The Medium and the Message

Prosodic Interpretation of Linguistic Content in Israeli Sign Language

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In natural communication, the medium through which language is transmitted plays an important and systematic role. Sentences are broken up rhythmically into chunks; certain elements receive special stress; and, in spoken language, intonational tunes are superimposed onto these chunks in particular ways — all resulting in an intricate system of **prosody**. Investigations of prosody in Israeli Sign Language demonstrate that sign languages have comparable prosodic systems to those of spoken languages, although the phonetic medium is completely different. Evidence for the prosodic word and for the phonological phrase in ISL is examined here within the context of the relationship between the medium and the message. New evidence is offered to support the claim that facial expression in sign languages corresponds to intonation in spoken languages, and the term "superarticulation" is coined to describe this system in sign languages. Interesting formal differences between the intonational tunes of spoken language and the "super-articulatory arrays" of sign language are shown to offer a new perspective on the relation between the phonetic basis of language, its phonological organization, and its communicative content.

Key words: prosody, intonation, sign language, Israeli Sign Language, superarticulation

1. Introduction

Many spoken languages have writing systems, and linguistic analyses are generally presented and exemplified in writing as well. These two facts have conspired to obscure a very important part of human communication, namely, the way we say what we say. In natural communication in spoken language, we break our utterances up into chunks, or constituents, and these constituents are characterized by intricate patterns of rhythm, prominence (or stress), and intonation. These patterns, which are referred to as prosody, give important cues to the syntactic structure of sentences, and also to semantic properties such as which parts of the sentence are in focus. They also provide subtler nuances of meaning beyond what is present in the words and their combinations. Since this prosodic pattern is physically inseparable from the speech stream, we might think of prosody as

intimately bound to the medium through which spoken language is filtered. This prosodic system is not peripheral; it is not optional; and it is not random. Rather, it is an essential and systematic part of language. In fact, it is often crucial for interpreting utterances. Consider as an example the story about the English professor who wrote (1a) on the board and asked the students to punctuate it; according to the story, men and women punctuated this string in different ways, shown in (1b) and (1c).

(1)   a.   Woman without her man is nothing
      b.   Men's punctuation: Woman, without her man, is nothing
      c.   Women's punctuation: Woman! Without her, man is nothing.

The fact that prosody is both essential and systematic can be demonstrated by using a fundamental tool of linguistic analysis — contrast. This tool rests on the assumption that the linguistic significance of any unit or element is determined by its ability to make minimal meaning contrasts. Let us consider some examples of ways in which different prosody can create minimal contrast in spoken languages, as preparation for the discussion of prosody in sign languages.

    The first distinction shows how **rhythm** is responsible for contrast. It is the familiar distinction between restrictive and nonrestrictive relative clauses.

(2)   a.   Restrictive relative clause:
              All linguists who want to learn more about sign language prosody will
              read this article.
      b.   Nonrestrictive relative clause:
              All linguists, who want to learn more about sign language prosody,
              will read this article.

The first example is restrictive because the clause 'who want to learn more about prosody' restricts 'linguists' to the group mentioned in the clause: **only** those who want to learn more about prosody will read the article. The second example is nonrestrictive: it means that **all** linguists want to learn more about sign language prosody **and** they will **all** read the article. The commas indicate the rhythmic chunking which distinguishes these two different interpretations of the same string of words. While each of the two sentences also has a different stress pattern and a different intonational tune in actual utterance, it is the rhythmic chunking that appears to be the most salient cue distinguishing these two sentences with their distinct meanings. In the absence of these rhythmic distinctions, i.e., if this sentence were to be artificially generated with rhythm distributed equally over each word, the addressee would have no way of knowing whether the speaker is referring to all linguists or only to those who want to know more about sign language prosody.

    In addition to rhythmic distinctions, **stress** or **prominence** may also

disambiguate two otherwise identical sentences. For example, the sentence 'Jerry called Bob a Republican, and then he insulted him', appears to be ambiguous if only the written version is considered. But in actuality, it is never ambiguous when spoken. Rather, there are two different prominence patterns, each one required by a different meaning of the sentence, as shown in (3a) and (3b), in which the stressed or prominent words are printed in italics:

(3) a.   Jerry called Bob a Republican, and *then* he *insulted* him.
            (Jerry insulted Bob.)
     b.   Jerry called Bob a Republican, and then *he* insulted *him*.
            (Bob insulted Jerry.)

Sentence (3a) means that Jerry insulted Bob, and that calling someone a Republican is not an insult. Sentence (3b) version means that Bob insulted Jerry, and that calling someone a Republican **is** an insult. The two versions render meanings that are completely distinct. Here again, if this sentence were to be artificially generated with equal prominence on all words of the sentence, the addressee would have no way of knowing whether, after the initial Republican-labeling, it was Jerry or Bob who did the insulting, and which of them was the recipient.

Determining 'who did what to whom' is a basic requirement for understanding language. In (3), the syntax alone cannot give us an unambiguous interpretation, because each of the pronouns 'he' and 'him' in the second clause could refer to either the subject or object of the main clause. It is only the prosody which can make this determination. The fact that there must be linguistic conventions in order for efficient communication to take place is neither surprising nor controversial. What comes as a surprise to many people, linguists included, is that some of these conventions are in the prosody alone.

Minimal pairs can also be created by manipulating only the **intonational tune**. In some languages, for example, the only difference between declaratives and *yes/no* questions is in the intonation, i.e. the rise and fall of the pitch of the voice. The examples in (4) come from such a language, Hebrew. (4a) has falling intonation whereas (4b) has rising intonation.

(4) a.   yoni halaX laXanut.
            Yoni went to-the-store
            'Yoni went to the store.'
     b.   yoni halaX laXanut?
            Yoni went to-the-store
            'Did Yoni go to the store?'

In informal registers of modern Hebrew, the rising intonation pattern of the *yes/no* question is the only way of distinguishing it from the declarative, and that is the

only function of that particular intonational pattern.[1] Linguistic intonation patterns like those suggested in (4) can be distinguished from paralinguistic intonation which indicates emotional state, for example (Ladd 1996), and which is outside the scope of this article. Here we deal only with linguistic intonation.

