

# *Visual Intonation in the Prosody of a Sign Language*

**Svetlana Dachkovsky, Wendy Sandler**

*University of Haifa*

## **Key words**

*componential structure*

*intonation*

*sign language*

## **Abstract**

While visual signals that accompany spoken language serve to augment the communicative message, the same visual ingredients form the substance of the linguistic system in sign languages. This article provides an analysis of visual signals that comprise part of the intonational system of a sign language. The system is conveyed mainly by particular actions of the upper face, and is shown to pattern linguistically and predictably in Israeli Sign Language. Its components, aligned with prosodic constituents, are associated with particular but general meanings and may be combined to derive complex meanings. The Brow Raise component is functionally comparable to **H** tones, signaling continuation and dependency, and characterizing yes/no questions and the if-clause of conditionals, for example. The component Squint instructs the addressee to retrieve information that is not readily accessible, and characterizes relative clauses, topics, and other structures. The details of the componential analysis proposed here explain why the two components together co-occur on such seemingly diverse structures as yes/no questions about mutually retrievable information and counterfactual conditionals. Like auditorily perceived intonational melodies, the visual intonational arrays in sign language provide a subtle, intricately structured, and meaningful accompaniment to the words and sentences of language.

## **1 Introduction**

Recent decades have seen an increased awareness of the fact that linguistic communication is not limited to the oral-aural channel. Visually perceived gestures of the hands, face, and body have been brought into the purview of research on spoken language, and some of these nonverbal communicative behaviors constitute what is sometimes

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*Address for correspondence.* Wendy Sandler, Sign Language Research Lab, University of Haifa, Mount Carmel, Haifa, 31905 Israel; e-mail <wsandler@research.haifa.ac.il>

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referred to as visual prosody, the topic of this special issue of *Language and Speech*. In sign languages, languages that are transmitted entirely in the visual modality, the same visual signals are organized into a constrained linguistic system, a system that shares certain key features with the prosody of spoken languages (e.g., Wilbur, 1991, 2000, for American Sign Language; Nespor & Sandler, 1999, and Sandler, 1999a, 1999b, for Israeli Sign Language; van der Kooij, Crasborn, & Emmerik, 2006, for Sign Language of the Netherlands). Sign languages have conventionalized ways of (1) dividing utterances into prosodic constituents; (2) making signs more or less prominent; and (3) conveying intonational “tunes,” tunes that are seen and not heard. Since the linguistic prosodic system of sign languages is constructed from the same raw ingredients available to speakers, studying the functions and patterning of sign language prosody can inform the investigation of the visual signals that accompany spoken language communication. Here we take a closer look at the intonational part of the prosodic system in one sign language, Israeli Sign Language (ISL).<sup>1</sup> We demonstrate that specific actions of the upper face, actions that also occur, if idiosyncratically, on the faces of speakers, comprise part of the linguistic intonational system in this language.

The view that facial expression in sign language corresponds to intonation in spoken language has been suggested by a number of researchers (e.g., Nespor & Sandler, 1999; Padden, 1990; Reilly, McIntire, & Bellugi, 1990a, 1990b; Sandler, 1999a, 1999c, 2005; Wilbur, 1991, 2000).<sup>2</sup> Here we provide evidence showing that specific actions of the brows and eyes in a sign language function and pattern much like intonational melodies of spoken language. We argue that the articulations Brow Raise and Squint have identifiable but general meanings, an approach which explains their occurrence on a range of utterance types. When they combine with one another, the resulting complex interpretation provides evidence that ISL intonational meaning is componential, as some have argued is the case in spoken language intonation as well (e.g., Bartels, 1999; Hayes & Lahiri, 1991; Pierrehumbert & Hirschberg, 1990). In the course of the exposition, we show that these actions are conventionalized and are aligned with prosodic constituents. In all of these ways, these linguistic facial expressions differ from emotional facial expressions also used by signers, a difference which is expected to be instructive in our understanding of the visual prosody that accompanies speech.

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<sup>1</sup> In earlier work, the term “superarticulation” was adopted in order to avoid the aural connotation of the word “intonation,” but, just as Stokoe’s term “cherology” gave way to the more general term “phonology,” we accept the suggestion of a reviewer and adopt the more general term “intonation” here. However, we draw the line at the words “tunes” and “melodies” for combinations of intonational elements, and substitute the word “arrays” instead.

<sup>2</sup> The association of certain facial expressions and other nonmanual behaviors with specific linguistic structures was first documented in detail by Liddell (1978, 1980). Liddell and some subsequent researchers have explained this association by positing a direct link between these nonmanuals and the syntactic structure of American Sign Language (see, e.g., Aarons, Bahan, Neidle, & Kegl, 1992; Petronio & Lillo-Martin, 1997; Wilbur, 1999). Here we assume that the link is indirect, and that intonation is part of the prosodic system, which in turn often aligns with syntactic structure. See Sandler and Lillo-Martin (2006) for explicit arguments in favor of this view.

We begin in Section 2 with a brief overview of relevant aspects of spoken language prosody. In Section 3 we outline the form and function of ISL intonation within the prosodic system. An analysis of the intonation system of ISL comprises Section 4, focusing specifically on yes/no and wh-questions, so-called “shared information,” and conditionals, plain and counterfactual. The form and distribution of the intonational arrays marking these constituents in our data will be dealt with in that section, where we investigate the meanings contributed by the individual actions Brow Raise and Squint. In Section 5, we deal with componential behavior of these articulations in ISL, showing how they combine to derive more complex meanings. In the final section of the article, we summarize the similarities but also describe differences between the intonational systems of spoken and signed languages, and point to some directions for future research.

## 2 Intonation as part of prosody in spoken language

The language stream is not a monotonous string, but is divided up into hierarchically organized rhythmic constituents. When we speak, we may mark the boundary of a prosodic phrase by lengthening the word that ends it, by pausing, or both. Prominence is assigned to some position in the phrase, and this phrasal stress also contributes to the rhythm and serves to set one phrase off from another.

Intonation, the music of everyday speech, constitutes part of the prosodic system. In our study of sign language intonation, we adopt Ladd’s definition of intonation as “the use of *suprasegmental* phonetic features to convey *postlexical* meanings in a *linguistically structured* way” (Ladd, 1996, p.6). Prosodic features of fundamental frequency, intensity and duration are suprasegmental in the sense that they are superimposed over constituents of different sizes, such as the word, the phrase, or the whole utterance. This system is postlexical because it conveys functions, meanings, and relations such as sentence type, speech act, focus, and other aspects of information structure at the level of phrases, utterances, or the discourse as a whole.

