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## Crosslinguistic variation in prosodic cues

*Gladys Tang, Diane Brentari, Carolina González  
and Felix Sze*

### 1 Introduction

Sign languages share a common inventory of properties that are used to mark prosodic constituents (e.g., nonmanuals of the face or properties of movement and rhythm; see Quer and Pfau, this volume). This chapter investigates whether there is crosslinguistic variation in the use of one prosodic cue – eye blinks – to mark prosodic constituents in sign languages. We will compare the prosodic use of blinks across four sign languages – Hong Kong Sign Language (HKSL), Japanese Sign Language (JSL), Swiss German Sign Language (DSGS) and American Sign Language (ASL). In the last fifteen years there has been significant work done in sign language phonology with regard to prosodic structure. Miller (1996), Wilbur (1994a), Boyes Braem (1999), Wilbur and Patschke (1999), Nespor and Sandler (1999), Sandler (1999a, 1999b), Brentari and Crossley (2002), Sandler and Lillo-Martin (2006) and Eccarius and Brentari (2007) have worked on various prosodic constituents, including the Intonational Phrase, the Phonological Phrase and the Prosodic Word (also called “Phonological Word” in Nespor & Vogel 1986). The studies presented here are built upon these earlier analyses, expanding our knowledge of crosslinguistic variation of the blinks.

The following research questions are addressed in this chapter. First, how much variation exists among sign languages in their use of a prosodic cue, such as blinks? Second, if crosslinguistic variation exists, what factors condition it? Third, are blinks always associated with intonational phrases crosslinguistically? After presenting introductory material, the results of three studies will be reported, each taking a slightly different vantage point on these questions. The first study is presented in section 2. It is an analysis of the potential areal influences on blink rates across both signed and spoken languages. The second study is presented in section 3. It examines the Intonational Phrase in four sign languages and addresses whether blinks are a good diagnostic for this constituent. After determining that

HKSL has a unique status based on the results of the first two studies, we examine this language in detail in a third study (presented in section 4) in order to determine the distribution of blinks in this language across prosodic constituents. In section 5, we summarize our findings and discuss their relation to the literature on prosody in sign languages more generally.

Study 1 is a quantitative study, while Studies 2 and 3 are qualitative. One point that becomes clear in this chapter is that both methodologies are essential for this type of analysis and neither is sufficient on its own. In all studies register, task demands, presence of an interlocutor and linguistic context were controlled for so that these could be ruled out as confounding factors.

### 1.1 Prosodic cues in spoken languages

In spoken language phonology, various proposals for a prosodic hierarchy have been put forward. Our study adopts the one first proposed in Nespor and Vogel (1986:16), shown in (1).

- (1) Prosodic Hierarchy  
 Utterance → I(ntonational) Phrase → P(honological) Phrase →  
 P(honological) Word<sup>1</sup>

We make three assumptions in this work. First, we assume that the prosodic hierarchy is present in all natural languages, signed and spoken, and that prosodic cues have the same role in signed languages as they do in spoken languages. They assist infants in segmenting linguistic strings into meaningful units (e.g., sentence, phrase, word, etc., Jusczyk 1997, Seidl 2007) and assist adults in parsing the linguistic signal, especially in ambiguous cases. For example, in '[John approached] [the man with a puzzled expression],’ the man had the puzzled expression, while in '[John approached the man] [with a puzzled expression]’ John had the puzzled expression (cf. Nespor & Vogel 1986). Second, we assume that the prosodic hierarchy is subject to well-formedness constraints commonly known as the “Strict Layer Hypothesis,” meaning that “a category of level *i* in the hierarchy immediately dominates a (sequence of) categories at level *i-1*” (Selkirk 1984:26). In (1) above, an I-Phrase is parsed exhaustively into P-Phrases, and P-Phrases into P-Words.<sup>2</sup> Third, we assume that there is no strict isomorphism between the morphosyntactic and prosodic levels of analysis, but rather the syntactic and prosodic components of a grammar are mediated by means of a phonology–syntax interface. We do not take a position on which interface proposal is the correct one from among those proposed in the literature (Selkirk 1982, 1984, 1995, 2005; Truckenbrodt 1999; and Seidl 2001).

## 1.2. Prosodic cues in sign languages





In the following sections, descriptions of common cues used in P-Words, P-Phrases and I-Phrases across sign languages are described.

### 1.2.1 *P(rosodic) Words*

Previous work on prosody in sign languages has demonstrated that a lexical sign is analyzed as a P-Word if it contains a maximum of one contrastive value in each of the phonological components: handshape, place of articulation (POA), movement, orientation and nonmanuals (Brentari 1998, Sandler & Lillo-Martin 2006). Further



Figure 23.1 Examples of P-Word constraints: coalescent assimilation of handshape in HKSL compounds (top); coalescence of clitics in ISL (middle); assimilation of the non-dominant hand in ASL compounds (bottom).

evidence comes from compounds and cliticized forms, where processes of assimilation and coalescence conspire to create forms that more closely conform to this general word-level prosodic constraint. For example, in the HKSL compound TASTE^GOOD ('tasty'), the two stems have different handshapes –  in TASTE and  in GOOD (Figure 23.1a). The compound undergoes a process of “handshape assimilation” (Sandler 1986). By adding the thumb node to the initial  handshape configuration of TASTE, the new handshape is . This creates a more well-formed P-Word because the two handshapes are now more similar to one another. Another example, the ASL compound BLACK^NAME ('bad reputation') demonstrates “non-dominant hand (H2) spread” in compounds (Liddell & Johnson 1986; Figure 23.1b). If the first sign in the compound is one-handed and the next two-handed, the H2 of the second sign regressively assimilates to the first, resulting in a well-formed P-Word with one H2 value for the compound. A third example, from ISL, shows cliticization of a pronominal index to a two-handed host sign, resulting in an output with one movement instead of two, again achieving a more well-formed P-Word (e.g., SHOP-THERE; Figure 23.1c; Sandler 1999b).

