. Each classifier sign was glossed using a prefix (either CLM, CLSS, CLH, or CLL depending on its function) followed by a short general description of its meaning (e.g., CLM:VEHICLE-MOVE).

Gestures refer to communicative actions that are non-lexical since they do not appear to be highly conventionalised in form and meaning (i.e., they rely on context to be properly understood) and/or are similar to some gestures that hearing non-signers produce (Johnston, 2012). The category of gesture was very broad because it includes a wide variety of communicative actions, from gestures that serve a discourse function (e.g., the palm-up gesture glossed as G:WELL), to those that encourage lexical retrieval (e.g., G:ERM, a gesture that involves wiggling of the fingers and is associated with periods of hesitation), to sequences of constructed action (represented on the hands alone) where the signer enacts an action of a referent in the discourse directly (e.g., G(CA):COVER-MOUTH-IN-PAIN where the signer demonstrates a referent in the story who has covered their mouth following an injury). Each token of gesture was glossed with a prefix (G), followed by a colon and a brief description of its meaning. Sequences of constructed action were further identified using the amended prefix (G(CA)). Sequences of constructed action were often difficult to distinguish from handling classifier signs because handling constructions often imitate the hand configuration used in real-world interactions with objects (i.e., the handling handshape used to depict the act of holding a key may be identical to the one used to handle a key). Following Cormier et al. (2012b), we decided to label these tokens as sequences of constructed action unless there was evidence to suggest otherwise (e.g., if the token exhibited features associated with signs belonging to other areas of the sign language lexicon). Therefore, many tokens which may be perceived as handling classifier signs by some researchers have been labelled as ‘gestural’ in our study.

Pointing signs, together with classifier signs, are partly lexical signs that make up the non-core native component of the sign language lexicon (Brentari and Padden, 2001). This category includes pointing signs functioning as pronominals, locatives, determiners and possessives. All tokens of pointing signs were glossed with a PT prefix followed by a colon and its function. For example, PT:PRO1, PT:PRO2, PT:PRO3 all indicate a pointing sign that function as a first, second or third person singular pronoun respectively. Other glosses used with pointing signs include PT:DET, for points functioning as determiners, PT:POSS for points functioning as possessives (which were also distinguished for person) and PT:LOC for locative points. If a pointing sign was used for plural reference, a -PL suffix was appended to the gloss (e.g., PT:PRO3PL). Classification of pointing signs into these grammatical functions was another significant challenge for this study. If a given token’s function was ambiguous between two possibilities (e.g., a point to a person standing in a particular location could either be a pronominal or locative point), both possible functions were included in the gloss (e.g., PT:PRO3/LOC), but, when its function in a particular context was even more ambiguous (as was often the case), it was labelled as a pointing sign alone with no additional description (e.g., PT). In some cases, it is possible that those tokens labelled as PT may later be reanalysed as tokens of buoys (see below): more work on these signs is yet to be undertaken.

Buoys refer to manual activity where the non-dominant hand is held in space while the dominant hand continues to produce signs and sometimes refers back to the non-dominant hand as a means of referent-tracking (Liddell, 2003). This category of buoys includes list buoys, theme buoys and pointer buoys as described by Liddell (2003). As noted above, it is possible that some tokens of ambiguous pointing signs (PT) might be better considered buoys (particularly pointer buoys).

The category of '*other'* refers to signs which were either unknown to the annotators or indecipherable for whatever reason (e.g., unclear in articulation and/or not clearly visible in the video recording). As we cannot be certain of each token's sign type, we have chosen to represent these tokens within this category. This category also includes tokens for which we have been unable to determine sign type or tokens which are ambiguous between two categories. For example, one token glossed as G(CA):FOLLOWING-TEXT-ON-PAGE/PT:LOC could be said to be a sequence of constructed action (i.e., the signer is imitating the action of someone reading with their finger following the lines within the book) or a pointing sign (i.e., the signer is pointing to lines within the imagined book). We also have several tokens of compounds in which one part is a fingerspelled form and the second is a lexical sign (e.g., FS:HONEY(H)^MOON meaning 'honeymoon'). As they cannot be placed neatly within one category, all these tokens have been categorised here as 'other'.

5. Results and discussion

Preliminary results based on 24,823 sign tokens indicate some similarities to the previous sign frequency studies as well as some notable differences that may be attributed to text type. In this section, we provide an overview of the most frequent items occurring in BSL, the distribution of sign categories, and a comparison of the objective frequency data with the subjective frequency ratings collected by Vinson et al. (2008). Where possible, we directly compare on our data to the frequency results reported for ASL (Morford and MacFarlane, 2003), NZSL (McKee and Kennedy, 2006) and Auslan (Johnston, 2012) based on a variety of registers.

