Chapter 2

What Is Prosody?

A stream of language, be it spoken or signed, can be examined for its various organizational components, including such units as sounds, syllables, handshapes, movements, words, phrases, sentences, and larger discourse segments. These interacting components, or constituents, are analyzed as belonging to different linguistic subsystems and are combined to create what is perceived as a stream of connected discourse (Crystal, 1969). Among the components are the segmental and non-segmental constituents of sound structure (in spoken languages) and sign structure (in signed languages). The non-segmental structure includes the language's prosody, that is, its means of indicating prominence and grouping of linguistic units (Shattuck-Hufnagel & Turk, 1996).

Prosody plays an essential role in the production and perception of every utterance, spoken or signed, in language (Cutler, Dahan, & van Donselaar, 1997). One area of linguistic inquiry that addresses the phenomenon of prosody is phonology, traditionally defined as the study of sound patterns and phonetic variation in spoken language (O'Grady, Archibald, Aronoff, & Rees-Miller, 2001). Evidence for specific prosodic constituents has come from phonological observations and from measurements of the acoustic and articulatory patterns in speech. Studies of perception, memory, and other aspects of language behavior also have supported the existence of prosodic constituents cross-linguistically. There is variation as to which properties of spoken language are described as prosodic, but they usually include intonation, rhythm, tempo, stress, lengthening, volume, and pausing (Fox, 2000; Wennerstrom, 2001). In signed languages, prosodic structure is expressed by changes in eye aperture, head movement, body leans, lengthening of signs, cheek puffing, nose wrinkling, and hand clasping, among other physical behaviors (Sandler, 1999a). Although the prosodic patterns of language have been of interest since antiquity, it has only been in the last half century that linguists have begun to systematically address the relation between prosodic properties of language and its segmental constituents. Currently, research

on prosody is being done on a variety of spoken and signed languages and in a number of linguistic contexts.

The focus of this book is the prosodic markers that occur at boundary points in a distinctive language-usage context, ASL interpretation. This book examines empirically determined boundaries, without identifying them as belonging to any specific level of linguistic structure. However, if theories of prosodic structure are correct, these boundaries are delimiting units that organize both production and perception.

This chapter provides an overview of the relevant research on prosody that has informed and guided this project. Admittedly, the overview is cursory in nature, touching only on a few of the analyses and models related to prosody and concentrating on prior research that informs the current study. Topics addressed in this chapter include the connection between syntax and prosody, prosodic properties that cue boundary points, and the theory of Prosodic Phonology. Research on prosody in signed languages has been heavily influenced by work on spoken languages; therefore, findings on the prosodic structure in both language modalities are discussed in this chapter.

Prosody in Spoken Languages: An Overview

Spoken language can be analyzed as having a hierarchical structure, with sounds as the smallest perceptible unit. Sounds can be grouped into syllables, which are assembled into words. These words are then grouped with adjacent words to create phrases of varying lengths, which may be grouped to form sentences and even longer strings of discourse. These various levels of spoken language are characterized by patterns of rhythm, timing, volume, and intonation—collectively known as prosody.

A universally accepted definition of prosody has been elusive. Shattuck-Hufnagel and Turk (1996) state that a satisfactory definition of prosody must include both a description of the relevant acoustic patterns of language as well as the higher-level constituents that account for the patterns. Crystal (1969) defines prosody as sets of phonetic properties, such as frequency (f0), duration, amplitude, quality, and reduction, which have variable relationships with their co-occurring segments. At one end is an abstract definition of prosody that is not necessarily linked to its expression and, at the other, a listing of the measurable suprasegmental features of language. Cutler et al. (1997) propose a definition that encompasses

both perspectives by defining prosody as "an abstract structure coupled to a particular type of realization" (p. 142).