The intonational part of prosody is linguistically structured in the sense that it is made up of a finite list of primitives—tones—which occur and combine with one another according to rules (Beckman & Pierrehumbert, 1986; Pierrehumbert, 1980). By dint of its temporal distribution, intonation reinforces the rhythmic structure of an utterance, while at the same time the individual tones add elements of meaning to the overall interpretation of the tune (Gussenhoven, 1984, 2004; Pierrehumbert & Hirschberg, 1990). Pitch accents, phrase accents, and boundary tones are aligned with elements on different levels of the prosodic hierarchy: the syllable, the prosodic word, the intermediate phrase, or the intonational phrase.

Intonational phrases, the focus of the present study, are the primary domain of intonational tunes; pitch accents, phrase accents, and boundary tones cluster together at their edges, each element having scope over its respective domain of interpretation (Beckman & Pierrehumbert, 1986; Hayes & Lahiri, 1991). Constituents such as nonrestrictive relative clauses (*[His books,]<sub>I</sub> [which I liked a lot,]<sub>I</sub> [are out of print]<sub>I</sub>*) typically occur in independent intonational phrases, as do topics, parentheticals, right

dislocated elements, and other constituents (Nespor & Vogel, 1986). The clustering of the individual tones at the intonational phrase boundary and the componential interpretation of the intonational contour are demonstrated in example (1), from Pierrehumbert and Hirschberg (1990, p.273), which has a typical yes/no question intonational pattern:

(1) Are legumes a good source of vitamins?

**L\* H H%**

According to their analysis, the **L\*** pitch accent on the stressed syllable of *vitamins* implies that the item is salient but does not form part of the utterance predication (in fact, by asking this question the speaker expects the hearer to include the marked item into his/her answer, and constitutes the predication). The forward directionality of the utterance is emphasized by the high rise, made up of a high phrase accent and boundary tone. The **H** phrase accent signals that the current intermediate phrase forms part of a bigger interpretational unit, and the **H%** boundary tone conveys the same information about the whole intonational phrase, which is to be followed and completed by the interlocutor's answer.<sup>3</sup>

Individual tones can reoccur in different environments conveying a stable basic meaning regardless of intonational, syntactic or lexical context. Consider the **H%** boundary tone in utterance (2), occurring at the end of instructions for starting a car, also from Pierrehumbert and Hirschberg (1990).

(2) If you're lucky                    you've started your car

**L H%**

**L L%**

The high boundary tone (**H%**) conveys continuation or incompleteness, indicating that the current phrase is to be interpreted with respect to a succeeding phrase. While in example (1) above, **H%** gets a canonical yes/no question interpretation, in example (2) the **H%** boundary tone contributes to the contingency relations in the conditional, and can imply a relation of causality and conditionality between two conjoined clauses. Examples (1) and (2) show that the connection between a certain intonational tune and an utterance type is not accidental; it reflects a particular functional feature of the construction.<sup>4</sup> The linguistic structure of spoken language intonation—its alignment with prosodic boundaries and its conventionalized componential interpretation—contrasts with paralinguistic

<sup>3</sup> Dainora (2002) shows that there are strong statistical propensities for some pitch accents and boundary tones to occur together, and suggests that a tonal rather than a tonal interpretation of intonational tunes is called for. Her results are striking, and call for perceptual experiments in order to determine whether they contradict Pierrehumbert and Hirschberg's claim that the individual components contribute to interpretation.

<sup>4</sup> Bartels (1999) argues that the **H%** boundary tone expresses the general meaning of unassertiveness and incompleteness. Her analysis explains why **H%** is such a common intonational phrase boundary tone, and provides a unified interpretation of the kinds of constituents it bounds.

uses of pitch variation for signaling emotions, which is not organized along linguistic lines (Ladd, 1996, p.12).

### **3 Intonation and prosody in Israeli Sign Language**

In sign languages, intonational properties are conveyed mostly by articulations of the upper face. Like intonational pitch excursions, intonational arrays of facial expression function postlexically to signal meanings which are typical of intonation: they mark prosodic constituents for various discourse functions, such as distinguishing sentence types (declarative utterances, wh- and yes/no questions); and they also express various propositional attitudes<sup>5</sup> like disbelief or assumption of shared knowledge. As we will show in detail in the following section, conventionalized facial expressions in ISL meet all of Ladd's criteria for intonation, and they are also componential in structure. These linguistic properties put the facial articulations discussed in this article in the category of linguistic intonational signals, and distinguish them from paralinguistic uses of face (see Dachkovsky, 2005).

We do not mean to imply that all facial expression in sign languages is intonational. Facial expression also functions in the grammatical system as a phonological component of lexical signs, as adverbial or adjectival markers (Anderson & Reilly, 1998; Liddell, 1980; Meir & Sandler, 2008), as mimetic character attributes, or as iconic gestures (of the mouth in particular; Sandler, 2003, in press). As with all humans, deaf or hearing, facial expression may also reflect emotions. We deal here only with the linguistic intonational function of facial expression.

In earlier work, ISL was shown to have prosodic constituents at the following levels of the prosodic hierarchy: phonological word, phonological phrase (see note 6), and intonational phrase (Nespor & Sandler, 1999; Sandler, 1999a, 1999b, 2005, 2006, in press; Sandler & Lillo-Martin, 2006). Here we focus on intonational phrases alone, the primary domain for intonation, and the patterns of facial actions that mark them.

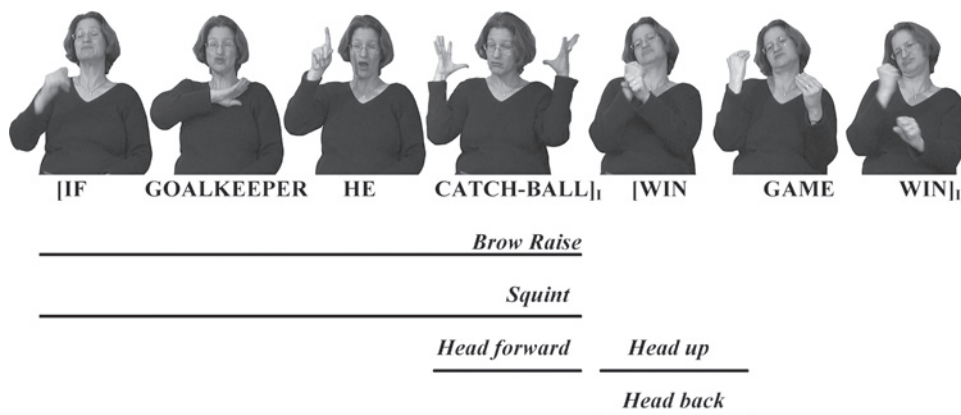
In an earlier study of 90 elicited sentences (30 sentences signed by three native ISL signers), Nespor and Sandler (1999) found that intonational phrases are systematically separated from one another by changes in head and/or body position and optional eyeblink. These corporeal signals are enhanced by rhythmic characteristics of the manual articulation of the final sign in the phrase, such as pause, hold, and increased

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<sup>5</sup> By the term "propositional attitude" we mean attitudes toward the propositions expressed in interactive discourse. That is, we communicate the way in which our mind entertains those propositions that we express: e.g., with doubt, belief, regret or pretense (Andersen & Fretheim, 2000; Sperber & Wilson, 1986). According to Andersen and Fretheim, basic types of propositional attitudes are cross-linguistically communicated via sentence types—declarative, interrogative, imperative, exclamative—while "more delicate attitudinal differences" can be expressed with the help of non-truth conditional particles, or intonation, or a combination of the two (2000, p.6).