5.1. Most frequent items

In a frequency analysis of 24,823 sign tokens, 2464 unique signs were observed. As has been observed for spoken languages (Leech et al., 2001) and sign languages (Johnston, 2012; McKee and Kennedy, 2006), a small number of unique signs make up a significantly large proportion of the frequency data. In other words, the top 10 signs form 28.0% of the data and the top 100 signs account for 56.6% of the data. In Table 1, the top 100 most frequent signs out of the 2464 different signs that occur are listed.

Ranking	ID gloss	Count	Percentage
1	*PT:PRO1SG	1724	7.0
2	G:WELL	1367	5.5
3	*PT:PRO3SG	961	3.9
4	PT:	793	3.2
5	GOOD	481	1.9
6	*PT:PRO2SG	409	1.7
7	*PT:DET	395	1.6
8	PT:LOC	345	1.4
9	SAME	253	1.0
10	RIGHT	229	0.9
11	*WHAT	193	0.8
12	G:ERM	191	0.8
13	G:HEY	168	0.7
14	NOW	165	0.7
15	LOOK	157	0.6
16	*PT:POSS1SG	148	0.6
17	WORK	140	0.6
18	THINK	138	0.6
19	BAD	135	0.5
20	N:ONE	132	0.5
21	DEAF	128	0.5
22	WANT	123	0.5

23	*PT:POSS3SG	121	0.5
24	CLM:PERSON-MOVE	121	0.5
25	*NO	118	0.5
26	LBUOY	117	0.5
27	GO	116	0.5
28	PAST	116	0.5
29	TRUE	116	0.5
30	PT:PRO3SG/LOC	115	0.5
31	KNOW	113	0.5
32	*BUT	112	0.5
33	SAY	108	0.4
34	*NOTHING	107	0.4
35	PT:LBUOY	107	0.4
36	N:TWO	103	0.4
37	*PT:PRO3PL	102	0.4
38	*BEEN	100	0.4
39	HAVE	100	0.4
40	ALL	96	0.4
41	GO-POINT	93	0.4
42	*WHY	93	0.4
43	GO-TO	87	0.4
44	SOME	85	0.3
45	MEANING	83	0.3
46	YEAR	81	0.3
47	*PT:PRO1PL	74	0.3
48	AREA	72	0.3
49	SIGN	71	0.3
50	DIFFERENT	70	0.3
51	CHILD	69	0.3
52	PT:PAST	69	0.3
53	RANKING	69	0.3
54	TIME	68	0.3
55	NEXT	66	0.3
56	LOOK2	63	0.3
57	OVER-TIME	62	0.3
58	AGE	60	0.2
59	HEARING	59	0.2
60	*WITH	58	0.2
61	*YES	58	0.2
62	ARRIVE	57	0.2

63	FINISH	56	0.2
64	*MUST	55	0.2
65	FEEL	52	0.2
66	HOUSE	52	0.2
67	MOTHER	52	0.2
68	CHANGE	51	0.2
69	KNOW-NOT	51	0.2
70	PERHAPS	51	0.2
71	GIVE	50	0.2
72	AGAIN	49	0.2
73	G:THAT-IS-ALL	49	0.2
74	SCHOOL2	48	0.2
75	UNIT	48	0.2
76	*WILL	48	0.2
77	HOME	47	0.2
78	*WHEN	47	0.2
79	GO-IN	46	0.2
80	MANY	46	0.2
81	PARTNER	45	0.2
82	OF-COURSE	44	0.2
83	G:DISMISS	43	0.2
84	HARD	43	0.2
85	NICE	43	0.2
86	DRINK	42	0.2
87	EXCITE	42	0.2
88	HAPPEN	42	0.2
89	MEET	42	0.2
90	*PT:BUOY	42	0.2
91	BACK	41	0.2
92	DEAF-AND-DUMB	41	0.2
93	GIRL	41	0.2
94	ALRIGHT	40	0.2
95	*AND	40	0.2
96	*HOW	40	0.2
97	CLM:VEHICLE-MOVE	39	0.2
98	NIGHT	39	0.2
99	OLD	39	0.2
100	TEACH	39	0.2

Table 1: Top 100 most frequent signs in BSL conversations[8]
(* indicates functional signs)