### 1.2.2 *P(honological) Phrases*

The P-Phrase is the next higher level. It is composed of one or more P-Words and also defines the domain of application of specific phonological rules, such as “phrase-final lengthening” of the final sign of the P-Phrase (Brentari 1998) and “H2-spread,” a bi-directional phonological process of assimilation (Nespor & Sandler 1999, Sandler & Lillo-Martin 2006).<sup>3</sup> In the syntax, P-Phrases are generally correlated with XPs such as DP/NPs and VPs. Prosodic cues for P-Phrases in sign language are shown in (2) for Israeli Sign Language, which has been studied at length for its prosodic characteristics (Nespor & Sandler 1999 and subsequent work). In (2), one P-Phrase is marked by a hold and the other two by reduplication at the right P-Phrase boundary.<sup>4</sup>

- (2) Prosodic constituency in Israeli Sign Language (Sandler 1999a:199)

[[BOOK THERE] <sub>PP</sub>	[HE WRITE] <sub>PP</sub>	[[INTERESTING] <sub>PP</sub>
hold	redup	redup'

‘The book he wrote is interesting.’

### 1.2.3 *I(ntonational) Phrases*

I-Phrases are the next higher level in the prosodic hierarchy, independent from the syntax but mediated by a phonology–syntax interface (Seidl 2001, Selkirk 2005). Following Wilbur (1994a), we take their syntactic correlate in sign languages to be an “ungoverned maximal projection,” most often realized as clauses, parentheticals

and topic (or topicalized) structures. Different sign languages appear to employ different strategies to mark these prosodic constituents. In ASL, I-Phrases are optionally marked by blinks, and longer pauses are also observed, the latter of which are indicated by holds and lengthening of the final sign, as reported in Wilbur (1994a). In ISL, besides optional blinks, I-Phrases are consistently marked by a change of head position or an across-the-board change of facial expressions (Sandler 1999a). The example in (3) from HKSL is from the data elicited for the analyses in Studies 2 and 3. It illustrates how our naturalistic data including both lexical signs and classifier constructions will be described in Study 3 (see Introduction, this volume, for more discussion about classifiers, and see Appendix for notational conventions). It was elicited as a description of the picture in Figure 23.2. There are four P-Words in the passage organized into three P-Phrases and two I-Phrases.<sup>5</sup> The two I-Phrases exhibit both blinks and lengthening. Notice there is also a blink after ROCKET, which is not a topic structure (i.e., there is no brow raise). As you will see later in the chapter, blinks can mark P-Phrases in HKSL.

(3) Prosodic structure of a Hong Kong Sign Language utterance<sup>6</sup>

	brow raise							
H1:	[[[MOON] <sub>PW</sub> ]	{	[	CL:round_object+be_located <sub>i</sub>	]	]	]	]
H2:	(copy of H1)							
								+length, +blink total dur. 1110 ms hold 630 ms
H1:	[[[ROCKET] <sub>PW</sub> ]	{	[	CL:rocket+lands_on <sub>i</sub>	]	]	]	]
H2:								
	+length,+blink total dur. 720 ms no hold							+length,+blink total dur. 1540 ms hold 870 ms

'On the moon, a rocket lands (there).'

Blinks are a good choice for a study on crosslinguistic variation or cross-modal comparison in prosody because they have been observed to be a prosodic boundary cue in numerous sign languages (e.g., ASL, DSGS, ISL, HKSL), but they do not assume this role in spoken languages. Baker and Padden (1978) conducted the first study of blinks, which included ASL signers and speakers of English. They observed that signers' blinks were more strongly correlated with linguistic structure than those of speakers. This was confirmed in Wilbur (1994a). Wilbur also identified two types of blinks in ASL: lexical blinks, which were longer in duration and overlapped at least 75 percent with the sign co-occurring with the blink, and periodic, inhibited eyeblinks, which we will henceforth call "boundary blinks."

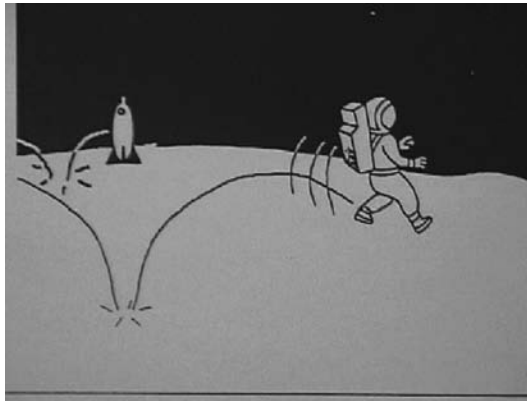


Figure 23.2 *Stimulus for the signed descriptions given in (3), (8), (9) and (10).*

Boundary blinks were shorter in duration and, when they overlapped with a sign, did so for less than 75 percent of the sign co-occurring with the blink. More recently, Sze (2008) analyzed HKSL based on a taxonomy of five blink types; a slightly modified version of this taxonomy, given in (4), is used throughout this chapter.

- (4) Blink types:
- a. *Boundary/prosodic*: blinks realized at the left- or right edges of IP; not necessarily correlated with signs ( $\leq 75\%$  overlap with a sign).
  - b. *Lexical*: blinks that overlap with a sign  $\geq 75\%$ , or which co-occur with every instance of the same sign, regardless of position.
  - c. *Physiological*: blinks involving movements of the hand(s) near the face, and blinks co-occurring with head movements (e.g., nods) and eye gaze changes.
  - d. *Hesitation and self-correction*: blinks produced while thinking or correcting oneself.

Using clauses and topics as syntactic means to find candidates for I-Phrases, Sze found that only 59 percent of the I-Phrases in her corpus were marked by a blink and that boundary blinks also occurred at the edge of other constituents 41 percent of the time. She therefore speculated that blinks might be indicative of smaller prosodic constituents in HKSL, but she did not venture into analyzing the identity of these constituents. This issue is pursued in Study 3.

The properties outlined in the preceding sections are used in the subsequent analyses. The notion of “sign count” referred to in Study 1 is based on the P-Word

criteria described in section 1.2.1. The boundary cues for I-Phrases and P-Phrases are employed in Studies 2 and 3, respectively. The syntactic structures associated with I-Phrases and P-Phrases are used to provide us with a set of candidates for a particular prosodic constituent (e.g., using clause, parenthetical or topic boundaries as a place to look for I-Phrase boundaries); however, the prosodic constituents themselves are defined by the prosodic cues presented in this section.