**Figure 1**

Distribution of intonational arrays on two intonational phrases. “If the goalkeeper had caught the ball, (the team) would have won the game.”



size and duration. The latter are found at the lower level intermediate phrase<sup>6</sup> boundary as well, but are often more exaggerated at the intonational phrase boundary. Crucially, *intonational phrase boundaries are also signaled by an across-the-board change in facial expression*. No matter which facial articulators are involved, for example, outer or inner eyebrows, upper or lower eyelids, and regardless of the articulation they manifest, they all typically change their position at the boundary between intonational phrases. The alignment of facial expression with intonational phrase boundaries is one of the motivations for attributing intonational status to facial expression in ISL (and possibly in sign languages generally). Just as elaborate and salient pitch excursions occur at intonational phrase boundaries in spoken languages, so do full intonational arrays change their configurations at these boundaries in this sign language.

Figure 1 shows the ISL sentence, “If the goalkeeper had caught the ball, they would have won the game.” Like the other sentences in the present study, we coded this sentence using an elaborate coding system that we developed, with 12 categories of rhythmic and intonational signals of the hands, body, head, and each facial articulator (see Section 4.1). Here, we show only those elements of the intonational arrays that are relevant for the discussion, specifically, articulations of the face and head. The line under the name of the articulation indicates its scope. Crucially, all aspects of facial expression and head position change between the two intonational phrases, as illustrated in the close-up in Figure 2.

<sup>6</sup> The Nespor and Sandler (1999) study adopts Nespor and Vogel’s (1986) terminology, in which the level below the intonational phrase is the phonological phrase. Here we use Beckman and Pierrehumbert’s (1986) term “intermediate phrase.” The differences between them need not concern us here.

**Figure 2**

Change in visual intonation at the IP boundary in a counterfactual conditional sentence.



The first intonational phrase of the utterance is characterized by Brow Raise and Squint, which co-occur with the whole phrase, and is terminated with a lean forward on the last sign. All nonmanual signals relax at the intonational phrase boundary, and the second intonational phrase starts with the head position up and back, and neutral expression on the upper face.

This description gives us good reason to believe that we are talking about a prosodic system, but some important observations about the interpretation of intonation remain unexplained. Specifically, we have found that Brow Raise characterizes not only yes/no questions, but conditionals and temporal adverbial phrases as well. And Squint characterizes mutually retrievable or “shared” information in some sense, but it also typically characterizes relative clauses, remote past, and other structures. Finally, the two articulations may combine as they do in Figure 1. A closer look at the semantics of these elements and their distribution provides a unified explanation of the way in which they function in the intonational system of ISL.

## 4 Meanings of ISL intonational articulations

As we have mentioned, previous research has shown that ISL has a rich system of facial configurations serving a wide range of communicative functions (Meir & Sandler, 2008; Nespor & Sandler, 1999; Sandler, 1999a, 2005). In this study we provide quantitative support for these observations. In addition, we break down complex intonational arrays into smaller components, and provide an analysis of the way complex meaning is built up by combining them.<sup>7</sup>

<sup>7</sup> These results are based on Dachkovsky (2005).

## 4.1

### Methodology

We created target sentences in Hebrew with specific types of linguistic structures that we expected would elicit particular facial expressions, based on earlier research. We aimed to elicit the following linguistic constructions: yes/no questions, wh-questions, neutral and counterfactual conditionals, relative and temporal clauses, and constituents containing mutually retrievable information. The sentence types were intermixed, and from eight to ten tokens were elicited for each construction. To avoid a listing effect, we wrote each sentence on a separate card. Each target sentence was embedded in a mini-discourse in order to provide a controllable context and to minimize extraneous associations that a signer might have had in his/her mind.

In choosing an elicitation procedure over analysis of spontaneous discourse, we follow the “read and pronounce” methodology commonly used in much spoken language intonation research (see Cerrato & Imperio, 2003; Hedberg & Sosa, 2003). In order to reduce both artificiality and interference from Hebrew, we modify the read and pronounce technique in the following way. Subjects do not read/translate the written sentence, but internalize its meaning, put the card aside, and create a corresponding ISL sentence, which they convey to another signer.<sup>8</sup> Subjects were five native ISL signers.

This technique aims to establish a base line for the intonational system in an understudied modality, the sign modality, and is intended to pave the way for future studies of spontaneous discourse. Our approach allows us to identify intonational patterns associated with certain meanings and types of utterances with a minimum of uncontrolled variables from the general discourse that could affect the intonation in ways that may not be rigorously analyzable. The study attempts to establish such a base line for Squint and Brow Raise in ISL, a language with a rich system of facial expression. Another reason for choosing an elicitation technique is the scarcity of certain sentence types in spontaneous discourse. Neutral and especially counterfactual conditionals are quite rare in natural discourse, making elicitation necessary in order to amass a large enough corpus for identifying patterns and establishing generalizations. Studies such as the present one based on elicited data will provide a basis for further research with spontaneous data that are necessarily messier and include contextual information that cannot be controlled.

The subjects were videotaped, and each sentence glossed with the help of native signer consultants. The data were then coded through frame-by-frame viewing, using the Facial Action Coding System (FACS) (Ekman & Friesen, 1978), which specifies each Facial Action Unit (AU) with a numeral.<sup>9</sup> Interpretations were checked by interviews with native signer consultants.

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<sup>8</sup> We attempt to avoid the pitfalls of a translation technique by training our subjects to become metalinguistically aware of the difference between Hebrew and ISL and by having them convey the message to another deaf signer. This method has proved successful in our work, measured by regularities in structure of the ISL sentences and the extent to which they differ from the Hebrew prompt.

<sup>9</sup> FACS is an anatomically based, descriptive system, identifying a set of 44 AUs. Alone or in combination, these AUs are intended to account for any observed facial movement and head posture. With a few exceptions, the Action Units have a one-to-one correspondence with single muscles as identified by anatomists. FACS also specifies a way of coding four levels of intensity, using the letters a–d, going from lowest to highest on the intensity continuum.