As has been observed for other sign languages, there appears to be a lower number of function signs within the top 100 signs in BSL when compared to spoken languages such as English. Using keywords associated with each ID gloss to identify functional signs (i.e., signs with grammatical as opposed to lexical meaning such as pronouns, determiners, conjunctions, modals, prepositions, interjections, and quantifiers), we observe 22 signs which can placed within this category amongst the top 100 most frequent signs in our data. This is less than half of the 46 function words that we identified using frequency lists extracted from the spoken component of the British National Corpus available online (Leech et al., 2001).[9] All three previous sign language frequency studies (ASL, Auslan, and NZSL) suggest that the reason for the lower frequency of function signs in sign languages compared to spoken languages like English may lie with the fact that prepositional content (e.g., 'on', 'in', etc.) may be expressed within a classifier predicate for example and that many clauses typically marked by a conjunction can be expressed non-manually (e.g., the use of raised brows has been documented as marking conditional clauses in many sign languages (e.g., Zeshan, 2004)). Although these claims have not been explored in detail within our dataset, they are likely explanations for the low

[8] Signs which were unknown and/or indecipherable (i.e., within the 'other' category noted above) represent 1.6% of the frequency data.
[9] We identified the following as function words: pronouns, conjunctions, determiners, interjections, quantifiers, modals and prepositions. Leech et al. (2001) provide parts of speech tags for all tokens appearing in the corpus and this is presented together with the frequency lists obtained from http://ucrel.lancs.ac.uk/bncfreq/flists (last accessed 9th April 2013). We selected tokens within the top 100 belonging to these categories above when determining the number of functional items in this subset.

number of functional signs within the top 100 signs in BSL conversations. The relative youth of sign languages compared to most spoken languages is another possible explanation (Meier, 2002). Young spoken languages (i.e., creoles) tend to have fewer function words than non-creoles (Hurford, 2012) and similarly it may be that sign languages are not old enough for functors to have grammaticalised from content signs (sign languages have been noted to have much in common with creoles, see Fischer, 1978).

As our data is derived entirely from spontaneous conversation and the Auslan frequency data is based on a variety of text types (although narrative data accounts for a large proportion of this dataset), it is possible to see which signs may be typically characteristic of conversational data. In Table 2, we compare signs appearing more that 4 times per 1,000 in our data to the Auslan study (Johnston, 2012). Since signs occurring in both the BSL and Auslan lists have been paired in Table 2 based on meaning (i.e., pairs do not always consist of signs which are formationally similar), it is more appropriate to talk about related concepts that are highly frequent in both datasets. To test whether the proportions observed for concepts occurring in both corpora were similar, a two-sample binomial test was applied. We corrected for multiple comparisons by applying the Bonferroni correction (n = 22, thus a critical p-value of .0022 was required to achieve an alpha level of .05 in significance testing). Note that where related forms have been conflated in Auslan, we have done the same for BSL for ease of comparison (e.g., PT:PRO2SG/PT:PRO3SG).

Ranking	ID gloss	Per 1,000	Per 1,000 in Auslan
1	*PT:PRO1SG	69.8	50.8
2	*PT:PRO3SG/PT:PRO2SG	55.5	32.5
3	*G:WELL	55.3	35.7

4	-PT:	32.1	-
5	*GOOD	19.5	10
6	*PT:DET	16	9.3
7	^PT:LOC	14	12.5
8	^SAME	10.2	10.2
9	-RIGHT	9.3	-
10	^WHAT	7.8	7.4
11	-G:ERM	7.7	-
12	-G:HEY	6.8	-
13	-NOW	6.7	-
14	+LOOK	6.4	14.4
15	^PT:POSS1SG	6	5.8
16	-WORK	5.7	-
17	^THINK	5.6	7.3
18	-BAD	5.5	-
19	^N:ONE	5.3	6.5
20	+DEAF	5.2	14.8
21	^WANT	5	4.4
22	-PT:POSS3SG	4.9	-
23	+CLM:PERSON-MOVE	4.9	7.7
24	-NO	4.8	-
25	-LBUOY	4.7	-
26	^GO	4.7	4
27	-PAST	4.7	-
28	+TRUE	4.7	6.8
29	-PT:PRO3SG/LOC	4.7	-
30	^KNOW	4.6	4
31	^BUT	4.5	4
32	^SAY	4.4	5.8
33	+NOTHING	4.3	7.3
34	-PT:LBUOY	4.3	-
35	-N:TWO	4.2	-
36	-PT:PRO3PL	4.1	-
37	-BEEN	4	-
38	+HAVE	4	10.6

(*is significantly more frequent in BSL; +is significantly more frequent in Auslan; ^no significant differences were observed, -frequency data for Auslan is not available).