## 2 Study 1: Blink rate in signed and spoken languages

In this study the blink rates were compared among four sign languages – HKSL, JSL, DSGS and ASL. Then two groups of signers – HKSL and ASL signers – were compared with two groups of speakers – Cantonese and English speakers. Our goal was to determine whether the blink rates of these groups were primarily due to *areal linguistic features* shared by sign languages or *areal cultural features* shared by the surrounding spoken language community and the sign language community. Subjects were asked to watch the *Canary Row* Tweety and Sylvester cartoon and retell each of the seven episodes of the story in their native language to another native language user. Two native signers from each of the four sign languages, six American English speakers and four Cantonese speakers from Hong Kong participated in this study.<sup>7</sup> The sessions were recorded, captured in iMovie and then transcribed using ELAN (Eudico Linguistic Annotator, Version 3.5).<sup>8</sup> The three longest episodes were chosen for the current investigation.<sup>9</sup> For all signed productions, the modified version of Sze's taxonomy of blinks given in (4) was adopted. For speakers, we measured only blink rate (blinks/minute) and noted where blinks occurred.

### 2.1 Results (a): Differences among the four sign languages

The narratives of the two native signers for each of the four sign languages were compared with respect to the properties in (5).

- (5) Properties transcribed for signers
- a. *Total blinks*: Total number of blinks (all types) per signer based on the three episodes
  - b. *Total signing time*: Total signing time for each signer based on the three episodes
  - c.  $\bar{x}$  *Sign rate*: Average number of signs per minute
  - d.  $\bar{x}$  *Blink rate*: Average number of blinks per minute

The data are given in Table 23.1. An ANOVA done on the means in Table 23.1 reveals a significant effect between sign languages for blink rate ( $F = 29.5$ ;  $p = .003$ ). After

Table 23.1 *Raw data of Study 1: sign languages (ASL, HKSL, DSGS and JSL)*

	Total blinks	Total signing time	Sign rate Signs/min	Blink rate Blinks/min
HKSL-1	140	4'27"	67	31
HKSL-2	186	6'23"	72	29
<b>HKSL</b>	326	10'50"	<b>70</b>	<b>30*</b>
JSL-1	68	3'02"	83	22
JSL-2	88	3'50"	76	23
<b>JSL</b>	156	6'52"	<b>80</b>	<b>23</b>
DSGS-1	68	3'14"	83	21
DSGS-2	106	4'47"	72	22
<b>DSGS</b>	174	8'01"	<b>78</b>	<b>22</b>
ASL-1	51	2'26"	63	21
ASL-2	97	5'09"	72	19
<b>ASL</b>	148	7'35"	<b>68</b>	<b>20</b>

a Tukey test, HKSL was found to have a significantly higher blink rate than the other sign languages (“\*” in Table 23.1 indicates significance), but the other three sign languages showed no significant differences among them. From these results we can conclude that the difference in blink rate is not a shared areal effect for the sign languages, because in terms of blink rate JSL behaved like ASL and DSGS, not like HKSL.

Wilbur (1994a) found that articulation rate affected blink rate – that is, the faster the signing the lower the blink rate. To control for this, three measurements were taken in this project: sign rate, sign duration with pauses and sign duration without pauses.<sup>10</sup> These measures each yielded the same result, which we call “signing speed.” Table 23.1 reports sign rate. The ranking of languages from fastest to slowest signing speed is JSL, DSGS, HKSL, ASL. Following Wilbur, one might predict that the highest blink rate should occur in ASL and the lowest in JSL; however, this is not what we found. Ranking the languages from the highest to lowest blink rate yields the following: HKSL, JSL, DSGS and ASL. ASL signers blinked, on average, approximately once for every 3.5 signs, while HKSL signers blinked, on average, once for every 2.3 signs.<sup>11</sup> From these results we can conclude that HKSL’s high blink rate was not due to signing speed.

## 2.2 Results (b): Differences between signed and spoken languages

ASL and HKSL were found to have the most extreme difference in the blink rate study above; therefore, we investigated these two languages further in order to determine if there is a cultural factor related to the surrounding spoken language



Table 23.2 *Average blink rates: signed and spoken languages*

	Production time (total)	Blink rate (Blinks/min)
HKSL (N = 2)	10'50''	30
ASL (N = 2)	7'35''	20
Cantonese (N = 4)	11'12''	40
English (N = 6)	13'36''	35

Table 23.3 *T-test results: signed and spoken languages*

Languages	t-value	p-value
Signed vs. spoken	2.44	.03*
HKSL vs. ASL	6.61	.02*
Cantonese vs. English	-.31	.77
HKSL vs. Cantonese	-1.05	.37
ASL vs. English	3.54	.01*

communities – English and Cantonese respectively – that might be responsible for the blink rate difference between the two sign languages.<sup>12</sup> We asked a group of four native Cantonese speakers and six native English speakers to perform the same task as the one described above. As in Study 1, each participant narrated each of the seven episodes of the *Canary Row* Tweety and Sylvester cartoon to a second native speaker of the language. The same three episodes were analyzed in terms of blink rate. The results are provided in Tables 23.2 and 23.3.

ASL and HKSL were compared to the spoken languages (English and Cantonese) using a t-test to determine if the modality of communication was a significant factor. Indeed, there was a significant difference in blink rate as a function of language modality (signed vs. spoken languages;  $t = 2.44$ ,  $p = .03$ ). As seen in Table 23.3, comparisons for all pairs using t-tests revealed a significant difference between ASL and HKSL ( $t = 6.61$ ,  $p = .02$ ) and between ASL and English ( $t = 3.54$ ,  $p = .01$ ). However, the differences between English and Cantonese speakers ( $t = -.31$ ,  $p = .77$ ) and between HKSL and Cantonese were not significant ( $t = -1.05$ ,  $p = .37$ ).