**Figure 3**

Typical yes/no question intonation. “Do you think it’s possible to learn a foreign language in one year?”



**4.2**

**Results: Correlation of facial expressions with particular linguistic structures**

The coded data were analyzed to see if there was systematic correlation between the type of linguistic construction/pragmatic function and nonmanual clusters. The data showed a very high degree of regularity in these structures, strongly supporting the conclusion that they reflect a conventionalized linguistic system.

For example, the study confirmed that yes/no questions in ISL are systematically marked by Brow Raise (AU 1+2, typically accompanied by lines in the forehead) and wide eyes (AU 5). This pattern was found in 100% of the yes/no questions elicited. Forward head movement (AU 57) occurred in over 94% of yes/no questions. This intonational array is illustrated in Figure 3. The underlined word in the figure caption is the one pictured. Table 1 shows the number of sentences of each type that was elicited and coded.<sup>10</sup>

<sup>10</sup> A similar combination of facial markers and head position for yes/no questions has been identified in American Sign Language (ASL) (Baker & Cokely, 1980; Baker-Shenk, 1983; Liddell, 1980), British Sign Language (BSL) (Deuchar, 1984; Woll, 1981), Swedish Sign Language (SSL) (Bergman, 1984), Sign Language of the Netherlands (SLN) (Coerts, 1992), Norwegian Sign Language (NSL) (Vogt-Svendsen, 1990).

**Figure 4**

Typical wh-question intonation. “Where is the book?”



Figure 4 illustrates a typical wh-question: AU 4 (which draws the brows together and/or lowers them) occurs in 92% of the wh-questions in our corpus, and AU 5 (which raises the upper eyelids making the eyes look bigger) in 75%. As with yes/no questions, a forward head movement (AU 57) characterizes wh-questions (100%).<sup>11</sup>

Squint (AU 44) is strongly associated with constituents whose status is negotiated between the interlocutors as retrievable: it appears in 95% of the relevant environments. For now, we will name this sort of information “mutually retrievable,” and will provide a more detailed description and analysis in Section 4.3.2.<sup>12</sup>

In Figure 5, *Yossi* is assumed to be someone known to both interlocutors, but not previously mentioned in the discourse. The Squint is an instruction to retrieve this shared information. This kind of facial expression also marked 85% of the restrictive relative clauses in our data.<sup>13</sup> It can occur, sometimes in combination with additional

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<sup>11</sup> Wh-questions are described as having furrowed brows as well as a characteristic head position in ASL (Baker-Shenk, 1983), SSL (Bergman, 1984), BSL (Deuchar, 1984; Kyle & Woll, 1985; Woll, 1981), SLN (Coerts, 1992).

<sup>12</sup> Brow Raise has been described as the most prototypical nonmanual marker in ASL topics (Baker-Shenk, 1983; Coulter, 1979; Liddell, 1980) and in SSL (Bergman, 1984). Alongside with Brow Raise, Squint was discussed as an alternative possibility for topic marking in DSL (Engberg-Pedersen, 1990), in which the two distinct markers indicate different pragmatic functions of topics. A similar difference was observed in ASL by Baker and Cokely (1980).

<sup>13</sup> The other 15% of the relative clauses in our data were marked not by Squint, but by Brow Raise. The content of these relative clauses restricts the referents by supplying the condition on which the fulfillment of the main predication is contingent. This condition can be understood as “systematic dependence” (Langacker, 1997; Ziv, 1997) holding between the content of the relative clause and the main predication. It is these contingency and continuation dependency relations that are signaled by Brow Raise in ISL.

**Figure 5**

Squint marking a mutually retrievable topic. “(I just got a fax). Yossi’s brother was killed in a car accident.”



grammatical facial expressions, on other types of constructions—parentheticals, temporal clauses referring to the remote past, and counterfactuals—as we discuss at length below. Squint is usually accompanied by Upper Lip Raise (AU 10).

We now have quantitative confirmation of the correlation of the specific intonational patterns with certain linguistic constituents observed in previous investigations of ISL (Nespor & Sandler, 1999; Sandler, 1999a). In addition, new patterns of nonmanuals distinguishing neutral and counterfactual conditionals emerged in a study that provides the basis for the present work (Dachkovsky, 2005). The if-clause (protasis) of neutral conditionals in ISL is marked by raised eyebrows (AU 1+2) in 100% of the conditionals in the study, and by widely opened eyes (AU 5) in 82%. This array is shown in Figure 6. A forward head position occurs in 91% of the protases of conditionals, intensifying toward the end of the phrase.<sup>14</sup> The percentages of occurrence of various facial articulations with particular types of ISL constructions are summarized in Table 1.

A subcategory of conditionals in ISL has its own complex intonational marking: counterfactual conditionals (Dachkovsky, 2005, 2008). The if-clause is always marked by Brow Raise (100%), and also consistently marked (95%) by Squint. Figures 1 and 2 in Section 3 above present the intonational arrays marking the protasis and apodosis in the ISL counterfactual conditional sentence, “If the goalkeeper had caught the ball, they would have won the game.” The array on the protasis is clearly different from that occurring in neutral conditionals such as the one shown in Figure 6. To understand this complex facial configuration, we need a deeper analysis of the meaning of each facial articulation, to which we turn in the next section.

<sup>14</sup> Characteristic nonmanual features of (neutral) conditionals, always including Brow Raise, were described by Baker and Cokely (1980), Baker and Padden (1978), Coulter (1979), Liddell (1986), and Reilly et al. (1990a, 1990b) for ASL; by Bergman (1984) for SSL; by Engberg-Pedersen (1990) for Danish Sign language (DSL), and by Coerts (1992) for SLN.

**Figure 6**

Typical intonational array of neutral conditionals. “If you eat now, you won’t be hungry for lunch.”



### 4.3

#### **Analysis: Atoms of intonational meaning**

Like intonational patterns in spoken languages, facial configurations in ISL—and possibly in other sign languages as well<sup>15</sup>—are componential in nature. Earlier claims of componentiality were based on broad functions of facial expressions, such as to mark yes/no or wh-questions (Coulter, 1978; Nespore & Sandler, 1999; Sandler, 1999c, 2005). Here we take a more fine-grained approach to the semantics of facial actions, which allows us to make generalizations across seemingly unrelated utterances, and to understand the contribution of individual facial actions to the meanings of complex facial expressions.

The analysis focuses on the two most frequently occurring facial components in our data: Brow Raise (AU 1+2) and Squint (AU 44). The FACS coding system used in this study decomposes facial configurations into separate action units, whose occurrence can then be independently traced in different linguistic contexts. Let us begin by looking at the systematic occurrence of Brow Raise.