Table 2: All signs occurring more than 4 times per 1,000 tokens in BSL compared to Auslan

Table 2 shows that 38 items occur at least 4 times or more per 1000 tokens in the BSL data. Additionally, 22 signs with related meanings (approximately half of this group) appear in both the BSL and Auslan frequency lists. This includes pointing signs functioning as pronouns (PT:PRO2SG, PT:PRO3SG) and determiners (PT:DET) and lexical items such as GOOD, SAME, RIGHT, WANT, and DEAF.

Table 2 demonstrates that pointing signs such as PT:PRO1SG and PT:PRO2SG/PT:PRO3SG are significantly more frequent in the BSL data than the Auslan data. Additionally, some pointing signs do not occur in the Auslan data at a rate of 4.0 or more (e.g., PT:POSS3SG and PT:PRO3PL). Although pointing signs are generally amongst the most frequent signs across the sign language frequency studies reported here (e.g., 6 pointing signs occur within the top 10 places in this study, 5 occur in the top 10 places in the NZSL study, 4 occur in the ASL study, and 3 occur in the Auslan study[10]), Table 2 appears to suggest that a higher rate of specific pointing signs (e.g., PT:PRO1SG, PT:PRO2SG/PT:PRO3SG) appear to be characteristic of spontaneous data. This may be due to a higher number of shifts in topics within the conversational data that require pronominal reference to be re-established each time.

Further differences can be attributed to text type. Other listed concepts, such as G:WELL and GOOD, are also significantly more frequent in the BSL data than the Auslan data. Additionally, some items such as RIGHT, G:ERM and G:HEY

[10] The differences in the number of pointing signs between these studies are also likely to be due to glossing practices (e.g., the ASL and Auslan study both conflate second and third person pronouns and we have an additional category for ambiguous points that may not represent a unique pointing category in itself).

do not occur at a rate of 4.0 or more in the Auslan data. These items might be said to be typical of spontaneous conversation. The gesture ‘G:ERM’ is often associated with periods of hesitation and lexical retrieval, G:HEY can be interpreted as an attempt to interrupt the conversational partner and take the floor, whilst GOOD and RIGHT may occur frequently as a manual backchannel. This is also true of G:WELL which is the second most frequent sign for both BSL and Auslan datasets but occurs at a significantly higher rate in the BSL data. This sign can be described as a palm-up gesture that is often used as a discourse marker (similarly to English ‘well’), and can convey a variety of meanings by changes in accompanying non-manual features. It has also been noted to function as a manual back-channel in NZSL (McKee and Wallingford, 2011). It is perhaps this wide variety of meanings that underlies why this specific sign is more frequent to casual conversation data than in narratives (i.e., it is likely to perform multiple roles as a discourse marker and as a manual backchannel sign in conversation).

Table 2 also demonstrates that the reverse is possible with some concepts (e.g., LOOK, DEAF, NOTHING, CLM:PERSON-MOVE, TRUE, HAVE) significantly more frequent in the Auslan data. Some high frequency concepts (e.g., WHAT, PT:POSS1SG, SAME, THINK, BUT, SAY, WANT, KNOW) also appear to occur at a similar level of frequency in both BSL and Auslan (i.e., we find no significant differences in the frequency of signs representing these concepts between the two datasets). Further differences may again be attributed to text type (e.g., the higher frequency of DEAF may be due in part to the identification sessions included in the Auslan frequency data in which participants identified themselves, explained their sign name and details about their childhood and schooling) whilst the similarities in highly frequent concepts may be expected across languages.

In Table 3, all signs occurring more than 4 times in the Auslan study are listed. As with Table 2, the results from the BSL study (where possible) are provided in the fourth column for comparison and a two-sample binominal test was carried out to determine if any differences were significant (with n = 32, a critical p-value of .0016 was required to achieve an alpha level of .05 in significance testing).