The data also revealed that speakers and signers had different blinking patterns, confirming Baker and Padden's (1978) and Wilbur's (1994a) ASL–English results. Speakers of both English and Cantonese performed similarly in two important ways. First, their eye blinks were not correlated with I-Phrase or P-Phrase boundaries; they occurred both at phrase boundaries and phrase-internally, and both on

and between words. Their appearance was not correlated with a particular grammatical category. Second, the Cantonese and English speakers' mean blink rates were not statistically different. This suggests that speakers as a whole were using a similar motivation for their blinking behavior, one that was of physiological origin, as reported in previous work. An example each from Cantonese and English are given below:

(6) Examples of Cantonese and English placement of blinks

a. Cantonese

bl  
 IP[gan1-zyu6 zek3 maau1 le1]IP  
 then cl cat SFP  
 'Then as for the cat, ...'  
 bl bl  
 IP[zau6 kam4 soeng5 sei2 keoi4 hai2 lei5-min6 jap6 laa3]IP  
 adv climb up water pipe loc in-side enter SFP  
 ... it climbs up through the water pipe.'

b. English

bl bl bl  
 IP [So instead of climbing up the drain]  
 IP[ he wants to climb in the drain]IP  
 bl  
 [so he starts climbing up the drain] IP

Taken together, these findings suggest that there are language-particular differences among sign languages in terms of their blinking rate. First, HKSL showed a higher blink rate than the other sign languages. Second, there was a significant difference between the blink rates in signed and spoken languages, but there was no significant difference between Cantonese and HKSL; therefore some influence of the surrounding spoken language community on HKSL blinking behavior cannot be ruled out.

### 3 Study 2: Identifying I-Phrases and the role of blinks

This study had two goals. The first was to identify the I-Phrase units using independent criteria (i.e., not the placement of blinks). The second goal was to test the hypothesis that blinks were primarily associated with the domain of an I-Phrase, as has been shown to be the case in ISL (Nespor & Sandler 1999), DSGS (Boyes Braem 1999) and ASL (Wilbur 1994a). Thirty still pictures were used as

stimuli for eliciting descriptions about motion and location events. We used pictures as stimuli for this study instead of the Tweety and Sylvester cartoon because picture descriptions are shorter, making it easier to compare productions within and across signers as well as within and across languages. We also wanted to neutralize differences based on storytelling/narrative abilities, which can become an issue in longer passages.<sup>13</sup> The signers' productions were videotaped in digital format, imported and then transcribed using ELAN. The elicited productions included both lexical items and classifier constructions.

### 3.1 Identifying I-Phrases

The first task was to independently identify I-Phrases, and to do so using a set of criteria independent from blink placement. We looked for candidates for I-Phrases using the morphosyntactic constituents associated with them – clauses, parentheticals and topic (or topicalized) structures. These I-Phrase candidates were then counted as an I-Phrase if at least two “boundary cues” of the ones listed in (7) were present at the left or right edge. As mentioned, all of these cues have been attested as linguistic markers in previous work. Therefore, in the current study, not only blinks, but also the three other cues listed in (7) were transcribed for analysis. We purposefully chose criteria for broad inclusion of I-Phrases for two reasons. First, we wanted to clearly distinguish cases that could be explained by previous analyses from those that still required an explanation. Second, I-Phrases have been shown to have a larger set of prosodic cues than P-Phrases or P-Words, so we wanted to allow for any two plausible boundary cues to count.

- (7) Prosodic cues transcribed: definitions and values
- a. *Lengthening* ( $x2$ ): a sign that is twice the length of its phrase-internal instantiation.
  - b. *Change in head position*: (i) head nod, or (ii) a change in head position to neutral after a tilt sideways, or tilt backwards.
  - c. *Change in brow position*: Raising/lowering of the brows to or from neutral position.
    - a. *Blinks*: Placement with respect to the sign (left- or right-edge), duration (ms) and type (described in (4)).

“Lengthening” was based on final hold time and total sign duration; both hold and duration are indicative of phrase-final lengthening, based on the different syllable types of signs (Perlmutter 1992, Brentari 1998). Other mechanisms were also used to lengthen a sign, such as adding repetitions to the final syllable, or by simply adding duration to a single movement. Syntactic structure was used as an

Table 23.4 *Average duration of phrase-internal signs based on syllable count and type*

Syllable count	Syllable type		
	Path	Trilled	Local
Simple movements			
a. Single ( $1\sigma$ )	300	300	250
b. Repeated ( $2\sigma$ )	350	350	300
Complex movements (path + ...)	none	550	none

independent criterion, in addition to prosodic cues, to identify signs that were likely to occur at an I-Phrase boundary, and these signs were compared with those thought to be phrase-internal. These I-Phrase “candidates” (based on syntactic structure) were categorized as I-Phrases only if they exhibited two of the cues in (7), following the methodology of primarily defining prosodic units in terms of prosodic cues (Pierrehumbert 1980). For cases where no such pair existed of the same sign, a set of sign-length averages was prepared, based on syllable count (one or two) and the syllable type. Syllable types were based on the different movement/syllable types in the Prosodic model (Brentari 1998) – syllables based on “local” movements, which are the relatively smaller movements due to handshape changes and orientation changes, “trilled” based on uncountable small repetitions and syllables based on “path” movements, which are the relatively larger movements of the elbow and shoulder. In a different project (Brentari *et al.* in press), ASL signers’ productions at the end of sentences were twice the length of the same signs when produced phrase-internally; therefore for lengthening to be “present” a sign had to be twice as long as its phrase-internal counterpart.<sup>14</sup> The phrase-internal averages for common syllable types in our data are given in Table 23.4.<sup>15</sup> Complex movements consisted of a path plus one of the other three types of movement – path, trill or local. Holds were seen primarily at the end of single movements, either local or path and were less reliable than sign duration as an indicator of sign lengthening.

With regard to “head position” and “brow position,” we were interested in changes of these articulators to or from neutral position, since these changes are often correlated with I-Phrase boundaries (Wilbur 1994a, Nespor & Sandler 1999) or sentence boundaries (Padden 1988). We, therefore, included these properties as well.

Blinks were coded for their “placement” with respect to the co-occurring sign (left-edge or right-edge), “duration” in milliseconds (ms) and “type” (prosodic, lexical, physiological, or self-correction/hesitation (see (4)). A boundary blink was judged to be at the left edge if it occurred during transitional movement while the

handshape of the hand was forming or during the first half of the sign.<sup>16</sup> A boundary blink was judged to be at the right edge if it occurred during the second half of the sign or during the transitional movement to rest or while the handshape was disintegrating.