#### 4.3.1

The meaning and distribution of Brow Raise

The behavior and meaning of Brow Raise in ASL have been the object of several studies. Coulter (1978) noticed that Brow Raise occurs on a number of structures in ASL—topics, relative clauses, conditionals, when-clauses, and other structures—and first suggested a unified explanation. He proposed that all structures with Brow

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<sup>15</sup> Since there is an overlap in nonmanual marking between ISL and other sign languages, this suggests that a componential analysis may account for patterns of sign language intonation in general.

**Table 1**  
Percentages of facial action units (AUs) for each linguistic constituent/construction

	<i>AUs 1+2</i>	<i>AU 4</i>	<i>AU 5</i>	<i>AU 10</i>	<i>AU 44</i>	<i>AU 53</i>	<i>AU 54</i>	<i>AU 57</i>
	<i>Brow</i>	<i>Brows</i>	<i>Eyes</i>	<i>Upper</i>	<i>AU 44</i>	<i>Head</i>	<i>Head</i>	<i>Head</i>
	<i>Raise</i>	<i>lowering</i>	<i>wide</i>	<i>lip raise</i>	<i>Squint</i>	<i>up</i>	<i>down</i>	<i>forward</i>
Y/N questions ( <i>N</i> = 20)	100		100				53	90
Wh-questions ( <i>N</i> = 20)		92	75					100
Relative clauses ( <i>N</i> = 35)				50	85			67
Mutually retrievable topics/referents ( <i>N</i> = 42)				78	95	70		
Neutral conditionals ( <i>N</i> = 39)	100		82				91	91
Counterfactual conditionals ( <i>N</i> = 39)	100		51		95		95	97

Raise describe background information and can be considered various kinds of topics. Observing that Brow Raise characterizes canonical yes/no questions as well as topics, including temporal and conditional clauses in ASL, Janzen (1998) attempted to explain the polysemy of Brow Raise by suggesting that topics were grammaticized yes/no questions. Wilbur and Patchke (1999) argued against such pragmatic analyses of Brow Raise which associated certain kinds of old, given, or presupposed information with this articulation, suggesting a semantic-syntactic analysis instead.<sup>16</sup> Our analysis of Brow Raise in ISL is in the spirit of Coulter, in that we also claim it is pragmatically determined, but the actual interpretation we propose is different, at least in ISL.<sup>17</sup>

The meaning of Brow Raise in ISL seems to correspond to the meaning of the high edge tone in many spoken languages,<sup>18</sup> as discussed in Section 2. Like its spoken

<sup>16</sup> Specifically, Wilbur and Patchke argue that all constituents with Brow Raise in ASL occupy A'-positions (either by being generated in these positions or by moving to them), and are associated with non-wh operators. This analysis is questioned in Sandler and Lillo-Martin (2006), on the grounds that no independent syntactic effects of Brow Raise are identified in Wilbur and Patchke's account, and that preposing of certain constituents, required by their analysis, is not supported.

<sup>17</sup> While some similar structures in both ASL and ISL are characterized by Brow Raise, we do not know whether Brow Raise patterns the same generally in the two languages.

<sup>18</sup> This interpretation of Brow Raise is suggested in Meir and Sandler (2008).

language counterpart (Bolinger, 1978; Pierrehumbert & Hirschberg, 1990), Brow Raise signals that the intermediate or intonational phrase marked by it is to be followed by another phrase, produced either by the same interlocutor or another.

This general continuation dependency<sup>19</sup> can via implicature have different, relatively more concrete semantic or pragmatic interpretations, depending on other properties of the utterance (Bartels, 1999). The componential approach to intonational meaning thus accounts for the contribution of H% to the dependency relations between the clauses, as in example (2) above. We now show how the meaning of ISL Brow Raise interacts with the text on which it usually occurs.

As we've said, the vast majority of straightforward yes/no questions in ISL, as in other sign languages, are marked by Brow Raise superimposed on the intonational phrase expressing the question, as illustrated in Figure 3 above. Similarly to the high boundary tone in spoken languages, Brow Raise in ISL signals continuation and forward directionality, thereby contributing to the dependency relations between phrases and clauses. This analysis explains why H% is present in most initial adverbial clauses in English (Ford, 1993) and predicts that Brow Raise in ISL will also mark temporal adverbial phrases such as *Yesterday*, or clauses like *After I graduate* as well. As shown in the temporal clause in example (3), the prediction is borne out.<sup>20</sup>

(3) Brow Raise

GO-OUT HOUSE, MEET NEIGHBOR.

"When I went outside, I met a neighbor."

Here the Brow Raise signals the dependency relation that holds between the subordinate adverbial clause and the main clause. In the absence of a lexical complementizer in ISL, the Brow Raise feature, along with fixed clause order, plays a crucial role in signaling an interpretation in which the second clause is contingent on the first.

Another type of adverbial construction characterized by Brow Raise is the if-clause of neutral conditionals. In conditional contexts, the basic general meaning of continuation dependency is interpreted via inference as contingency and causality, which are the most salient features of interpretation for this type of construction. Figure 6 above illustrates a typical neutral conditional with Brow Raise. Another example of a conditional in which the protasis is marked by Brow Raise is provided in Example (4) and Figure 7.

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<sup>19</sup> By dependency relation we mean a satisfaction-precedence relationship (Grosz & Sidner, 1986), where the intention underlying utterance B dominates that underlying utterance A. This means that the satisfaction of the intention in A contributes to the satisfaction of the intention in B, and A can be interpreted only with respect to a subsequent B.

<sup>20</sup> In all examples from our corpus, the italicized English version is a translation of the Hebrew sentence that elicited the ISL sentence glossed, and not a translation of the ISL sentence.

**Figure 7**

Brow raise marking continuation in neutral conditional. “If he invites me to his birthday party, *I will go.*”



(4)

Brow Raise

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 IF INDEX INVITE-ME BIRTHDAY-PARTY OF-HIM I GO

“If he invites me to his birthday party I will go.”

Brow Raise on the first intonational phrase, which corresponds to the protasis, signals that attending the party is contingent on receiving an invitation. With this marking, even in the absence of the manual sign IF, which is optional in ISL, the utterance is interpreted as a conditional. As in the example of the spoken language conditional in Example (2) of Section 2, the intonational feature contributes to the implicature of causality and conditionality of the utterance.

In order to confirm the role of the Brow Raise in signaling dependency between the clauses, we elicited the utterance in (4'), where no explicit contingency between the two propositions is involved, and compared it with (4). As predicted, the two formed a minimal pair: the first clause of 4' is not marked by Brow Raise. The neutral brow position in this clause is illustrated in Figure 8.