Ranking	ID gloss	Per 1,000	Per 1,000 in BSL
1	*PT:PRO1	50.8	69.8
2	*G(5-UP):WELL	35.7	55.3
3	*PT:PRO2/PT:PRO3	32.5	55.5
4	+DEAF1/2	14.8	5.2
5	+LOOK	14.4	6.4
6	+BOY	12.7	0.5
7	^PT:LOC	12.5	14
8	-DSM/L(BENT2):ANIMATE-MOVES/AT	10.6	-
9	+HAVE	10.6	4.0
10	SAME	10.2	10.2
11	*GOOD	10	19.5
12	*PT:DET	9.3	16
13	+DSM(1/X)ENTITY-MOVES	7.7	4.9
14	-DSS(BC):CYLINDRICAL/CURVED/CIRCULAR	7.6	-
15	^WHAT	7.4	7.8
16	^THINK	7.3	5.6
17	+NOTHING	7.3	4.3
18	+NOT	7	0.2
19	+DOG1/2	6.9	0.8
20	^REAL	6.8	4.7
21	+PEOPLE1	6.8	0.6
22	^ONE	6.5	5.3
23	+WHY-BECAUSE	6.3	3.8

24	+SIGN	6.3	2.9
25	-DSM/L(2/H):ANIMATE-MOVES/AT	6	-
26	-G(CA)	5.8	-
27	^SAY	5.8	4.4
28	^PT:POSS1	5.8	6
29	+WITH1/2	5.6	2.3
30	-DSM/L(5):MANY-MOVE/AT	5.3	-
31	+IN	5	0.6
32	-FROG1/2	4.8	-
33	-DSS(1):TRACE	4.7	-
34	-WOLF	4.5	-
35	-DSS/L(5):MASS/SHAPE-AT	4.4	-
36	^WANT	4.4	5
37	+SEE	4.2	0.04
38	-YELL1/2	4.1	-
39	^KNOW	4	4.6
40	+CAN	4	1.5
41	^GO	4	4.7
42	+YES1/2	4	2.3
43	^BUT2	4	4.5

(*is significantly more frequent in BSL; +is significantly more frequent in Auslan; ^no significant differences were observed, -frequency data for BSL is not available).

Table 3: All signs occurring more than 4 times per 1,000 tokens in Auslan

compared to BSL[11]

Table 3 reveals that, out of 43 concepts occurring at least 4 times in the Auslan frequency data, 11 do not occur at all in the BSL data. These 11 concepts noticeably include 6 signs that have been labelled as classifier signs: e.g., DSM/L(BENT2):ANIMATE-MOVES/AT, DSM/L(2/H):ANIMATE-MOVES/AT, DSM/L(5):MANY-MOVE/AT. In contrast, only one classifier sign occurs frequently in the BSL data (CLM:PERSON-MOVE) but at a significantly lower rate. Several concepts represented by lexical signs are statistically less frequent in BSL. These include the signs WHY-BECAUSE, SIGN, WITH1/2, BOY, and DOG1. Some signs that do not occur at all in the BSL data include the nouns FROG1/2, and WOLF. Again, these differences may reflect the larger proportion of narrative texts in the Auslan corpus, some of which were specifically selected to elicit classifier signs of motion, location and handling. The effect of text type can also be seen by looking at the most frequent fully-lexical signs in the Auslan study. The highly frequent signs BOY, WOLF, FROG and DOG are clearly due to retellings of the Aesop's fable "The Boy Who Cried Wolf" and the picture story "Frog, Where Are You?"

5.2. Data by sign category

In Table 4, the distribution by sign category is provided together with distributional data from the ASL (Morford and MacFarlane, 2003) and Auslan (Johnston, 2012) studies.

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[11] The Auslan study generally follows similar guidelines as the current study regarding annotation of sign categories although classifier signs are glossed with the prefix DS (short for 'depicting sign', which reflects a difference in the terminology used to refer to this sign category) followed by information regarding the handshape used and its orientation (e.g., DSM/L(BENT2):ANIMATE-MOVES/AT).

Sign category	BSL (n =24,823)	ASL (n = 4111)	Auslan (n = 63,436)
'Core' lexical signs	60.3%	73.2%	65.0%
Pointing signs	23.0%	13.8%	12.3%
Gestures	8.9%	0.2%	6.5%
Fingerspelling	3.0%	6.4%	5.0%
Classifier signs	2.3%	4.2%	11.0%
Buoys	0.5%	n/a	n/a
Other	1.9%	n/a	n/a
Sign names[a]	n/a	2.3%	0.2%

[a]We did not separate sign names from the other categories shown in the BSL data. Sign names refer to signs used to represent a person's name, a placename, the name of an institution, etc. Sign names are either subtypes of lexical signs or are derived from fingerspelling (with varying degrees of lexicalisation). Therefore, for the purposes of this study, and unlike the previous sign language studies, we decided to categorise sign names as either lexical signs or as fingerspelling forms.