In English, intonation alone can distinguish two interpretations of ambiguous sentences. Let's consider the following example, from Pierrehumbert & Hirschberg (1990). The sentence 'Do you want an apple or banana cake?' may be interpreted as meaning either a choice between an apple cake and a banana cake, or between an apple (piece of fruit) and a banana cake. However, these two interpretations can be disambiguated by intonation, as shown in (5). The notation is an extension of Pierrehumbert's system (1980) and will be discussed further in Section 3. In the example, L and H stand for low and high tones; ⋆ stands for the accented tone; and % stands for an intonational phrase boundary, a constituent that will also be defined in Section 3. It is enough to note here that these examples are distinguished by two tonal contrasts: the low tone on 'apple' in (5a) versus the high tone on 'apple' in (5b); and the intermediate high tone before the disjunction 'or' in (5b), but no intermediate tone in (5a).

(5)   a.   Do you want an apple or banana cake?   (apple cake or banana
                        L⋆   **H⋆**   **L   L%** cake)
      b.   Do you want an apple   or banana cake?   (fruit or cake)
                        H⋆ H   **H⋆**   **L   L%**

Examples (1)–(5) have shown that prosody makes an important, indeed sometimes a crucial, contribution to the meaning of utterances. As any good stage actor can demonstrate with a myriad of different prosodies for any utterance, both linguistic and paralinguistic, the prosody may carry even **more** communicative information than the words themselves. To use a new interpretation of the words of Marshall McLuhan[2] — sometimes the medium **is** the message.

These examples are offered to illustrate some of the roles of prosody, in advance of delving into the nature of the prosodic system itself, which is actually quite complex. The phonetic expression of prosody in spoken language involves manipulation of duration, volume, pitch, and timing. The phonetic patterns of

1.   While a minimal contrast can be made by rising intonation in English as well, the intonational distinction is not straightforwardly syntactic as it is in Hebrew, merely changing a declarative to an interrogative. Rather, in a sentence like 'John went to the store?', the rising intonation adds special meaning, such as incredulity. The normal way of making a *yes/no* question from a declarative in English is by inversion (and 'do'-insertion in this example), as in the translation of (4b), in addition to an intonation pattern — one which is distinct from any of a number of possible questioning intonations that could accompany the string 'John went to the store?'

2.   McLuhan, M. & Q. Fiore (1967). *The Medium is the Message.* New York: Bantam Books.

prosody interact in systematic ways with other components of the grammar: phonology, morphology, syntax, and semantics. All of these other grammatical components have been shown to exist in sign languages, and to bear significant similarities to their spoken language counterparts (see e.g. Sandler & Lillo–Martin in press, for a recent overview). Given the importance of prosody for linguistic communication, it is reasonable to expect that sign languages will have a comparable system.

As the physical modalities are quite different, however, a comparison of this system in spoken and signed languages promises to reveal what is universal about prosody in human communication, and to pinpoint what is modality-dependent. These considerations form the context for the investigations reported here. One of the challenges to understanding prosody in sign language is to fathom the phonetic system, entirely different from that of spoken language, so that a meaningful comparison can be made of the ways in which phonetics is marshaled to serve prosody in the two language modalities. It will be shown that such a comparison can indeed be drawn in an instructive way. In what follows, two aspects of the prosodic system of the natural sign language of most of the deaf people in Israel, Israeli Sign Language (ISL), will be described. Evidence will be presented, partly from a joint study conducted with Marina Nespor, for prosodic constituency and intonational tunes in this language. First, the **prosodic word** and the **phonological phrase** will be shown to constitute prosodic constituents in ISL. That is, they have a prosodic reality distinct from their morphological and syntactic properties. It will then be argued that facial expressions enter into a system that will be called 'superarticulation', one that has much in common with intonation in spoken languages, but that is characterized by some differences as well.

2.   Two prosodic constituents in spoken and signed language: The prosodic word and the phonological phrase

I begin with spoken language prosodic constituents, before turning to sign language. The speech stream is broken up into chunks that make the grammatical constituency and structure clearer, and also highlight information that is relatively more important. It has been proposed that these constituents form a hierarchy:

(6)   Prosodic Hierarchy (after Selkirk 1984; Nespor & Vogel 1986)[3]
            syllable > foot > prosodic word > phonological phrase > intonational
            phrase > phonological utterance

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3.   The constituent 'clitic group', argued for in Nespor & Vogel (1986), has been omitted from its place between the prosodic word and the phonological phrase in the hierarchy in (6), both because its existence as a unit distinct from the prosodic word has become a controversial issue for spoken language, and because I have found no such distinction in sign language.

Each of these levels is marked by certain phonetic correlates, and each has been shown to be the domain for certain phonological rules. Both of these findings are considered evidence for the existence of the constituents in the hierarchy. In addition, even those prosodic constituents that correspond to morphosyntactic or syntactic constituents — i.e., the prosodic word and the phonological phrase — are not always precisely coextensive with them. This nonisomorphism between (morpho)syntactic and prosodic constituency is seen as evidence that prosodic structure is a component of the grammar in its own right, rather than simply being a reflex of other components, such as the syntactic component. While space does not permit a comprehensive discussion of these issues, some of them do require unpacking for the purposes of this paper, and we turn to that task now. For detailed explanation and argumentation in favor of the prosodic hierarchy and its implications, see, e.g., Selkirk (1984), and Nespor & Vogel (1986).

2.1. *The prosodic word*

One of the tests of wordhood is the ability of a word to stand alone, to be a minimal free form. The word is also the domain of lexical stress assignment. These characteristics are prosodic, but they generally coincide with other properties of words, such as the existence of a form-meaning or form-function correspondence and membership in some syntactic category. In some cases, however, elements which may be considered independent words on the basis of such grammatical properties behave less independently from the prosodic point of view. Function words may rhythmically group together with nearby content words, bearing no stress and otherwise losing phonetic strength — essentially becoming part of the stronger words. The most obvious example of this is clitics, such as pronoun clitics in French shown in (7), or auxiliary contraction in English, shown in (8), in which the function words merge with content words, called 'hosts'.

		individual words		*cliticized forms*	
(7)	French				
	a.	je aime	[žə em]	j'aime	[žem]
		'I love.'			
	b.	je le aime	[žə lə em]	je l'aime	[žə lem]
		'I love him.'			
(8)	English				
	a.	Terry is	[tɛri ɪz]	Terry's	[tɛriz]
	b.	Kim will	[kim wil]	Kim'll	[kiməl]

Each cliticized form is a single prosodic word, made up of two morphosyntactic words.