### 3.2 Use of blinks

The second task of this study was to determine whether blinks consistently and exclusively mark I-Phrases. That is, are I-Phrases always marked by a blink (“consistency”), and are blinks used only to mark an I-Phrase (“exclusivity”). Table 23.5 displays a profile of each signer’s prosodic blink productions. Blinks were divided into (U)tterance (those at the start or end of the production), I-Phrase ( $\geq 2$  cues) or “other.” For both I-Phrase(R) and I-Phrase(L) boundaries, those attributed to Utterance boundaries are given in square brackets in Table 23.5 – that is, those at the beginning and end of the production. Table 23.5 shows the total number of blinks, total number of I-Phrases, percentage of right and left edges of an I-Phrase marked by a blink, and total number of “other” blinks (those that did not meet the criteria for an I-Phrase). For this analysis only boundary blinks were used; the lexical and physiological blinks have been removed.

While the number of occurrences here are not sufficient to do quantitative measures, a number of qualitative generalizations can be drawn from the data presented in Table 23.5. Considering these results in terms of consistency and exclusivity, I-Phrases are *consistently* marked by a blink in all four sign languages. In other words, it is clear from the data in Table 23.5 that when there are two or more cues present, a blink is almost always one of the cues. However, I-Phrases are marked *exclusively* by blinks only in three of the sign languages – ASL, JSL and

Table 23.5 *Profile of prosodic blinks in four sign languages*

	Total blinks	Total IPs	IP(R) blinks / Total IPs	IP(R) blinks / Total blinks	IP(L) / Total blinks	Other / Total blinks
HKSL	132	71	63/71 (.89)	63/132 (.48) [17 U(R)]	16/132 (.12) [all U(L)]	53/132 (.40)
JSL	83	61	61/61 (1.00)	61/83 (.73) [17 U(R)]	20/83 (.24) [19 U(L)]	2/83 (.02)
DSGS	48	46	42/46 (.96)	42/48 (.88) [15 U(R)]	2/48 (.04) [all U(L)]	4/48 (.08)
ASL	57	48	48/48 (1.00)	48/57 (.84) [22 U(R)]	9/57 (.16) [all U(L)]	0/57 (.00)

Table 23.6 *Blinks and their concomitant cues in four sign languages.*

	Blink + Length	Blink + HN	Blink + BP	HN + Length	Total
HKSL	52 (.83)	2 (.03)	9 (.14)	0 (.00)	63 (1.00)
JSL	16 (.26)	40 (.66)	3 (.05)	2 (.03)	61 (1.00)
DSGS	23 (.50)	8 (.17)	7 (.15)	8 (.17)	46 (1.00)
ASL	37 (.77)	0 (.00)	11 (.23)	0 (.00)	48 (1.00)

DSGS. It is not the case in HKSL that if you see a blink, you can infer that it is an I-Phrase boundary. In HKSL 40 percent of the prosodic blinks in HSKL were categorized as “other,” while the percentage of “other” blinks in ASL, JSL and DSGS was quite low (0%, 8% and 2%, respectively).

In terms of edges, there was a tendency for blinks to occur at the right instead of the left edge of an I-Phrase in these four sign languages. We did not observe the occurrence of left edge in the absence of right-edge marking. In other words, any left-edge marking of a prosodic constituent implies right-edge marking for the same constituent. However, to what extent this observation provides a basis for us to formulate an implicational universal about edge marking in sign language requires further investigation. Some tokens of blinks occurring at the left edge were observed. All were U(L) boundaries except for one instance of an I-Phrase(L) blink in JSL. Most of the left-edge tokens were in HKSL and JSL; far fewer from ASL and very few from DSGS.

The data shown in Table 23.6 focus exclusively on I-Phrase boundary cues – i.e., the co-occurrence of the four cues studied – lengthening, head nods and brow position (i.e., return to neutral position after a brow raise). Crosslinguistic variation was found here as well. Among all the cues analyzed in the data, phrase-final lengthening most frequently co-occurred with blinks at I-Phrase boundaries in ASL, DSGS and HKSL, while in JSL the presence of head nods was the most frequently co-occurring cue in this position. Examples in (8) demonstrate this crosslinguistic prosodic difference.

(8) Examples of language particular differences in concomitant cues

(1 = blink, 2 = lengthening, 3 = head nod)<sup>17</sup>

a. HKSL (video example 2)

\_\_topic\_\_\_\_\_  
 [MOON CL:round\_object + be\_located]<sub>IP(1,2)</sub> [ROCKET CL:rocket  
 + lands]<sub>IP(1,2)</sub>  
 [CL:‘person exits and walks weightlessly’]<sub>IP(1,2)</sub>

## b. JSL (video example 3)

\_\_topic\_\_\_\_\_

[CL:earth + be\_located]<sub>IP(1,3)</sub> [CL:rocket + takes off]<sub>IP(1,3)</sub>

\_\_topic\_\_\_\_\_

[CL:moon + be\_located]<sub>IP(1,3)</sub> [CL:rocket + lands]<sub>IP(1,3)</sub>

\_\_topic\_\_\_\_\_

[CL:person\_in\_a\_space\_suit]<sub>IP(1,3)</sub> [CL:person + exits\_and\_jumps\_around\_weightlessly]<sub>IP(1,3)</sub>

## c. DSGS (video example 4)

[MOON UP-THERE]<sub>IP(1,2)</sub> [MAN LIGHT CL:person\_walks\_weightlessly]<sub>IP(1,2)</sub>

[CL:person\_in\_a\_space\_suit]<sub>IP(1,2)</sub>

## d. ASL (video example 5)

[ROCKET CL:rocket + takes\_off\_and\_lands]<sub>IP(1,2)</sub> [S-P-A-C-E-M-A-N CL:person + exits\_and\_walks\_weightlessly]<sub>IP(1,2)</sub>

In summary, this study revealed crosslinguistic similarities and language-specific differences concerning blinks at I-Phrase boundaries. First, blinks occur at I-Phrase boundaries in all four languages consistently, but only in three of these languages are blinks a marker of I-Phrase boundaries exclusively. Blinks consistently appear at I-Phrase boundaries in HKSL, but blinks occur in many other locations as well; therefore, we cannot use this cue as a crosslinguistic diagnostic of I-Phrases. Second, language-particular differences in the cues that co-occurred with blinks were also found.