Table 4: Distribution of sign categories in BSL, Auslan and ASL

Table 4 indicates that, when the 24,823 sign tokens taken from BSL conversations are divided according to sign category, nearly two-thirds of this dataset (60.3%, n=14,966) consists of signs from the core lexicon. The next two largest categories are pointing signs (23.0%, n = 5718) and gestures (including gesture-like signs and tokens of enactment or constructed action) (8.9%, n=2211). The remaining 7.7% consists of fingerspelled signs, classifier constructions, buoys, and tokens glossed as 'other'.

Two-sample binomial tests were conducted to test whether the proportions observed in BSL differed from Auslan or from ASL, only considering those categories with nonzero values (Bonferroni correction for multiple comparisons required a critical p-value of .005 to achieve an alpha level of .05 in significance testing). Following these analyses, significant differences (p = <.0001) were observed for all five categories examined (core lexical signs, pointing signs, gestures, fingerspelling and classifier signs). That is, core lexical signs are significantly less frequent in the BSL conversational data when compared to the ASL and Auslan data. The frequency of classifier constructions and fingerspelling is also significantly lower in BSL than in the ASL and Auslan data.

Conversely, the frequency of pointing signs is significantly higher in the BSL conversational data when compared to the ASL and Auslan data as is the frequency of gesture tokens. As mentioned earlier, the fact that pointing signs are significantly more frequent in BSL when compared to ASL and Auslan can clearly be attributed to text type. Note, that both Morford & MacFarlane (2003) and Johnston (2012) found that the frequency of pointing signs was greater in casual signing contexts (i.e., in conversation) when compared to more formal contexts (i.e., interviews and narratives). This observation can also be extended to classifier signs which were also reported to be more frequent in narrative than casual texts in the ASL and Auslan data. Therefore, a high proportion of pointing signs and a low occurrence of classifier signs overall can be said to be characteristic of conversational data.

Gestures are the second most frequent non-lexical sign type to occur in BSL and occur significantly more frequently in the BSL data when compared to ASL and Auslan. It appears that a higher frequency of specific gestures may be typical of conversational data as demonstrated in the previous section. When combined with pointing signs, these two categories form the bulk of the non-lexical material observed in the BSL data (31.9%). However, the category of ‘gesture’ in the BSL study is very broad and includes tokens that represent sequences of constructed action where the signer enacts an action of a referent in the discourse. When the 'gesture' category is further divided into either manual gestures serving a discourse function or sequences of constructed action, we find that this category consists of the former to a larger extent (7.6%) with few tokens of constructed action (1.4%). Additionally, the lexical status of these manual gestures is likely to be subject to some debate. For example, it is not clear if G:WELL, the second most frequent sign in our data, is also identified as a gesture in the ASL study (as it was classed in both the BSL and ASL study). If we were to describe this single token as a lexical sign, this would bring the proportion of signs classed as gesture down to 3.4% and increase the category of fully lexical signs to 65.4%. In other words, differences in proportions (with the ASL study in particular) may be attributed to variation in glossing practices across studies.

Fingerspelled forms are significantly less frequent in the BSL data when compared to ASL and Auslan. This is interesting in the light of anecdotal reports that the rate of fingerspelling in BSL is perceived to be lower overall than the rate of fingerspelling in ASL and Auslan but it is not clear if this difference will persist with larger data samples. Although it is possible that differences in fingerspelling between the datasets may be indicative of a difference between the languages themselves, another possible explanation is that they are indicative of text type since nearly a third of the ASL and Auslan datasets consist of formal prepared texts. Researchers have observed that frequent use of fingerspelling (together with other features which represent other types of language contact with English) characterises varieties of signing used in more formal settings (e.g., a church service) when compared to casual conversation (e.g., in a bar), Deuchar, 1977). Additionally, our study appears to contradict previous reports that place the rate of fingerspelling in BSL at approximately 10% (Sutton-Spence, 1994) (although this figure has been questioned by Brennan, 2001, who suggested a lower but unspecified figure). These differences may also be linked to text type as much of the data which Sutton-Spence uses in her analysis is taken from *'See Hear!',* a deaf magazine show targeted at the deaf community and it is possible that the use of fingerspelling on television (i.e., a formal setting) may be much higher than that observed in casual conversation as noted above. Alternatively, the inclusion of regions (e.g., Bristol) where the rate of fingerspelling is believed to be lower, according to Sutton-Spence et al. (1990), may have affected the overall frequency of this category. A frequency study that includes a wider cross-section of regions will shed light further on this point.