Sign languages show similar effects (Sandler 1999a). That is, in connected signing, certain function words may optionally lose some of their phonetic strength and combine in some way with nearby content words. In Israeli Sign Language (ISL), pronominal forms may cliticize onto hosts. The pronouns that may cliticize are personal pronouns, deictics, or possessive pronouns. The first two of these have G handshapes (index finger extended, other fingers closed); the third type has an F handshape (index and thumbtips touching to form a circle, other fingers extended). Two phonological processes create two different types of clitics: coalescence and handshape assimilation.

Coalescence takes the following form. When a symmetrical two-handed sign (the host) is followed by a pronoun, the dominant hand begins the host sign together with the nondominant hand, but halfway through production of the host sign, the dominant hand signs the pronoun, while the nondominant hand simultaneously completes the host sign.[4] The result is that the pronoun spans the same syllable as its host, losing its own syllabicity, as in the French examples (7) and the English examples (8) above.

The plain form of the sign SHOP is shown in Figure 1. Figure 2 shows the beginning and end of the cliticized form SHOP-THERE, in which the nondominant hand (h2) is articulating the end of SHOP, and the dominant hand is articulating the end of THERE (which is normally a one-handed sign). By coinciding with their hosts, these pronouns lose their syllabicity, a phenomenon noted for example in English auxiliary contraction (Selkirk 1984).[5]

4.   Symmetrical two-handed signs are Stokoe's 'double-dez' signs (1960). In simple terms, both hands have the same handshape, and they move symmetrically. The other main type of two-handed signs are those in which the nondominant hand serves as a place of articulation for the dominant hand. The latter type does not enter into coalescence. For discussions of the phonology of two-handed signs see, e.g. Battison (1978), Sandler (1989, 1993), Brentari & Goldsmith (1993), and van der Hulst (1996).

5.   Wilbur (1999a, this volume) observes that in American Sign Language, pronouns are not stressed phrase finally, while signs belonging to a lexical category receive prominence in that position.

a. SHOP (beginning)   b. SHOP (end)

Figure 1: SHOP, citation form

a. SHOP (beginning)   SHOP-THERE (ending, cliticized form)

Figure 2: SHOP-THERE, cliticized form with h2 coalescence

Interesting confirmation for the claim that host plus clitic form a single prosodic word comes from mouthing. In ISL, signers often mouth words from Hebrew. However, this mouthing is clearly not a spoken Hebrew accompaniment to ISL. Mouthing of that sort would be impossible, since the syntax and morphology of the two languages are so different from each other. Rather, mouthing seems to be a kind of systematic borrowing from Hebrew, with a structure of its own. This structure has little if anything to do with the structure of Hebrew, and I therefore take it to be part of ISL. In the coalesced host plus clitic forms, signers systemati–cally mouthed the Hebrew word for the host only (not the clitic), and, crucially, the timing of this mouthing spanned the whole form of host plus clitic. If the host

and the clitic (in the example, SHOP and THERE) behaved like two separate words, mouthing of the host content word (SHOP, 'Xanut' in Hebrew) would be expected to span only the time during which the dominant hand signed that word. When the dominant hand begins to sign the clitic function word (THERE, 'šam' in Hebrew), either no mouthing would be expected, or mouthing of the Hebrew translation of the function word would be expected. However, such mouthing patterns never occurred in the coalesced forms. Rather, the content word was systematically mouthed over the signed production of both the content word and the function word. This pattern is evidence that the two morphosyntactic words do indeed form a single prosodic word.

In the other type of cliticization, the pronoun assimilates the handshape of the host sign.[6] Here, the pronoun retains its own syllabicity, but it is phonetically weakened by losing its handshape.[7] The first person pronoun in ISL, shown in Figure 3, is formed by a pointing gesture toward the chest of the signer, made with a G handshape: the index finger extended and the other fingers closed. In the cliticized form, the first person subject pronoun assimilates the handshape from the host sign.

Figure 3: Pronoun, I (citation form)

6.   Note that this assimilation appears to violate the predictions of the feature hierarchy proposed in Sandler (1987, 1989, 1996), according to which the handshape cannot assimilate without palm orientation also assimilating. However, the assimilation that occurs in cliticization is a postlexical process, occurring only when words are combined with each other, and postlexical phonological processes are often non-structure-preserving, as this one is. Therefore, it is not seen as a counterexample to the generalization expressed by the feature hierarchy, which expresses a relation that holds between handshape and orientation within the lexicon only.

7.   This type of assimilation has also been reported in American Sign Language (e.g. Corina 1990; Wilbur 1996, this volume)

Figure 4 shows the form I-READ, in which the first person pronoun 'I' has assimilated the V handshape from READ, extracted from a sentence meaning, 'I read the story fast'.[8]

a. I (clitic)   b. READ (beginning)   c. READ (end)

Figure 4: I, cliticized with handshape assimilation from READ

In Figure 4a, the nondominant hand is already in its position as place of articulation for the host sign READ. This type of spreading of the nondominant hand is analyzed as an external sandhi rule whose domain is the phonological phrase, and will be described in detail in Section 2.2. It is not related to cliticization. Rather, it is the handshape assimilation on the dominant hand that is of interest here.

It is argued in Sandler (1999a) that each of these processes invokes constraints that hold on the prosodic word: **the monosyllable constraint**, stating that ISL words 'prefer' to be monosyllabic; and the **selected finger constraint**, stating that there should be only one group of selected fingers in a prosodic word.[9,10] It appears that the position of the pronoun and host within the larger constituent, the phonological phrase, determines which type of cliticization may take place.

8. The facial expression in figures (4a, b, c) adds intensiveness to the meaning, 'fast'. This may be equivalent to what have been described as adverbial facial expressions in ASL (Liddell 1980).

9. These constraints have been proposed for ASL as well (e.g. Coulter 1982; Mandel 1982), but there is no consensus on their domain, nor has a treatment of interaction among these constraints been proposed for that language.

10. In satisfying the monosyllable and selected finger constraints, other constraints such as Battison's (1978) Symmetry Constraint are violated, however. These observations lead to a constraint interaction analysis. Specifically, it is argued in Sandler (1999a) that ISL cliticization is the result of postlexical reranking of lexical constraints on the prosodic word. In this view, it is not surprising that lexicalized compounds in ISL do not show the postlexical coalescence and assimilation effects.

Assimilation occurs in weak phrase-initial position, while coalescence occurs in prominent phrase-final position. We now turn to that next higher constituent on the prosodic hierarchy, the phonological phrase.