(4')

INDEX INVITE-ME BIRTHDAY-PARTY I GO-THERE

“He invited me to his birthday party and I went.”

Brow Raise can also link topics to comments. In ISL, a topic-prominent language, utterances tend to be divided into two parts: the topic, what the sentence is about, and the comment, the information predicated about the topic (Rosenstein, 2001). Topic-comment structures are used to organize discourse, serving as an anchoring point and common ground for the interlocutors (Mathesius, 1975; Mithun, 1991). As the topic in a sentence is expected to be continued and completed by the comment, the former is interpreted in light of the latter. Under this interpretation, a

**Figure 8**

Facial intonation of the sequence of clauses lacking any signals of dependency between them. “He invited me to his birthday party and I went.”



Brow Raise on the first intonational phrase containing a topic is seen as signaling a dependency relation between the two intonational phrases (Dachkovsky, 2005). This analysis of Brow Raise explains why this intonation is so often found in yes/no questions, the protasis of conditionals, sentence-initial temporal adverbials and topics. Like the **H** tone which appears on the same kinds of constituents in many spoken languages, Brow Raise signals continuation and dependency.

4.3.2

The meaning and distribution of Squint

Squint is another facial action that occurs with great frequency in ISL.<sup>21</sup> While it is noted in other sign languages, this intonation appears to be especially widely used in ISL. Squint occurs in a range of seemingly unrelated contexts, but closer analysis reveals that these contexts can be unified through the concept of the retrieval of information that is not readily accessible (Ariel, 1991; Sperber & Wilson, 1986). Specifically, by using Squint, a signer points out to the addressee that the information so marked is not automatically or immediately accessible and is to be retrieved from his/her background knowledge. On this view, the meaning of the Squint may have something in common with the selection meaning of the English Fall–Rise, which Gussenhoven characterizes as meaning “The speaker may select a Variable from the background” (Gussenhoven, 1984, p.201). Thus, following Dachkovsky (2005), we propose that the Squint serves as a signal of the Low Accessibility status of the linguistic material it is

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<sup>21</sup> Brow Raise marking seems to be very widespread among genetically unrelated sign languages. However, in languages other than ISL, to date Squint has only been attested and discussed as a common and meaningful nonmanual component in Danish Sign Language (DSL) (Engberg-Pedersen, 1990). Engberg-Pedersen defines the meaning of Squint in the form of an instruction from the signer to the addressee: “I think you know this item, so, please, search your memory and bring the item into your consciousness, because this item is that I am talking about” (p.123). Engberg-Pedersen’s description of Squint’s function in DSL is very close to that of ISL.



aligned with—a function which accounts for its appearance in a wide range of contexts, including counterfactual conditionals, as we shall see.

The Squint alone (without Brow Raise) can be associated with less accessible topics, relative clauses and temporal clauses with reference to the remote past. All of these contexts can be subsumed under the notion of Low Accessibility, as defined by Ariel (1991), meaning that the specific context supplying the required antecedent is not just not given, but is to be actively searched for (Sperber & Wilson, 1986).

Clearly, some items in a discourse are more easily accessible than others. As context retrievals are crucial for utterance interpretation, natural languages have developed a rich system for marking different degrees of accessibility to the addressee (Ariel, 1985a, 1985b, 1988, 1991). In Ariel's system, four factors—distance, competition, saliency and unity—account for the hierarchy of various grammatical markers along an Accessibility continuum. Less accessible information tends to be explicitly marked by the speaker, since its automatic retrieval by the addressee cannot be taken for granted. We argue that Squint in ISL co-occurs with a range of forms that are relatively low on the accessibility hierarchy according to these criteria. This linguistic function of Squint is compatible with the extra-linguistic use attributed to it by Darwin, 1998[1872]: Squint is involved in concentrating on something specific when the object of the focus is distant or difficult to see, and the rest of the environment is to be excluded.

Topics are especially sensitive to nuances of information status and these nuances are expressed in part through intonational marking. As topics often serve as anchors that help to relate new information to what is already known (accessible) to the addressee, it makes sense that topics themselves may be known to different degrees, that is, that they can have different accessibility rankings. Topics in our data that bear Low Accessibility status are marked by Squint. Their Low Accessibility can have various discourse motivations. For example, if the antecedent of the topic is not mentioned in the previous linguistic discourse and is only extra-textually accessible, this would render a low accessibility ranking for the topic. In addition, topics often presuppose competition with other potential topics. According to Ariel, "The more competitors there are, the less the specific antecedent intended by the speaker is uniquely accessible to the addressee" (Ariel, 1991 p.23). In example (5(a)) and Figure 9(a), the topic marked by Squint involves both competition between potential referents and distance from the immediate situation and discourse.

(5)                      Squint

(a) **MALE YOSS I HE I FRIEND CHILD GROW.**  
**TOGETHER KINDERGATEN LATER SCHOOL TOGETHER GROW.**  
**ABRUPTLY MANY-YEARS-PASS DISAPPEAR.**  
**MANY-YEARS-PASS.**

                     Brow Raise                      Brow Raise

(b) **YESTERDAY HE MALE YOSS I CALL ME**

"Yossi has been my friend since childhood. We went together to the kindergarten, then to school. Then he suddenly disappeared. Many years went by. Yesterday Yossi called me."

**Figure 9(a)**

Low accessibility constituent, *Yossi* (from example (5a) marked by Squint



**Figure 9(b)**

High accessibility constituent, *Yossi* in (5b), not marked by Squint



In signing the name, *Yossi* in example (5(a)), the speaker assumes that the interlocutor can retrieve the intended antecedent. However, the retrieval cannot be automatic, both because the antecedent has not been mentioned in the previous discourse, and because it competes with other possible referents, as *Yossi* is a common name. In this context the Squint signals to the interlocutor that the information in this constituent should be retrieved from his/her background knowledge.

This analysis predicts that if the antecedent is mentioned in the preceding linguistic context, it is not to be marked by Squint in subsequent reference, provided no other factors that inhibit accessibility are involved (e.g., competition among the referents, spatial or temporal distance from the immediate communicative situation, etc.). And indeed, in example (5(b)) and Figure 9(b) the second mention of the same referent does not yield Squint marking, because the antecedent is easily accessible from the same stretch of discourse and does not have to be retrieved by the addressee. The telltale line under the eyes that indicates AU44, Squint, is present in Figure 9(a), and

absent in 9(b). Instead, 9(b) is marked by Brow Raise as a continuation marker on the topic, as predicted by the analysis proposed in Subsection 4.3.1 above.