Prosody and syntax are bound together in the linguistic system. For example, prosody regularly marks certain syntactic structures, such as parentheticals, tags, nonrestrictive relatives, and appositives. Another prosody-syntax link may be found in the role of prosody in disambiguating sentences that may be understood in more than one way (Allbritton, McKoon, & Ratcliff, 1996; Lehiste, 1972; Price, Ostendorf, Shattuck-Hafnagel, & Fong, 1991; Streeter, 1978). Further, it has been argued that prosody contributes information about connections among constituents in discourse, conveying meaning beyond what is provided through lexical and syntactic systems (Swerts & Hirschberg, 1998; Wennerstrom, 2001). Finally, prosody interacts with syntactic structures to create boundaries in discourse, which are the focus of this book.

It is evident that there are many ways to convey similar ideas in language, both syntactically and prosodically. As Hirschberg (2002) observes, research on prosody is more a matter of "finding likelihoods," rather than simply mapping prosodic features directly onto syntax or semantics (p. 32). It is known that speakers have options for the prosodic treatment of a given syntactic structure (Price et al., 1991); therefore, syntax does not entirely determine prosody. Additional factors that may influence a speaker's decision about what prosodic features to employ for a given utterance include the focus of an utterance (Frota, 2000; Ladd, 1986; Pierrehumbert & Beckman, 1988), whether it contains new or previously given information (Brown, 1983), the assumptions shared by the speaker and the addressee, and speaking rate.

Prosody is perhaps the most complex and difficult area to study in the linguistic system because it is intimately related to every other aspect of that system, from phonetics to discourse (Sandler, 1999b). But it is precisely this centrality in human language that has made its study so engaging. Since spoken language prosody is better understood than signed language prosody, two areas of inquiry about spoken language prosody are examined in the following sections because of their relevance to understanding how boundaries are marked in speech: (1) the role of prosody in the comprehension of boundaries in discourse, and (2) the hierarchical organization of prosodic constituents.

Utterance Boundaries and Spoken Language Prosody

How do listeners understand spoken language? The tasks necessary to achieve comprehension include perceiving, decoding, interpreting, and often coconstructing the message that is produced by a speaker. To achieve comprehension, the listener must, among other things, recognize individual words and how they are linked together syntactically and semantically, and understand how the syntax fits into a larger discourse structure (Cutler et al., 1997). In addition, it appears that, through prior exposure to language, a listener intuitively knows that prosodic phrases divide an utterance into meaningful "chunks" of information (Bolinger, 1981). Chunking has been found to be important to comprehension and perceived naturalness of language production (Sanderman & Collier, 1997). That is, to comprehend language input, one must be able to parse it into meaningful units. Speakers use both syntactic and prosodic structure to parse the language stream into units, although the relative importance of the two may be different in different contexts.

This section reviews the body of literature that addresses how prosodic features mark phrasal boundaries in spoken language discourse. The study of the production and perception of prosody in relation to phrasal and syntactic structure has provided a wealth of information about the realization of prosody and its potential to affect comprehension. There are a variety of proposals as to the organizational structure of phrasal units (for a survey, see Shattuck-Hufnagel & Turk, 1996). Although it is clear that languages differ as to the nature and number of phrasal units that they utilize, some kind of phrasing has been identified in virtually every language that has been examined from this perspective. The principal acoustic dimensions identified as marking phrasal structure are frequency (f0), duration, intensity, and segmental spectral properties.[1]

In the history of psycholinguistic research on this issue, findings have suggested that the prosodic structure of an utterance has a role in aiding the listener in perceiving, organizing, and comprehending spoken language. The methods used to address this have included measuring response times when performing a language task, evaluating judgments about well-formed and ill-formed prosody, as well as other measures for assessing language processing by the listener (McWhorter, 2003).

1. Refer to page 27 for studies on the phrasal marking in signed languages.

As early as 1961, Epstein found that a string of nonsense syllables is recalled better when presented in acceptable sentence structure than without, but only if spoken with the prosodic cues typical to the syntactic construction. In a similar study, spoken strings of words with grammatical constructions were more easily replicated than ungrammatical strings, but only if spoken with sentence prosody (Martin, 1968). Later, results from a related experiment suggested that speakers could recognize previously heard sentences, even nonsense utterances, more accurately if the same prosody was used in both the first and second presentation (Speer, Crowder, & Thomas, 1993). Several other studies have supported the finding that acoustic phrase marking tends to occur at major syntactic boundaries (Brown & Miron, 1971; Cooper & Paccia-Cooper, 1980; Goldman-Eisler, 1972; Klatt, 1976).