2.2. *The phonological phrase*

The phonological phrase corresponds in certain ways to noun phrases, verb phrases, and adjective phrases. According to the theory of Nespor & Vogel (1986), the phonological phrase includes the head of such phrases (i.e., the noun, verb, or adjective, respectively) and all words belonging to the phrase on one side of the head — either before the head or after it. The basic word order properties of the language determine which side of the head belongs in the same phonological phrase with the head. If the language is head first, followed by complement or other modifiers, like English or Hebrew, then the phonological phrase includes the head and all the material before it (not the complements). If the language is complement first and then head, like Turkish, then the phonological phrase includes the head and all the material after it. This definition is from Nespor & Vogel (1986):

(9)   Phonological phrase domain: The domain of a P (phonological phrase) consists of a C (clitic group) [i.e. a prosodic word; see text below: WS] which contains a lexical head X (Noun, Verb, or Adjective) and all Cs on its nonrecursive side up to the C that contains another head outside of the maximal projection of X.

As explained in Footnote 3, I am assuming here that 'clitic group' is replaced in this definition by 'prosodic word'. Nespor & Vogel found that there is a characteristic prominence pattern within phonological phrases, and that this pattern also depends on the basic word order of the language. In head–complement languages like English or Italian (10a), prominence is normally at the end of the phonological phrase; in complement–head languages like Turkish (10b), it is at the beginning.[11]

(10) a.   Italian: [per *me*]$_P$
                       'for me'
     b.   Turkish: [*benim* ıçın]$_P$
                        me   for
                       'for me'

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11.   In examples (10a, b), the heads are the pronouns meaning 'me'. Prepositions do not count as heads for phonological phrase formation, and are considered to be material on the nonrecursive side of the head within the same phonological phrase.

These examples are comprised of a head and noncomplement words in the same syntactic phrase. The head is the noun, a member of a major lexical category, and the preceding preposition in Italian, a head-complement language, is included in the same phonological phrase in (10a). In (10b), the postposition is included in the same phonological phrase in Turkish, a complement-head language. In Italian, prominence is at the end, as it is in English, also a head-complement language. In Turkish, a complement-head language, the prominence is at the beginning.

There are various kinds of evidence for the phonological phrase constituent in spoken languages. Phonetically, phonological phrases are sometimes set off by phrase final lengthening, slight pauses and/or changes in pitch. As we have seen, one end of a phonological phrase has more prominence than the rest of the phrase. In addition, there are phonological rules, such as assimilation rules, that alter the segmental content of words, and that operate only within the phonological phrase. That is, they respect the boundaries separating phonological phrases.

An example of such a rule is the Italian rule of Raddopiamento Sintattico, which lengthens (geminates) a consonant at the beginning of a word after a stressed syllable. The rule applies within phonological phrases, indicated by bold and underline, in example (11a), but not across a phonological phrase boundary, as shown in (11b). The divisions into phonological phrases in the translations of these examples may give the reader an intuitive feel for this constituent.

(11) Raddopiamento Sintattico within the phonological phrase in Italian (Nespor & Vogel 1986):

a.   [Il tuo pappagallo] $_P$ [é **p**iú **l**ocquace] $_P$ [del mio] $_P$
        '[Your parrot]   [is *more* talkative]   [than mine].'

b.   [Guardó] $_P$ [piú attentamente] $_P$ [e vide] $_P$ [che era un pitone] $_P$
        '[He looked] [*more* carefully]   [and saw] [it was a python].'

The stressed vowel triggers gemination of the following consonant. But the rule applies only if the trigger and the next consonant are in the same phonological phrase. The [p] in *piú* ('more') in the first example is geminated — i.e., the closure of the lips is held longer — following the stressed [é] within the same phonological phrase. However, the [p] in the same word in the second example is not geminated, though it also follows a stressed vowel ([ó] in *guardó)* because the phonological phrase boundary comes between. The overall effect of such rules may be to reinforce the rhythmic pattern of the sentence. From a linguistic point of view, such rules provide evidence that sentences are broken up into phonological phrases in the mind of the speaker.

We now turn to ISL. Analyzing a videotaped corpus of 90 sentences — 30 different sentences translated from Hebrew to ISL and signed by three native signers — Nespor & Sandler (1999) report evidence for phonological phrases in Israeli Sign Language. It appears that the basic word order of the language is head-

complement (or head–modifiers), although word order is relatively free, and topic fronting is common.

(12) Examples of basic word order in ISL
    a.   DOG SMALL]$_{NP}$
    b.   BUY BICYCLE]$_{VP}$
    c.   TIRED REALLY]$_{AdjP}$
    d.   I PERSUADE (HIM) STUDY]$_{\text{main clause, subordinate clause}}$

In order to examine the prosody of this language, an elaborate coding system was developed, including the following categories: brows, eyes, cheeks, mouth, mouthing (of Hebrew words), head, torso, reduplication, hold, pause, speed, size. Sentences were glossed at the top of the page, and each category in which some articulation occurred was marked, in such a way as to align the extent of the articulation with the sign or sequence of signs it cooccurred with.[12]

    In this preliminary study, it was found that phonological phrases conform to the algorithm in (9), and prominence is at the end, as predicted, since ISL appears to be basically a head-complement language. The correlates of prominence are argued to be reduplication, hold at the end of the prominent sign, or pause after the last word in the phonological phrase.[13] An example is shown in (13), where 'P' stands for phonological phrase, and 'I' for the larger constituent, intonational phrase.

(13)   [[book–there]$_P$ [he write]$_P$]$_I$ [[interesting]$_P$]$_I$
            hold   **redup**   **redup**
        'The book he wrote is interesting.'

'Pause' was recorded when a brief lack of movement was observed between signs, and the hands relaxed, assuming a more neutral handshape and location. 'Hold' was recorded when the signing hand or hands retained the handshape, and remained at their location relatively longer than normal, according to the judgements of native signers who coded the sentences. According to the theory of sign

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12.   All coding was performed by a native signer and a trained linguist conversant in ISL working together. We made two changes in the coding categories as we worked. First, we eliminated the category 'eyegaze', as we judged it to be controlled by the syntax and other factors, and not by the prosody (see Bahan 1996). Second, we discovered that more information about the behavior of the hands was required. In particular, coding of the assimilation and coalescence effects described in § 2.1. was added; and the spreading behavior of the nondominant hand to be reported in § 2.2. was also independently coded.

13.   Minimally, these markers argue for the existence of phonological phrases since they set off the phrases phonetically. For arguments that they are indeed prominence markers, see Nespor & Sandler (1999).

language phonological structure assumed here (Sandler 1989), all holds are derived, either morphologically or prosodically. They are not part of the underlying representation of signs. I will return to this point below.