Finally, the division of types into categories of lexical and non-lexical signs reveals that more than a third of the frequency data consists of non-lexical signs. A similar level of distribution according to lexical and non-lexical categories (i.e., lexical items account for approximately two thirds of the frequency data) has also been reported for Auslan (Johnston, 2012) and ASL (Morford and MacFarlane, 2003). However, the category of lexical signs is significantly lower in the BSL dataset when compared to the ASL and Auslan studies. This comparison highlights that informal conversation data consists, to a large extent, of non-lexical material and is more than what would be observed when using frequency data derived from a variety of sources (such as narratives or prepared data).

In summary, the present study has demonstrated that signing used in informal conversation is characterised by a higher rate of pointing signs and gestures, fewer classifier signs, and a lower proportion of fully lexical signs than would be observed in other contexts (e.g., more formal texts or narrative texts).

5.3. Subjective frequency and objective frequency

Of the 300 lexical signs investigated in Vinson et al. (2008) only 149 occur one or more times in the frequency analysis reported here. Additionally, there is a tendency for signs in Vinson et al. to be rated as relatively frequent overall (mean subjective frequency = 5.13 on a 1-7 scale where 7 is maximally frequent). For these reasons even if subjective frequency is an accurate estimate of objective frequency, we are not likely to observe such a strong relationship as was reported by Balota et al (2001) for English, since objective frequency measures were derived from texts exceeding one million words in size, and for which subjective frequency measures spanned the full rating scale.

To examine the relationship between objective frequency and subjective frequency in our data in more detail, we carried out a two-step procedure. First, we discarded those signs that never occurred in the BSL Corpus data (N=151) and tested the correlation between subjective frequency and (log-transformed) frequency among the remaining 149 signs. Variation along both dimensions was highly limited even after excluding words that did not occur in the corpus; for frequency there were 25 signs occurring only once in the set and 16 occurring twice; and there were not many signs rated low for subjective frequency. Both of these characteristics can be seen in Figure 1: signs with log(frequency) of 0 (i.e., one occurrence) vary substantially in subjective frequency as indicated by the multiple points occurring along the x-axis; and there are hardly any points occurring on the left half of the Figure (i.e., low subjective frequency ratings). Despite this, there was a significant, positive relationship between objective frequency and subjective frequency ($r(147) = .391$, $p < .0001$).

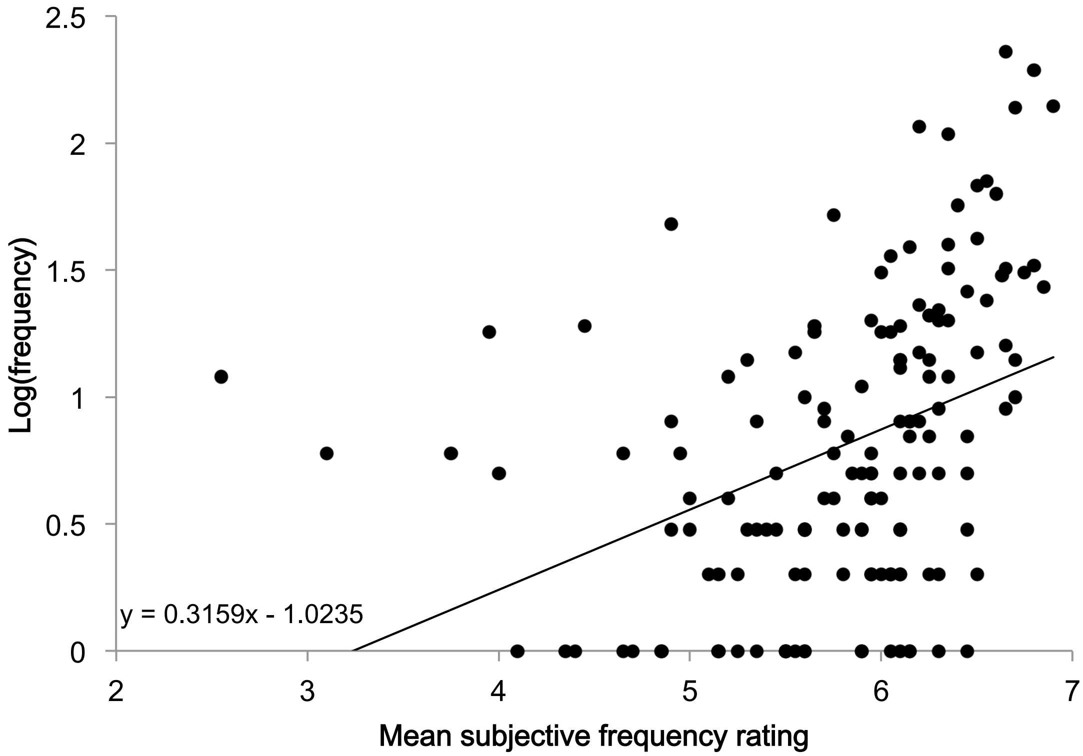

Figure 1: Log(frequency) as a function of mean subjective frequency rating and best-fit linear relationship between the two (N=149 BSL signs).