Speakers select a specific set of linguistic features in order to communicate an underlying message (Gumperz, 1982). For example, pausing while speaking is a strategy that enables the listener to break the discourse structure of a message into chunks and to interpret its meaning. In fact, a consistent finding in prosody is the presence of longer pauses at more important boundaries in discourse (Holmes, 1988; Mushin, Stirling, Fletcher, & Wales, 2003; Noordman & Vonk, 1999; Ouden, Wijk, & Swerts, 2000). Longer pausing is found to occur at the conclusion of a larger discourse segment (Grosz & Hirschberg, 1992; Hirschberg & Nakatani, 1996). Results such as these suggest that phrasal structure is used by speakers to organize the message being communicated and by perceivers to process the input (Cutler et al., 1997).

Studies have shown that speakers and listeners do not rely solely upon syntax to determine boundaries in discourse; rather a range of prosodic cues provides information about their location. In one experiment, Passonneau and Litman (1996) asked subjects to identify points in an informal, spoken, monologic narrative where they perceived the occurrence of a discourse boundary; that is, where the speaker finished one communicative task and began a new one. The subjects demonstrated a significant pattern of agreement on the location of discourse segment boundaries. Examination of the structure of the narrative showed that segmentation, coherence, and linguistic devices (including prosody) were all influencing factors that cue the location of boundaries.

The specific prosodic cues that mark boundary locations are revealed in a number of studies. For example, perceptible differences were found in sentence-final lengthening, pause duration, and voice quality at the

boundaries between sentences, regardless of whether or not they are produced at the end of a paragraph (Lehiste, 1975, 1979). In English, these cues tend to be very localized: sentence-final lengthening affects primarily the coda of the syllable immediately preceding the boundary; however, at a major discourse boundary, some lengthening also occurs in the syllable immediately following the boundary (Fon, 2002; Wightman, Shattuck-Hufnagel, Ostendorf, & Price, 1992). Pauses and pitch have been found to be highly informative features in the detection of both sentence and topic boundaries (Shriberg, Stolcke, Hakkani-Tur, & Tur, 2000). In a recent examination of Swedish and American listening groups, it was found that individuals were able to successfully identify the location of boundaries in the language that they did not know (Carlson, Hirschberg, & Swerts, 2005). These findings support the claim that syntax alone does not fully predict the way that spoken utterances are organized. For this reason, prosody is a significant issue for the examination of auditory sentence processing.

Based on these findings, it is accepted "that prosody plays an important role in a listener's ability to interpret the speaker's intent" (Wightman et al., 1992, p. 1707); however, there are still questions about how cues in the acoustic signal actually mark the boundaries. Studies have shown that prosodic phrase boundaries are marked by a variety of acoustic cues that include intonation, pausing, and duration (Shattuck-Hufnagel & Turk, 1996). There is no consensus, however, on the relative importance of these cues and how each is used to signal boundaries. Moreover, only in a few languages has there been much investigation of precisely what boundaries are actually signaled. The study of prosody at phrasal boundaries is expected to grow due to recent commercial demands for the information. One interest in the interplay between prosody and discourse-level organization is driven by the desire to improve synthesized texts for human-machine communication (Hirschberg, 2002; Smith, 2004).

This section has reviewed some of the research on how prosody interacts with syntax to create boundaries in discourse. However, many questions remain to be answered. In the following section, a description is given of how prosodic structure can be organized into a phonological hierarchy, similar to what has been suggested for syntactic structures.