The behavior of 'reduplication' held some surprises for us. It turned out that the position of a sign within a phonological phrase often predicts whether a sign is reduplicated or not, regardless of whether it is lexically specified as reduplicated. That is, signs that are underlyingly reduplicated could lose their reduplication in non–prominent (e.g. phrase-initial) positions within phonological phrases, while signs that are underlyingly not reduplicated often do get reduplicated (sometimes several times) when they occur in prominent phrase-final position. Signs that are underlyingly reduplicated behave the same way phrase-finally as those that are not. The upshot of this discovery is that, in ISL at least, it is not possible to tell whether or not a sign is lexically reduplicated by observing it in a sentence.[14,15]

The evidence so far suggests that phonological phrases exist in ISL, and that they are prominence-final. More evidence for phonological phrases in the language comes from a phonological process that occurs only within the phonological phrase domain: the spread of the nondominant hand. The rule, which is optional, is triggered by a two-handed sign. The nondominant hand spreads beyond the trigger, backwards, and/or forwards, but never spreads beyond the phonological phrase boundary.[16]

As seen in Figure 5, the nondominant hand retains the handshape and location for the sign PERSUADE in the sequence meaning, 'I persuaded him to study', whereas the dominant hand signs the next word STUDY. STUDY is a one-handed sign in citation form. The context of the sequence is given in (14).

(14)   [[MALE HUMAN-CLASSIFIER THERE]$_P$]$_I$ [I PERSUADE STUDY]$_P$]$_I$
            'I persuaded him to study.'

As an articulator that is anatomically a twin to the dominant hand articulator, the nondominant hand has no equivalent in spoken language. Also, the nondominant hand is not generally an independent articulator in sign languages (Brentari & Goldsmith 1993; Perlmutter 1991; Sandler 1989, 1993; van der Hulst 1996). Yet

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14.   For a discussion of reduplication by position in LSQ (the sign language of Quebec), see Miller (1996).

15.   If ASL reduplication behaves like that of ISL, this could explain why the fact that the nouns of noun/verb pairs are lexically reduplicated was not obvious (Supalla & Newport 1978).

16.   Both symmetrical two-handed signs and signs in which the nondominant hand is a place of articulation may trigger spreading. Occasionally, however, the latter type of sign may behave somewhat differently. If the sign is decomposed so that the nondominant hand is interpreted as a classifier morpheme, then it may spread beyond the phonological phrase boundary to an intonational phrase boundary or even to the end of a larger discourse unit.

its existence is exploited in sign language to mark the phonological phrase domain. As is typical of phonological processes, signers are not aware of this process, yet sentences of all three of our consultants were characterized by it. Nondominant hand spread occurred in 53 of 247 phonological phrases.[17,18]

a. PERSUADE   b. STUDY

Figure 5: Spread of the nondominant hand within a phonological phrase

The domain of this spreading, taken together with other phenomena described above, indicates that it could be misleading to observe the phonological form of signs without taking into account the larger prosodic context of which they are a part. This sort of nondominant hand spread has been found in compounds in ASL (Liddell & Johnson 1986; Sandler 1987, 1989) and in ISL. But the ISL data reported here raise a question about those earlier findings: It could be that in ASL too the domain of nondominant hand spread is the phonological phrase rather than the compound.

As mentioned, reduplication is also manipulated by prosodic factors, which means that one cannot determine whether or not a sign is lexically reduplicated by merely observing it in the signing stream. Similarly, the prosodic behavior of holds, which appear to be inserted phonological-phrase-finally, also call into

17. Our impression is that this number represents a high percentage of the phrases in which two-handed signs occurred, although we have not quantified this precisely.

18. A reviewer suggested that an example parallel to the Italian RS example, in which sandhi does not take place because of a phonological phrase boundary, would further support the claim about domain. However, since the h2 spread sandhi rule that we found in ISL is optional, I do not believe that its nonoccurrence is the best evidence for domain effects. Rather, I submit that those cases where h2 does spread but stops precisely at the phonological phrase boundary are more convincing. In many cases of h2 spread, the phonological phrase boundary coincided with an intonational phrase boundary. In others, the spread was stopped by another two-handed sign. Excluding all those cases, we were left with nine examples in which the only possible explanation for the interruption of h2 spread was the existence of a phonological phrase boundary, and there were no cases in which such a boundary did not block spreading.

question certain assumptions about the underlying form of signs. In particular, the suggestion that holds are part of the underlying representation of most signs, as claimed in the Move-Hold model of Liddell & Johnson (1989 *inter alia*), seems to require further scrutiny in the light of the present results. Since any sign in isolation constitutes its own phonological phrase — and, by extension, its own intonational phrase and phonological utterance — and since at least some holds are inserted according to the properties of these prosodic constituents, it is possible that the holds observed in citation forms are not underlying at all (see Perlmutter 1992; Sandler 1986, 1989 for suggestions along these lines).[19] Because the prosodic phenomena reported here are those of ISL and not of ASL, however, such suggestions must be seen at this point as just that, suggestions for more extensive investigation.

3.   Intonation on the face: Superarticulation

In spoken language, intonational melodies are superimposed on the rhythmically marked constituents, phonological phrase and intonational phrase. The latter constituent, the intonational phrase, is the next higher constituent above the phonological phrase in the prosodic hierarchy. Typically, topicalized and other extraposed elements, parentheticals, nonrestrictive relative clauses, among other structures, form their own intonational phrases. Examples from ISL are shown in (15). The English translations involve the same kind of intonational phrasing.

(15) a.   Parenthetical:
              [DOGS THOSE]$_I$ [YOU KNOW]$_I$ [LIKE EAT COOKIES]$_I$
              Dogs, as you know, like cookies.'
       b.   Nonrestrictive relative clause:
              [BOOKS HE WRITE PAST]$_I$ [I LIKE]$_I$ [DEPLETE]$_I$
              'The books he wrote, which I like, are sold out.'
       c.   Right dislocated element:
              [THEY TIRED]$_I$ [PLAYERS SOCCER]$_I$
              'They are tired, the soccer players.'
       d.   Topicalized element:
              [[CAKE]$_P$]$_I$ [I EAT-UP DEPLETE]$_P$]$_I$
              'The cake, I ate up completely.'

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19.   Liddell (1990) emphasizes that holds in the Move-Hold theory are defined as segments in which all aspects of the sign are in steady state, a definition which is compatible with the holds coded in our data. The difference is that in the MH theory, these steady state periods are claimed to be underlying, i.e. specified in the lexicon, while the claim adopted here and elsewhere in my work is that holds are either derived morphologically or imposed by the prosody.