Now that we have determined that HKSL behaves differently in rate and use of blinks, the next study analyzes the use of blinks in this language more closely.

#### 4 Study 3: blinks and prosodic constituents in HKSL

The goal of this study was to analyze the distribution of blinks and their concomitant cues in HKSL, primarily those in the “other” category from Study 2; that is, those marking prosodic constituents other than the I-Phrase. Sze (2008) suggested that in HKSL blinks might mark smaller prosodic constituents than I-Phrases, at different grammatical junctures; however, she did not venture into identifying what these prosodic constituents were or how they interacted with each other.<sup>18</sup> The same thirty pictures used in Study 2 were used to elicit descriptions from two native HKSL signers, using the same taxonomy of blink types listed earlier in (4). As in Study 2 we focused on the boundary-sensitive blinks.

As we shall see, the results suggest that HKSL is prosodically similar to ASL, JSL, DSGS, except for the distribution of eye blinks. A large percentage of blinks marked I-Phrases, but some marked P-Phrases internal to an I-Phrase, albeit to a lesser extent, and sometimes even P-Words internal to a P-Phrase were marked by blinks to a limited extent. The results confirm Sze's conclusions, but the analysis here also provides a way to distinguish I-Phrases from P-Phrases on the basis of strong vs. weak lengthening.

#### 4.1 Identifying I-Phrase and P-Phrase constituents

The first task was to assign I-Phrase and P-Phrase constituent boundaries independently from the placement of blinks. The following procedure was used, similar to that used in Study 2. For this analysis the morphosyntactic units associated with I-Phrases were used to provide us with a set of candidates for this prosodic constituent – clauses, parentheticals and topic (or topicalized) structures – and those morphosyntactic structures associated with P-Phrases were used to provide a set of candidates for P-Phrases – XPs such as DP/NPs and VPs. However, just as in Study 2, prosodic units were ultimately defined by prosodic criteria. From the sets of candidates for I-Phrases and P-Phrases provided by the syntax, I-Phrases were defined as those units containing at least two “boundary behaviors” of the ones listed in (7). P-Phrases were defined using a weaker criterion; namely one of the boundary behaviors listed in (7) had to be present.

#### 4.2 Use of blinks

The second task was to determine which cues were used to mark I-Phrases and P-Phrases for each signer, and particularly, whether blinks were the most relevant cue. A summary of the distribution of blinks over the three types of prosodic constituents is presented in Table 23.7 (i.e., I-Phrase, P-Phrase and P-Word).

Table 23.7 *Distribution of HKSL blinks by prosodic constituent boundaries*

Sgr	I-Phrases				P-Phrases				P-Words	
	Total IPs	IP (R)	IP (L)	No(R) Blink	Total PPs	PP (R)	PP (L)	No(R) Blink	Total PW	PW (R)
1	71	63 (.89)	16 (.23)	8 (.11)	89	35 (.39)	0 (.00)	54 (.61)	336	18 (.05)
2	66	49 (.74)	16 (.24)	17 (.26)	72	38 (.54)	0 (.00)	34 (.46)	304	5 (.02)



Table 23.8 *HKSL blinks and concomitant cues for I-Phrase boundaries*

Sgr	Total IPs	+ Length + Blink	- Length + Blink	+ Length - Blink	- Length - Blink	$\bar{x}$ SignDur PW (R) of IP
1	71(1.00)	50(.71)	13(.18)	2(.03)	6(.08)	977 ms
2	66(1.00)	35(.53)	14(.21)	9(.14)	6(.12)	1043 ms

There were seventy-one and sixty-six I-Phrase(R) boundaries respectively for Signer 1 and Signer 2; those for Signer 1 were already reported in Study 2. The remaining blinks were intermediate P-Phrases within the I-Phrase and a handful of P-Word boundaries within a P-Phrase. Signer 1 was more meticulous in describing the pictures, hence producing more P-Phrases than Signer 2 (160 vs. 138 total). Despite similar backgrounds, there was individual variation with the two native signers in terms of the number of prosodic constituents produced.

#### 4.2.1 *Blinks at I-Phrases*

Table 23.7 shows that of the I-Phrases present, most were marked by a blink (Signer 1, 89%; Signer 2, 74%).<sup>19</sup> Even though Signer 1 signed at a faster rate than Signer 2 and fewer blinks might be expected, Signer 1 systematically produced a blink at the right edge of I-Phrases and even more often than Signer 2. This confirms our finding in Study 1 that the speed of signing did not influence overall blink rate. Note also that some I-Phrases were not marked by a boundary blink (Signer 1, 11%; Signer 2, 24%), but they contained at least two of the other boundary behaviors listed in (7).

As in Study 2, lengthening was defined relatively, rather than absolutely, requiring that a form be double in length to count as I-Phrase lengthening. Table 23.8 shows concomitant cues for I-Phrase boundaries; lengthening occurred frequently at I-Phrase boundaries (74% and 67% in Signers 1 and 2, respectively),<sup>20</sup> and a high proportion of I-Phrase boundaries exhibited “+ Length, + Blink” (71% for Signer 1 and 53% for Signer 2).

Because of the picture description task that was used, many sentences containing classifier constructions were elicited. These typically contained one or more nominal categories for subject, object or locative, followed by a classifier construction involving a verb of motion or location. Both I-Phrases in (9) demonstrate this. In the first I-Phrase, the nominal subject UP^WORLD ‘moon’ precedes a locative predicate ‘CL: round\_object\_be\_located\_here.’ In the second, ROCKET precedes the motion predicate ‘CL: rocket + lands\_on\_round\_object<sub>i</sub>.’ The initial nominals form their own P-Phrases (discussed in the next section).