The relative clause is another construction whose pragmatic function makes it susceptible to Squint marking.<sup>22</sup> Restrictive relative clauses, like the one in example (7) below, are usually marked by Squint, since they restrict the set of possible referents about which the predication holds.<sup>23</sup>

(7) Squint

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HOUSE INDEX I TOGETHER-WITH-YOU SEE INDEX RENT  
“Finally we rented the apartment that I’d seen together with you.”

Following Ochs-Keenan and Schieffelin (1976), we see this kind of structure as bringing to the foreground a referent that is known or knowable to the addressee. That is, the initial referent of the relative clause, *the house*, is assumed to be known from some prior experience, but is not a current topic of conversation. The relative clause has the function of moving a referent that the addressee can identify or recognize, but which is not salient now, into the center of attention of the communicative interaction between the interlocutors. By restricting the domain and identifying only one appropriate antecedent, relative clauses help to build a common ground of shared information. In this example, the Squint signals that one particular apartment is retrievable from the set of available apartments. The shared experience is that the interlocutors had previously seen the apartment together.

The analysis predicts that temporal adverbial clauses, usually marked by Brow Raise, can, in particular contexts, be marked by Squint (or by Brow Raise and Squint together; see Section 5). Sentence (8) provides an example of the former, a temporal adverbial clause marked by Squint.

(8) Squint

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GAME YOU LOSE DISAPPOINTED YOU  
“When you missed the game, were you disappointed?”

The decisive factor here is the signer’s subjective evaluation of the remoteness of the event in the subordinate clause. In this context, the signer assumes that the game referred to is far from the current discourse topic or occurred a long time ago. Squint instructs the addressee that the event or period of time referred to in the time clause is not immediately accessible and is to be retrieved.

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<sup>22</sup> While relative clauses are usually marked by Squint in ISL, they are apparently marked by Brow Raise in ASL (Liddell, 1978) and in German Sign Language (Pfau & Steinbach, 2005). Pfau and Steinbach (2006) note that both topics and relative clauses may have Brow Raise in German Sign Language. They attribute overlaps of this kind—the same facial articulation on seemingly different types of linguistic expressions—to semantic similarities in the two types of structures, an insight that is compatible with the analysis we develop here.

<sup>23</sup> This type of relative clause can optionally be marked by Squint and Brow Raise together, if the Brow Raise signals continuation to another clause.

So far we have examined the general invariant meanings and functions of the individual facial components Brow Raise and Squint, and have seen how they manifest themselves in different linguistic environments. Like tunes in the intonational systems of spoken languages, facial components retain their basic meanings in all the contexts discussed here, interacting with the meaning of the text to convey the full interpretation of the utterance.

## 5 Co-occurrence of intonational elements: a componential analysis

Like tones in spoken languages, individual facial actions can combine with each other, each contributing a distinct meaning to the general interpretation of the utterance (Nespor & Sandler, 1999; Sandler, 1999a, 1999b; Sandler & Lillo-Martin, 2006). But unlike tones, which combine sequentially, individual facial movements are layered upon one another simultaneously. Nespor and Sandler (1999) give the example of the sentence “Have you seen that movie (that we were talking about)?,” which is simultaneously marked both by the Brow Raise that marks yes/no questions and by the Squint signaling information shared by interlocutors. A complex interpretation is born from an intricate interaction of intonational, syntactic, semantic, and pragmatic features. The distinction between neutral and counterfactual conditionals clearly illustrates this phenomenon in ISL intonation and supports the more fine-grained analysis of the meaning of each intonational component proposed here.

Let us first consider functional properties of counterfactuals. They express negative belief toward the fulfillment of the condition (the apodosis). Counterfactual conditionals entail knowledge to the contrary of the proposition in the if-clause, which underlies the negative belief about the then-clause (Dancygier, 1998). In the sentence, “If you had attended the classes, you would have passed the exam,” it is presupposed that you did not attend the classes and did not pass the exam. Without this implied knowledge of what actually happened, the hypothetical construction cannot be construed as counterfactual. Let us now look at the counterfactual conditional in the ISL shown in example (9) and pictured in Figures 1 and 2 above.

(9) Brow Raise + Squint

IF GOALKEEPER HE CATCH-BALL, WIN GAME WIN

“If the goalkeeper had caught the ball, (the team) would have won the game.”

In ISL, if-clauses of counterfactual conditionals are systematically marked simultaneously by both Brow Raise and Squint (see Table 1). The function of Brow Raise in counterfactual conditionals is the same as in conditionals in general: to mark continuation and dependency. But how does the addition of Squint lead to a counterfactual interpretation? The answer can be found through elaborating the notion of Low Accessibility.

In uttering a counterfactual conditional, the speaker is aware that the proposition in the protasis is contrary to known fact. In other words, counterfactuals “are predictions made in spite of knowledge to the contrary” (Dancygier, 1998, p.50). This means that the counterevidence for the proposition expressed in the counterfactual is accessible to the speaker, and should also be made accessible to the addressee. In

**Figure 10**

Brow Raise alone marks the protasis of neutral conditional. “If the goalkeeper catches the ball, the team will win the game.”



many spoken languages, past tense morphology is interpreted as an instruction to the interlocutor to infer or retrieve knowledge to the contrary of the condition expressed in the protasis, as in the example “If you had attended classes” above. We argue here (following Dachkovsky, 2005) that Squint serves the same function in ISL.

In the goalkeeper example, the Squint instructs the interlocutor to access the presupposition “the goalkeeper did not catch the ball,” which is just the opposite of the literal content of the if-clause “... the goal-keeper had caught the ball.” In a sense, the use of Squint for information that is known but not easily retrievable in counterfactual conditionals is metaphorical: the signer is extending the meaning of Squint beyond its normal use to imply that the information expressed in the if-clause is not part of the factual world, and hence not automatically retrievable.

If Squint does not occur on the protasis of the conditional, the whole construction is interpreted simply as a neutral conditional rather than a counterfactual. Example (9') below is a neutral conditional that forms a minimal pair with the counterfactual conditional in (9) above. The neutral conditional is illustrated in Figure 10.

(9') Brow Raise

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IF GOALKEEPER HE CATCH-BALL, INDEX GAME WIN  
 “If the goalkeeper catches the ball, the team will win the game.”

This analysis reveals two properties of intonation. First, each facial articulation represents a general semantic interpretation; and, second, individual articulations can be simultaneously combined with one another to produce complex meanings. This analysis allows us to refine earlier treatments. Rather than claim that the combination of Brow Raise and Squint in the sentence, “Have you seen that movie (that we were talking about)?” reflects a combination of a yes/no question and shared information, as Nespor and Sandler (1999) suggest, we now analyze the contribution of each intonational

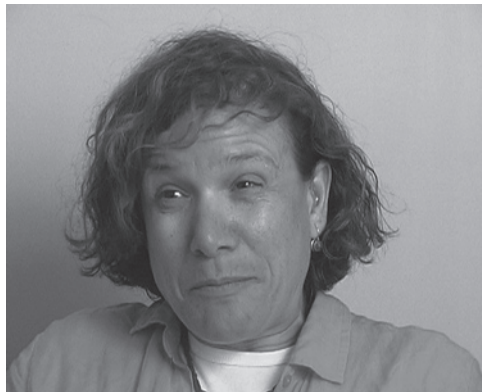
**Figure 11**

Yes/no question with mutually retrievable information. “Did you buy that car?”