The intonational phrases of spoken language are so named because they are bounded by intonational tunes, although phonological phrases can also be so bounded.[20]

The fact that the same tunes can be superimposed on strings of different lengths is one of the properties that shows this system to be independent of the segmental level of structure. Intonation is therefore considered to constitute a suprasegmental level of structure. This system is complex, and my investigation of it in ISL is just at the beginning stage. The observations that follow, then, are preliminary, but already strongly suggestive. It will be shown that there are clear similarities between intonation in spoken language and certain uses of facial expression in sign language, and some potentially instructive differences as well.[21]

The inventory of forms of spoken languages includes more than lists of sounds, lexical items, and syntactic structures. It also includes lists of intonational tunes — sequences of tones of different pitches — which have meanings of their own, and are therefore sometimes referred to as morphemes (e.g. Hayes & Lahiri 1991). Some of these meanings correspond to sentence types, like the Hebrew declaratives and questions shown in (4). Others may disambiguate grammatical function, as shown in (5), or may add nuances of meaning, such as irony or incredulity. There are two types of units which create the pitch excursions or tunes of intonation — pitch accents and boundary tones — and the placement of these tunes is systematic. Pitch accents associate to the stressed syllable of the focused word in a constituent and contribute to the impression that the word is prominent or stressed, whereas the boundary tones occur at the ends of prosodic constituents.

Each tonal unit — the pitch accent, the phonological phrase boundary tone, and the intonational phrase boundary tone — can itself involve more than one tone in some languages, so that these sequences can become quite complex. In the following Bengali example (from Hayes & Lahiri 1991), a focus contour is followed by a continuation rise. The focus contour is an $L^\star$ pitch accent followed by an H phonological phrase boundary tone and an L intonational phrase boundary tone — $L^\star$ H_P L_I — and it means that the phrase so marked is emphasized within the sentence. The continuation rise is simply a high tone H and means that

20.   In the interest of coherence, I am following Hayes & Lahiri (1991) in assuming that the phonological phrase is the same as the intermediate phrase of Pierrehumbert and Beckman (1986) for the purposes of intonation.

21.   Some key references in intonation research are Beckman & Pierrehumbert (1986); Bolinger (1986, 1989); Gussenhoven (1984); Hayes & Lahiri (1991); Ladd (1996); and Pierrehumbert (1980).

some other related information is following.[22] According to the rules for place-
ment of pitch accent and boundary tones, the whole sequence of four tones is
pronounced on a single Bengali word *harlo.*

(16)   [jodio ram [harlo,]$_P$]$_I$ (o k^{h}ub b^{h}alo k^{h}elec^{h}ilo)
                         L⋆ H$_P$ L$_I$ H$_I$
              'Although Ram lost,   (he very well played).'

According to the analysis of Hayes & Lahiri, among the other tunes occurring in
Bengali in addition to the focus tune are the *yes/no* question tune L⋆ H$_I$ L$_I$, the
declarative tune, H⋆ L$_I$, and the *wh*-question tune L⋆ H$_P$ L$_I$. The componentiality
of tunes is demonstrated by showing that tunes may combine with each other and
retain their meanings. Just as the focus tune can combine with the continuation
rise, as shown in (16), for example, the declarative tune may also combine with
the continuation rise.[23]

     The tones of spoken language intonation are transmitted by a single articula-
tor, the glottis. Only one tone at a time may be produced, because it is not
possible to vibrate the vocal cords at two different frequencies simultaneously.
Presumably, then, in order to arrive at a large vocabulary of contrastive tunes,
there must be complex sequences of tones. Another feature of spoken language
intonation is that the same channel is also involved in transmitting the lexical items
themselves, a fact which must surely influence the placement of intonational tunes,
forcing them to be synchronized with the words and the rhythmically marked
constituents.[24]

     Since intonation does carry such an important linguistic load, it would be

22. According to the theory of Pierrehumbert (1980), all contrasts can be phonologically
     represented with combinations of only high and low tones, although the perceived melodies
     contain a much wider range of pitches.

23. The Bengali examples are chosen because of their simplicity and clarity. See Pierrehumbert &
     Hirschberg (1990) for a componential analysis of tunes in English intonation.

24. It is actually possible to produce more than one perceivable pitch simultaneously, either by
     enhancing certain harmonics of the fundamental frequency or by vibrating other structures in
     the vocal tract in addition to the vocal cords. These techniques are used in certain cultures of
     Siberia and central Asia in so-called throat-singing (Levin and Edgerton 1999). According to
     my understanding, however, it would be difficult if not impossible to superimpose speech on
     this voice that has more than one tone. In the first type of throat singing, the tongue and lips
     are employed in the service of enhancing certain harmonics of the fundamental frequency set
     up by the vocal cords, and would not be available for further articulation. In the second type,
     movement of the tongue or lips that would be necessary for speech would obscure or cancel
     the tones created by the second source. In any case, it appears that neither type cooccurs with
     speech. As the authors write, throat-singing is "an expressive language that begins where verbal
     language ends."

surprising if sign languages did not have a way of expressing the same kinds of information. Yet, as is clear from the foregoing description, the phonetics of intonation in spoken language has no counterpart in sign language. The lexical items in sign languages are transmitted mostly by the hands.[25] We have seen that the rhythmic behavior of the hands and certain articulations, e.g. handshape, can cue prosodic constituents, such as the phonological phrase and the prosodic word. However, no evidence has been found to indicate that the hands simultaneously transmit meaningful suprasegmental units that are independent of the words and their meaning, i.e., no evidence that they also articulate an intonation-like level of structure, comparable to what the vocal cords do in spoken language. To find the equivalent of intonation in sign language, one must look beyond the hands, to the face.

Many researchers have demonstrated that nonmanual signals including facial expressions can signal different types of syntactic structures in American and other sign languages, such as *yes/no* and *wh*-questions, topicalized constituents, relative clauses (e.g. Aarons et al. 1992; Baker-Shenk 1983; Coerts 1992; Liddell 1978, 1980; Petronio & Lillo-Martin 1997), and even agreement marking (Bahan 1996). Recently, research has begun to seriously investigate the claim that many facial articulations may be best understood as fulfilling the role of intonation (e.g. Reilly, McIntire & Bellugi 1990; Sandler 1999b; Wilbur 1991, 1996, 1999a, b).