- (9) HKSL (video example 6; description of the picture in Figure 23.2 by Signer 1)<sup>21</sup>

H1: [[[UP]<sub>PW</sub> [WORLD]<sub>PW</sub> ]<sub>PP</sub> ]<sub>IP</sub>  $\left[ \left[ \left[ \text{CL:round\_object+be\_located}_i \right]_{PW} \right]_{PP} \right]_{IP}$   
 (copy of H1)  
 +blink +length(1.5x) +length(2x)+blink  
 (980 ms) (890 ms)

H1: [[[ROCKET]<sub>PW</sub> ]<sub>PP</sub> ]<sub>IP</sub>  $\left[ \left[ \left[ \text{CL:rocket+lands\_on}_i \right]_{PW} \right]_{PP} \right]_{IP}$   
 H2:  $\left[ \left[ \left[ \text{CL:round\_object}_i \right]_{PW} \right]_{PP} \right]_{IP}$   
 +length(x1.5) +length(2x)+blink  
 (480 ms) (880 ms)

‘The moon is located here; a rocket lands on it.’

As in other sign languages previously studied, topics often form their own I-Phrase. The first I-Phrase in (10), (repeated from (3)) is a topicalized structure; it contains a brow raise, a blink and double lengthening.

- (10) HKSL (video example 1; description of the drawing in Figure 23.2 by Signer 2)

brow raise  
 H1: [[[MOON]<sub>PW</sub> ]<sub>PP</sub> ]<sub>IP</sub>  $\left[ \left[ \left[ \text{CL:round\_object+be\_located}_i \right]_{PW} \right]_{PP} \right]_{IP}$   
 H2: (copy of H1)  
 +length(2x), +blink  
 (1110 ms)

H1: [[[ROCKET]<sup>22</sup>]<sub>PW</sub> ]<sub>PP</sub> ]<sub>IP</sub>  $\left[ \left[ \left[ \text{CL:rocket+lands\_on}_i \right]_{PW} \right]_{PP} \right]_{IP}$   
 H2:  $\left[ \left[ \left[ \text{CL:round\_object}_i \right]_{PW} \right]_{PP} \right]_{IP}$   
 +length(x1.5),+blink +length(2x),+blink  
 (720 ms) (1540 ms)

‘On the moon, a rocket lands (there).’

Table 23.9 summarizes the distribution of nominal and verbal categories with respect to how they interact with blinks to mark P-Phrase and I-Phrase boundaries. In this analysis, those P-Phrases with a boundary blink are assigned to either I-Phrase final or intermediate P-Phrases. Given the syntactic structure discussed previously, blinks marking an I-Phrase boundary are usually mapped onto the verbal categories, and this result is consistent with both Signer 1 (87 percent) and Signer 2 (76 percent). But note that in most of these cases, this is an artifact. These verbal categories are basically P-Phrases; they become candidates for I-Phrases because they occur in sentence-final position, creating a potential I-Phrase boundary, in line with the “Strict Layer Hypothesis.”

Table 23.9 *Distribution of HKSL blinks and syntactic categories*

Syntactic Categories	Signer 1			Signer 2		
	Total PPs	#IP Blinks	#PP Blinks	Total PPs	#IP Blinks	#PP Blinks
	160	63	35	138	49	38
Nominal	71 (.44)	8 (.13)	23 (.66)	66 (.48)	12 (.24)	30 (.79)
Verbal	89 (.56)	55 (.87)	12 (.34)	72 (.52)	37 (.76)	8 (.21)

#### 4.2.2 *Blinks at intermediate P-Phrases*

The data in Table 23.7 show that 39 percent of Signer 1's and 54 percent of Signer 2's intermediate P-Phrases (i.e., those internal to an I-Phrase) are marked by a blink, but a large number are not (61% for Signer 1 and 46% for Signer 2). So for the first time in our data, we see a trade-off between speed and blink rate in Signer 1, not at the I-Phrase but at the P-Phrase level. In other words, when the speed of signing is fast, the P-Phrase may get re-bracketed, affecting the alignment of the syntactic constituents within the prosodic constituent.

In (11) we see an example showing that the verbal complex may consist of a series of P-Phrases, one of which is the VP 'take the rabbit's ears' and a classifier predicate which expresses the manner of taking the rabbit by holding its ears. The picture eliciting the description is given in Figure 23.3. Many of the I-Phrases include more than one classifier predicate, each of which forms its own P-Phrase.

Figure 23.3 *Stimulus for the signed description given in (11).*



morphologically in our data, H2-Spread was not a reliable P-Phrase cue here (Brentari & Crossley 2002).<sup>24</sup>

In summary, a P-Phrase could be marked only by a blink, only by a relatively weak form of lengthening (x1.5), or by both a blink and a lengthening (x1.5). To function reliably, lengthening must be measured relative to signs of the same syllable structure in phrase-internal position (preferably from the same discourse and the same signer). This analysis, which includes a weaker form of lengthening along with blinks, accounts for the P-Phrases of 74 percent of Signer 1's and 84 percent of Signer 2's P-Phrases (see Table 23.10).

#### 4.2.3 *Blinks within P-Words*

Sometimes a blink with no other cue was also observed between two lexical elements of a compound. These forms were determined to be single P-words based on the criteria given in section 1.2. The examples in (13a) are nominal compounds, and those in (13b) consist of a manner verb plus a classifier predicate or a series of classifier predicates.

#### (13) P-Word blinks

- |                                                     |                                        |
|-----------------------------------------------------|----------------------------------------|
| a. BLACK <sup>^</sup> BELT 'blackbelt'              | adj <sup>^</sup> N (video example 8)   |
| UP <sup>^</sup> WORLD 'moon'                        | adv <sup>^</sup> N                     |
| RUN <sup>^</sup> ROAD 'running-track'               | V <sup>^</sup> N                       |
| b. CRAWL <sup>^</sup> CL:person + crawls 'crawl-to' | verb <sup>^</sup> CL (video example 9) |
| CL: handle + lifts_a_roll <sup>^</sup> CL: handle + | CL <sup>^</sup> CL                     |
| puts_roll_on_shoulder                               |                                        |
| 'lift and put a roll of fabric on shoulder'         |                                        |

The examples in (13b) seem to suggest that some verbal groups in HKSL form verbal complexes like 'CRAWL<sup>^</sup>CL:person\_crawls,' which were marked in a special way with respect to ordinary P-Words in HKSL. These were first observed in Eccarius and Brentari (2007) in their study of two-handed classifier constructions, but here the phenomenon occurred in both one- and two-handed forms. A few P-Word blinks also occurred at syntactic boundaries, such as in a DP domain between a lexical N and its associated functional morphemes such as determiner, number and quantifier. In the VP domain, they were found between the V and its object complement. These blinks are not lexical but boundary blinks by definition, because they did not span the lexical signs and occurred at the right edge of the sign. To what extent such blinks bear linguistic consequences in these cases is still uncertain, but the fact that they occur in these positions warrants investigation in the future.