**Figure 12**

Counterfactual conditional. “If she had been more confident, she would have passed the driving test.”



element in a way that is at once more fine grained and more general, one that enables us to capture more generalizations in the intonational system of the language.

We are now in a position to explain why the yes/no question with mutually retrievable information and the counterfactual conditional have the same (or very similar) intonational arrays,<sup>24</sup> although the precise interpretations are not identical. The typical intonation of a yes/no question with mutually retrievable information

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<sup>24</sup> Slight differences between the intonational arrays marking different linguistic constructions can be the result of the same facial articulations having different intensities. The question of whether these intensity differences reflect different semantic interpretations is left for future research.

and of a counterfactual conditional are provided for clarity in Figure 11 and Figure 12 respectively.

Brow Raise marks continuation—to the second clause in the counterfactual conditional and to the anticipated utterance of the interlocutor in the yes/no question. Squint in general signals to the interlocutor that s/he is to retrieve information. In counterfactual conditionals (illustrated in Figures 1, 2, and 12), Squint instructs the interlocutor to infer or retrieve knowledge to the contrary of the condition expressed in the protasis. In the yes/no question, the use of Squint has a more straightforward interpretation, since the information to be retrieved is stated. The interlocutor is instructed by Squint to retrieve the experience of having talked about a particular movie.

We see from these examples that complex meanings are constructed from simpler parts, and that both the simple and the complex intonational arrays have clear but general meanings which combine with the meaning of the segmental string to yield the full interpretation of the utterance.

## 6 Summary and conclusion

By examining the facial components of Brow Raise and Squint in ISL, it is possible to discern invariant general meanings, leading to systematic interpretations of their contribution to utterances of the language. In the data accounted for here, we see that Brow Raise may be comparable to high tone in many spoken languages, signaling continuation or forward reference, and characterizing polar questions, the if-clause of conditionals, and other structures. Squint instructs the addressee to retrieve information that is not readily accessible, and is often found on such structures as relative clauses and topics. When the two articulations combine, we see evidence of componentiality in the system, as each facial action retains its general meaning, and the interpretation of the combination is the sum of its parts. In this way, we see that Brow Raise and Squint together may characterize polar questions about mutually retrievable information, such as “Did you see that movie we talked about?” as well as the protasis of counterfactual conditionals like, “If the goalkeeper had caught the ball, (they would have won the game).” In the latter case, the information to be retrieved is not automatically accessible because it is contrary to the real state of affairs.

It is not only the case that the same intonational pattern can characterize different kinds of syntactic structures. The converse is also true: the same type of structure syntactically may be characterized by different intonational patterns. For example, yes/no questions often have falling intonation in spontaneous discourse (Hirschberg, 2000), and wh-questions may have raised brows in ISL (Meir & Sandler, 2008). These observations underscore the fact that intonation is an exceedingly rich system in language, and that it comprises an independent component of the grammar. The present study shows that sign languages have intonational systems too. This means that it is possible to create an intonational system as part of prosodic structure in the visual modality. It further implies that we cannot do without it, that prosody is a universal property of human language.

As pointed out in notes 10, 11, 12, 14, 21, and 22, researchers have documented similar intonational marking for yes/no questions, wh-questions, and conditionals

in several different sign languages. Squint with similar properties to those of ISL has been described for only one other sign language so far, DSL (see note 21). The present investigation goes beyond earlier studies by providing quantificational data, by investigating the interaction between facial expression and other prosodic markers, and by providing a componential analysis of nonmanual patterns. Also unlike earlier studies, the present investigation offers a semantic analysis of individual articulations to account for the fact that the same nonmanual articulations and arrays can be found with different types of structures.

Much of the present analysis points to similarities between spoken and signed languages, such as the range of functions attributed to both **H** tones and **Brow Raise**. However, there are differences as well. The spoken system is more linear, while sign languages are more simultaneous in structure. This difference permeates all levels of linguistic structure in the two modalities (see Sandler & Lillo-Martin, 2006, chap. 25 and Vermeerbergen et al., 2007, for recent discussions of this phenomenon), and may be especially instructive in the context of the “visual prosody” accompanying spoken language that is the predominant topic of this special issue. In spoken language, intonational phrase boundary tones consist of either a unitary **H%** or **L%**. They are interpreted together with the preceding phrase accent and pitch accent, but the three types of intonational components occur in a sequence, and each has scope over a constituent of a different size. Spoken language intonational tunes must necessarily involve sequences of tones, because the vocal folds cannot simultaneously produce more than one pitch. In sign languages, there are independent articulators of intonation. An intonational element involving the eyebrows, for example, may co-occur simultaneously with an element activating the eyelids, and the system does exploit this potential. Another, related difference in the two modalities concerns the production of text and tune. In spoken language, both are produced with the same vocal apparatus. But in sign language, the text and aspects of its prosodic rhythm are conveyed by the hands, while other prosodic elements of rhythm and especially intonation are conveyed by independent articulators: the head, the torso, and articulators of the face. This shows us that the visual modality has more degrees of freedom, and future research must determine the extent to which this flexibility, and the simultaneity of articulation that it affords the intonational system, is exploited by the linguistic organization of sign languages.

Simultaneity of expression is afforded both by the fact that different parts of the body can move at the same time and by the ability of the visual system to perceive visual cues simultaneously. While the speech signal is conveyed in relatively more linear fashion, the potential for simultaneous communication using other parts of the body is richly utilized by speakers and signers alike. Speakers in all cultures produce manual gestures which augment the verbal message (Kendon 1988, 2004; McNeill, 1992). Signers, whose hands are predominately occupied by the transmission of lexical items, also produce attendant iconic gestures—with their mouths (Sandler, 2003, 2009). Finally, speakers simultaneously punctuate their speech with signals produced by the head and face, sometimes referred to as visual prosody, described in the other articles of this special issue. These signals comprise a paralinguistic system available to all human communicators. A compelling goal for future research is to try to determine what the broader repertoire is, how universal it is, and in what specific ways it complements the prosody that is acoustically transmitted. We hope we have contributed to



this goal by providing an analysis of the way in which a sign language avails itself of the same kinds of signals and molds them into a linguistic system.

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