My work on Israeli Sign Language, some of it together with Marina Nespor (Nespor & Sandler 1999), has begun to uncover clear similarities as well as some differences between intonation in spoken language and facial articulation in ISL. Because the term 'intonation' reflects a vocal bias, I will use the more neutral term 'superarticulation', for this level of structure in sign languages. In place of 'tunes', I will use the term 'arrays'. A goal of our ongoing research is to establish the phonological primitives of the system of superarticulation (intonation), so that each significant articulatory component will be designated as a facial articulation (tone), and a systematic combination of these components as a superarticulatory array (tune).

In ISL as in other sign languages, different facial expressions systematically distinguish declaratives from questions, and *yes/no* questions from *wh*-questions. As with tunes in spoken language, additional nuances of meaning are also systematically communicated by facial articulations in sign language (such as the expression meaning 'intensively' in Figure 4). Finally, arrays of facial expressions, like tunes, are anchored to intonational phrases and to phonological phrases.

Let us consider the formal distribution first. Figure 6 shows a sentence from

25.   Some lexical items in ISL and ASL (and probably all SLs) involve facial articulation in addition
       to manual articulation. Since these are lexical and not prosodic, they are not discussed here.

ISL divided into phonological phrases (P) and intonational phrases (I), and coded according to the system we have developed.

	[[BOOK-THERE]ₚ	[HE WRITE]ₚ]ᵢ	[[INTERESTING]ₚ]ᵢ
brows	up _____		down _____
eyes	squint _____		droop _____
mouth		'O' _____	down _____
tongue			
head	tilt _____		
mouthing	'book'_____		'interesting'__
torso	lean _____		
hold	=		
reduplication	–1	x 3	x 4
pause			
speed			slow
size		big	big

Figure 6: 'The book he wrote is interesting.'

Recalling the discussion of phonological phrase markings, we see that the first phonological phrase, BOOK-THERE, has a hold at the end of THERE; the word WRITE, the last word of the second phonological phrase HE WRITE, is reduplicated with three iterations; and the only word in the last phonological phrase INTEREST-ING, is also reduplicated, iterated four times. The word BOOK, which is reduplicat-ed (two iterations) in citation form, is formed only once here (indicated in our coding system by minus one –1), because it occurs in a weak position in the phonological phrase, at the beginning.

This sentence is divided into two intonational phrases, which are separated by a change in head position, a phenomenon which was ubiquitous in our data; nearly all intonational phrases in our corpus were separated by a change in head position. The other clear signal for intonational phrase boundaries in the ISL data is an across-the-board change in all facial articulations.[26]

This correspondence between the domain of the intonational phrase constitu-ent and the domain of facial articulation is seen as analogous to the correspon-

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26. Optionally, intonational phrases may also be separated by pauses and/or eyeblinks. See Baker & Padden (1978) and Wilbur (1994) for treatments of eyeblinks in ASL.

dence between the edge of intonational phrases and the occurrence of boundary tones, and is an argument in support of the claim that superarticulation in ISL fulfills one of the same grammatical roles as intonation in spoken language: signaling the extent of the constituent.

While all facial articulations systematically change at the intonational phrase boundary, some of them may characterize only one phonological phrase within the intonational phrase. The analogy with spoken language is clear: Just as phonological phrases can have boundary tones in spoken language, so facial articulations can characterize phonological phrases in sign language. Recall the minimal pair distinguished by intonation, shown in (5) and repeated here as (17) for convenience. In each sentence, there are two pitch accents, one on 'apple', and one on 'banana'. In (17a), there is only one phonological phrase, bounded with a L tone (underlined), and followed by the intonational phrase boundary tone, L%.

(17) a.   [Do you want an apple or banana cake]$_P$]$_I$ (apple cake or banana
                       L⋆   H⋆   <u>L</u>   L%   cake)
     b.   [[Do you want an apple]$_P$ [or banana cake]$_P$]$_I$ (fruit or cake)
                      H⋆ <u>H</u>   H⋆   <u>L</u> L%

In (17b), there are two phonological phrases, the first marked with a H boundary tone, and the second with a L. In both (17a) and (17b), the intonational phrase boundary tone L% has scope over the whole intonational phrase (the whole sentence in these examples).

The ISL example in Figure 6 above bears certain formal similarities to the English example in (17). For purposes of comparison, let us focus first on the first intonational phrase BOOK-THERE HE WRITE. The brows are raised over the whole intonational phrase. This intonational phrase is made up of two phonological phrases BOOK-THERE and HE WRITE. These two phonological phrases do not have identical superarticulatory arrays. The first phonological phrase is characterized by a squinting of the eyes. While we are still far from a taxonomy of super-articulations and their meanings, we have established that the eye squint, discussed below, roughly bears the meaning 'information shared by signer and addressee'. The second phonological phrase is not marked by the eye squint, but it is marked by an 'O'-shaped mouth gesture. This sort of superarticulatory configuration was common in the corpus: one facial articulation, such as brow raise, marked a whole intonational phrase, while another, such as an eye or mouth gesture, marked only one of two phonological phrases within the same intonational phrase. There are, then, formal similarities between intonation and superarticulation.

Similarities are seen functionally, as well. In particular, different facial articulations correspond to different meanings or grammatical entities. For example, *yes/no* questions are distinguished from *wh*-questions and from declaratives by different superarticulatory arrays, just as they are distinguished by

different intonational tunes in Bengali, Hebrew, and other spoken languages. As indicated in Figure 6, information that is shared by the signer and addressee is signaled by another superarticulation, the eye squint. A comparison can be drawn with English, in which intonation can reveal what the speaker considers to be mutually believed by speaker and hearer (Pierrehumbert & Hirschberg 1990).

As in spoken language, the resulting arrays of superarticulation are componential in nature. As we have seen, one can distinguish the Bengali declarative tune and continuation tune, and each can combine with other tunes, while retaining their meanings. Similarly, in ISL different superarticulations can occur independently or cooccur, still retaining their individual meanings as well.

The componential nature of superarticulation in sign language can be demonstrated by illustrating individual superarticulations, and then their cooccurrence in natural signing of ISL. First, the facial articulation for *wh*-questions is shown in Figure 7, from a question meaning 'Where is the house?' It consists of furrowed brows and a forward head position.

Figure 7: *Wh*-question superarticulation

Figure 8 shows the superarticulation that signals information that is shared by signer and addressee, consisting of squinted eyes, produced in a sentence meaning 'That house we were talking about is there.'