## 5 Discussion and conclusions

In this chapter several contributions have been made to our understanding of variation in the expression of prosodic cues of sign languages; some previously held views about prosody have been confirmed and some challenged. Methodologically, the studies employed different dimensions of analysis and emphasized the importance of having converging independent sources of evidence in order to draw conclusions about prosody in sign language. By having comparative data on blinks in surrounding spoken languages, we were able to determine that blinks function linguistically in sign languages but not in spoken languages, confirming the results of Baker and Padden (1978) and Wilbur (1994a). By comparing a range of sign languages in Study 2 with respect to some common cues, we found crosslinguistic variation with respect to the distribution of these cues. Lastly, by having a detailed description of the non-conforming language, in this case HKSL, we discovered a more precise way of measuring phrase-final lengthening to distinguish between I-Phrases and P-Phrases. For these four unrelated sign languages, a similar set of cues were used to mark prosodic constituents, but the distribution of at least one cue (i.e., blinks) may be language-specific, as we have seen from the analysis of the HKSL data.

With regard to how much variation exists in the use of blink rate, the results of Study 1 demonstrate that there is language-particular variation in blink rate among the sign languages that were studied. HKSL signers had a higher mean blink rate than that of the other sign languages. With regard to the factors that condition this variation in blink rate, we cannot rule out the possibility that the high rate of blinks in HKSL is, in part, due to an influence from the surrounding cultural community, because the rate of blinks is statistically similar between HKSL and Cantonese. Speakers of both English and Cantonese showed similar blink rates and no correlation between prosodic constituency and blinks, while ASL, JSL and DSGS had a significantly lower rate of blinks; all sign languages had more systematic boundary blinks than spoken languages.

With regard to how much variation exists in the use of blinks to mark I-Phrases and the concomitant cues that accompany them, in Study 2 we confirmed that if I-Phrases are identified independently from blinks, as they were here, blinks are still highly correlated with this prosodic category (at least 74 percent). But, while blinks consistently mark I-Phrases in the four sign languages studied, blinks do not exclusively mark I-Phrases in HKSL; that is, blinks cannot be used as a diagnostic for I-Phrases in this language. We also found that crosslinguistic variation exists in the concomitant cues that occur with blinks. In three of the four sign languages analyzed (ASL, HKSL and DSGS), lengthening was the strongest concomitant cue, while in JSL it was head nod.

In Study 3, we analyzed HKSL for the placement of the blinks that did not fit into an I-Phrase analysis in order to establish the pattern employed in this language. Blinks more consistently marked I-Phrases than any other constituent, but also P-Phrases to a lesser extent, and there were some exceptional cases of a boundary blink in the middle of a compound and between a head and its complement. The results show that the frequency of blinks decreases when the prosodic constituent gets smaller (Sze 2008). We found that except for blinks, HKSL had a prosodic pattern similar to other sign languages that have been studied to date.

An additional finding was that total sign duration, including holds, repetitions and duration of the movement, when measured in a relative way among the three types of prosodic constituents, is predictive of prosodic constituency. P-Words exhibit no lengthening; P-Phrases exhibit a weakened form of lengthening (one and one-half times that of phrase-internal forms) and I-Phrases exhibit a strong form of lengthening (twice that of phrase-internal forms). Since lengthening was sensitive to prosodic boundaries, we were able to propose an analysis of HKSL based on this cue in order to differentiate P-Words, P-Phrases and I-Phrases. This analysis argues that lengthening will vary by prosodic position, a proposal that first appeared in Miller 1996 with regard to repeated movements (i.e., that the number of repetitions is closely tied to the prosodic position of a sign). The analysis of P-Phrases in HKSL can be applied to other sign languages, and it suggests an explanation for why P-Phrases are so difficult to characterize in a unified way. They form intermediate constituents, one with a stronger juncture than at a P-Word but with a weaker juncture than that of an I-Phrase.

There are still many open questions concerning prosody in signed and spoken languages that are beyond the scope of this chapter – such as which elements of prosody are truly contrastive, which ones have a role in other components of the grammar, such as syntax, morphology, etc., and which ones are purely prosodic. But given the important role that prosody plays in parsing the linguistic signal into meaningful constituents in all natural languages (in both adults and infants), understanding prosody and its crosslinguistic variation is important for work on constituent structure generally and on sign language constituent structure in particular.

#### **Appendix Notational conventions specific to this chapter**

**carat symbol ‘^’:** e.g., RUN^ROAD ‘running-track.’ This indicates a compound, either lexical or classifier.

**H1:** e.g., ‘FATHER, ROCKET, MOON, CL: rocket + lands\_on.’ one- and two-handed lexical signs, or elements of classifier constructions on the dominant hand.

**H2:** e.g., ‘CL:round\_object<sub>i</sub>.’ Elements of classifier constructions on the non-dominant hand. If a classifier element on H2 is a copy of that on H1, this is indicated as ‘(copy of H1)’ or

**bracketing:** e.g., H1: ‘ $\left[ \left[ \left[ \text{CL: rocket+lands\_on}_i \right] \right] \right]$ ’  
 H2: ‘ $\left[ \left[ \left[ \text{CL: round\_object}_i \right] \right] \right]$ ’<sub>PW</sub>PP<sub>IP</sub>

- a. If the dominant and non-dominant hands are articulated at the same time, they are considered part of the same P-Word, following the analysis of two-handed classifiers given in Eccarius and Brentari (2007).
- b. ‘subscripted PW, PP, IP’ indicate that the elements contained in the brackets are a Prosodic Word, a Phonological Phrase and an Intonational Phrase, respectively.

**Addition symbol ‘+’:** e.g., ‘CL: rocket+lands\_on.’ The ‘+’ separates the handshape from the movement of classifier elements encoded simultaneously. This representation appears on H1 usually. Sometimes there is no phonological movement on H2 when it is used to express an existential predicate (Wallin 1996). Existential predicates are not indicated in the notation.