As we discarded signs not occurring in the frequency data for the analysis above, we also verified whether they exhibit properties consistent with a relationship between objective frequency and subjective frequency. To do this we simply compared the subjective frequency of those signs that occurred in the corpus (i.e., those plotted in Figure 1) with those that never occurred. Those that occurred in the corpus (mean subjective frequency = 5.80, SD = .73) were rated as more familiar than those never occurring (mean subjective frequency = 4.47, SD = 1.30), $t(298) = 10.94$, $p < .0001$). This shows that the non-occurrence of signs in the corpus is not simply a product of the corpus content itself but indeed also reflects a reliable underlying relationship between objective frequency and subjective frequency. We suggest that these findings reflect the same kind of relationship between subjective frequency and objective frequency that has been reported for spoken/written languages (e.g., Balota et al., 2001), with a magnitude of correlation that may be expected given the relatively small sample size (Brysbaert & New, 2009).

The use of subjective frequency ratings in place of frequency has been questioned by Johnston (2012) who reports a weak relationship between the two based on a direct comparison of his Auslan frequency data with the subjective frequency ratings collected for BSL (Vinson et al. 2008). However, our findings here suggest that there is a much closer relationship between the two than that implied in Johnston (2012) although it is not clear if the same observation can be made with Johnston's data if a similar statistical analysis was conducted. The weaker relationship observed in Johnston (2012) may instead reflect the content of the different corpora investigated. This underlines the importance of using corpora that consists of appropriate texts when making comparisons to subjective frequency (a point which Johnston also acknowledges in his paper).

As BSL subjective frequency ratings are only available for 300 lexical signs (Vinson et al., 2008) and our frequency data is only based on 24,823 tokens, our investigation of the degree of relationship between subjective frequency and frequency is necessarily limited. However, recent research involving spoken languages indicates that the development of frequency corpora better representing individuals' language exposure (i.e., preferring data in naturalistic/informal contexts) has been said to eliminate any utility of subjective frequency measures (Brysbaert and Cortese, 2010). If emphasis is placed on producing frequency data derived from more natural and spontaneous texts, this may go some way towards addressing limitations relating to size as they correlate to behavioural measures better than counts based on other types of texts (Brysbaert and New, 2009). However, one cannot discard the consideration of corpus size entirely; Brysbaert and New also argue that objective frequency counts from corpora smaller than 16M words do not exhibit sufficient variation in the low-frequency range to be particularly strong predictors of behavioural data. Indeed, there is likely to be frequency variation among the 151 BSL signs for which we have subjective frequency measures but for which objective frequency is constant (i.e., they never occurred in our sample). It therefore remains an open question as to whether the benefits of the objective frequency measures we report here, particularly their source in casual conversation, will outweigh issues related to corpus size, for researchers seeking information on frequency. Only future studies will determine whether subjective frequency contributes further toward explaining behavioural effects beyond the objective measures we report here. We advocate that researchers addressing issues potentially subject to lexical frequency effects should consider taking both subjective and objective frequency measures into account.

6. Conclusion

Lexical frequency effects are so pervasive within language that we would be remiss in not considering frequency when attempting an understanding of language structure. However, until recently, frequency measures for sign languages have not been readily available due to a notable absence of machine-readable corpora for sign languages until recently. The objective frequency study reported here is the first sign language frequency study to be based entirely on spontaneous conversation which forms part of the BSL Corpus (Schembri et al., 2011). The results reported here highlight the potential for text types to influence the frequency of lexical items as well as the frequency of different sign categories (e.g., pointing and classifier signs). The fact that we find evidence of a positive relationship between subjective frequency and frequency suggests (and confirms predictions by Brysbaert and Cortese, 2010) that frequency data deriving from spontaneous conversation is a better and more accurate indicator of this relationship than data derived from narrative texts. This supports similar observations that have been made for spoken languages (Brysbaert and New, 2009) and suggests that the effect of text type on lexical frequency is modality independent, an important observation in the exploration of linguistic diversity and linguistic universals (Evans and Levinson, 2009).

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