Figure 8: Shared information superarticulation

Finally, the two can occur together in a *wh*-question that involves shared informa-tion, characterized by the brow and head positions of *wh*-questions together with the eye position of shared information. This is shown in Figure 9, from a sentence meaning 'Where is that house we were talking about?'

Figure 9: *Wh*-question and shared information superarticulation

The compositionality of superarticulation in ISL is further supported by the fact that shared information can also combine with *yes/no* question superarticulation (Nespor & Sandler 1999). These examples suggest that the primitives of super-articulation are different positions of the brows, eyes, cheeks, mouth and head (at least), while the primitives of spoken language intonation are L and H tones plus accent. In spoken language, the tones align with focused words, with phonological phrase boundaries, and with intonational phrase boundaries. In ISL, superarticulations

cooccur with phonological phrases and with intonational phrases, extending from initial to final boundary.

Many other researchers have stressed the importance of facial expression and other nonmanuals in ASL, as pointed out at the beginning of this section. But most of those studies have either been descriptive/phonetic or have dealt with the role of nonmanuals in syntax. The hypothesis presented here is that facial expression corresponds to intonation in spoken language. Similar suggestions have been made for ASL (Reilly et al. 1990; Wilbur 1991, 1994, 1996, 1999b). I am further hypothesizing that, like intonation, superarticulation is an independent component of the grammar which interacts with syntax, but should not be considered part of syntax — a hypothesis that must be tested in future research. Research is also needed to determine the range of superarticulations and meanings, as well as to compare the systems in the two modalities with more detail and depth. Yet the findings reported above, together with those reported in Sandler (1999a, b) and Nespor & Sandler (1999), already strongly suggest that the superarticulation of sign languages bears significant similarity to the intonation of spoken languages.

Together with the similarities, however, there are also interesting differences between the phonetic instantiations of intonation in the two modalities. In spoken language, as we have seen, intonations consist of sequences of high and low tones, some accented and others not, all transmitted in the vocal channel. In sign language, the facial articulations involve a number of channels — e.g. the eyebrows, upper and lower eyelids, the mouth — and each of these may articulate more than one gesture. Furthermore, none of these is used for transmitting the lexical information. All of this means that in sign language there is no need to sequence the articulations in order to arrive at a large vocabulary of tunes or arrays. Rather, the articulations can be generated simultaneously with each other, and simultaneously with the signs. And indeed they are. Rather than pinpointing prosodic constituent boundaries and arranging themselves there in a tone-like sequence, sign language superarticulations covary internally and are produced simultaneously with each other, and with entire prosodic constituents. Rather than intonational tunes, then, we may think of these combinations of facial expressions as superarticulatory arrays. We now turn to some implications and questions raised by these findings.

4.   Discussion and directions for future research

A novel implication for **spoken** language arises from this study: that the spoken language tunes formed by sequences of pitch accents and boundary tones are an artifact of the spoken modality, and not a requirement of the linguistic system *per se*. That is, a system that superimposes some kind of linguistic form upon our

utterances in order to classify semantic, pragmatic, and syntactic structures, and to convey nuances and scope of meaning, appears to be a universal characteristic of human language, but the form of this system is modality-specific in interesting ways.

Clearly, many questions remain in the study of sign language prosody as well, some of which are currently under investigation in our lab. One question not yet addressed is whether an equivalent of pitch accents exists in sign languages. In spoken languages, pitch accents, which apparently have some elements of meaning of their own, interact with the focus structure of utterances by aligning with focused constituents and adding salience to them. While there has been some work on focus and prominence in sign language, by Wilbur and her colleagues (see Wilbur 1999a, b, this volume) and also by Nespor & Sandler (1999), the phonetic correlates of prominence described are manual, not nonmanual/super-articulatory. This is worthy of more careful study. As explained in Section 3, other burning questions remain about the full vocabulary of superarticulations and arrays, and their interaction with syntax, semantics, and pragmatics. All of these are left to future research.

Certain superarticulations are candidates for sign language universals, for example, those that mark *yes/no* questions and *wh*-questions. These may have been grammaticized from universal nonlinguistic facial expressions (see Campbell et al. 1999). It has been suggested that some universal spoken language intonations may have originated in nonlinguistic sources (Ohala 1984), and have since been 'phonologized' (Gussenhoven 1999; and for relevance to sign language, Sandler 1999b). Other prosodic elements seem to be sign language specific. For example, native signers of German Swiss Sign Language incorporate body sways which prosodically mark discourse constituents (Boyes-Braem 1999).

Another area that is underinvestigated is the distinction between linguistic and nonlinguistic superarticulation. Like spoken language intonation, which includes both linguistic and paralinguistic elements (Ladd 1996), sign language also distinguishes affective from linguistic intonation, and these have been shown to be differentially affected by damage to different areas of the brain (Corina, Bellugi & Reilly 1999). Yet the full range and behavior of each type have not been fully investigated.

The results reported here highlight the relation between phonetics and phonology in human language in general. We have seen that ISL divides utterances into prosodic constituents of the same kind that spoken languages do with similar relation to other aspects of the grammar. Both modalities have prosodic words that may consist of more than one morphosyntactic word, phonological phrases that are constructed from syntactic phrases but are not isomorphic to them, intonational phrases, and tunes (or their equivalent, arrays of superarticulations) which are componential and meaningful. Yet the phonetic correlates are quite different. Spoken language has variations in pitch, duration, and intensity, and

phonological rules affecting segments that apply within particular prosodic domains. Sign languages also have variations in duration and perhaps in intensity, but that is where the phonetic similarity ends. Sign language prosody uses number of iterations, as well as several different articulators (on the face) that are independent of one another and of the primary channel of transmission. Rules apply within the domain of prosodic constituents, as in spoken languages, but they are of a different nature phonetically, often involving the 'twin' articulator — the nondominant hand — an element with no parallel in spoken languages.

In the sign language superarticulation system, the primitives are far greater in number than the two pitches of spoken language intonation, and, as we have seen, they are also independent of the channel for transmission of lexical items. This suggests that the sign language superarticulation system may have the potential to be richer than spoken language intonation, in the sense that meanings may be more specific and more varied, and the potential for simultaneous combination may be greater than the potential for sequences of L and H tones. One might speculate that it is here that future research may uncover formal and functional differences as well. By carefully comparing the prosodic systems of signed and spoken languages, this line of investigation offers a new and provocative perspective on the relationship between the medium and the message in the two natural human language modalities.

Acknowledgments

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