Hierarchical Organization of Prosodic Constituents in Spoken Languages

Early generative theory characterized phonology of a language by a linear organization of segments and phonological rules of the surface morphosyntactic structure (Chomsky & Halle, 1968). Reaction to this theory resulted in other models that viewed phonology as a set of interacting subsystems, each governed by its own principles, and included theories of the metrical grid, autosegmental phonology, and prosodic phonology (Nespor & Vogel, 1986). One approach to accounting for prosodic patterns is found in theories that propose a hierarchy of phonological constituents. Following earlier work on hierarchy in syntactic tree structures, Liberman and Prince (1977) suggested a similar organization of rhythmic units of spoken languages. The notion of a hierarchy provided a way to account for the multiple levels of prominence in language.

Bolinger (1981) suggested that there are different types of prominence, rather than different degrees of it. Bolinger's view was that primary and secondary word stress differs, not in degree or type of articulatory or acoustic prominence, but in where the prominence occurs. Other researchers (e.g., Beckman & Pierrehumbert, 1986; Ladd, 1986; Pierrehumbert, 1980; Selkirk, 1978, 1980, 1986) proposed hierarchies of constituents that characterize various phonological levels, although there remains ongoing debate about which phonological constituents comprise each of the levels. Other studies supported the claim that various types of prominence correspond to different levels in the hierarchy (e.g., Shattuck-Hufnagel, Ostendorf, & Ross, 1994; Sluijter, 1995).

Although the theory of hierarchical organization was originally created to account for syntactic structure, the proposed prosodic structure is separate from, but influenced by, the morphosyntactic structure of the utterance. The theory of prosodic phonology was put forth by Nespor and Vogel (1986) as a phonological model of the organization of prosodic constituents in spoken language. According to this theory, the mental representation of speech is divided into a hierarchy of units, or chunks, and each prosodic constituent serves as a "domain of application" (Nespor & Vogel, 1986) of rules and phonetic processes. Therefore, prosodic phonology theory provides a model of how morphosyntactic structure is linked to a hierarchy of prosodic constituents and how phonological patterns correlate with the different constituents.

To validate these claims of a prosodic structure that interfaces with syntax, a number of issues needed resolution. One limitation on researchers' ability to test theories was the lack of a standardized transcription method for the prosodic dimensions of speech. Since prosodic features are not represented in English orthography, researchers relied on punctuation in their descriptions. This need stimulated the development of schemes for prosodic annotation, such as the ToBI system (Beckman, Hirschberg, & Shattuck-Hufnagel, 2005) that allows researchers to compare their findings more easily, within and across spoken languages, and facilitated the construction of annotated speech corpora.[2]

Prosody in Signed Languages

To date, the majority of research on prosody has been on spoken languages and the acoustic and articulatory dimensions specific to speech. Signed languages are expressed and perceived through the visual-manual modality dimension; therefore, the study of their prosodic structure must take into account their distinct form. Although different in means of expression, prosodic systems in signed languages are comparable in function to spoken language (Wilbur, 1999). For example, the cessation of speech, or a pause, is a frequently used prosodic cue to mark boundaries in spoken languages. The pause also occurs in ASL, but with a different means of production. In ASL pausing, there is a cessation, not of sound, but of movement, and the signer can continue to hold the sign in space while maintaining the watcher's attention on the sign (Winston, 2000, p. 109).

Another example of modality variation between sign and speech has been described as "layering" (Wilbur, 2000). Layering is the capability to simultaneously produce multiple phonological elements while each retains a specific meaning or function. For example, in sign production, a particular handshape can convey an object of a certain size or shape, or the agent handling the object, while the verbal aspect can simultaneously be represented through movement modifications. According to Wilbur (2000), layering is a "linguistic adaptation" (p. 217) to the visual modality of signed language. It serves prosodic and pragmatic purposes, and is distinct from the linear organization of spoken language. Layering is exploited in the production of nonmanual markers produced simultaneously with manual signs.

2. ToBI stands for Tones and Break Indices.

One of the challenges in analyzing the phonetic structure of signed languages has been that production is highly variable across signers. To date, this variation in expression has received fairly little attention in the literature (for exceptions, see Crasborn, 2001; Wilbur, 1990; Wilbur & Nolen, 1986; Wilcox, 1992), but the scant phonetic description of signed languages has been caused by the lack of tools to accurately measure the articulation of signs. Video recordings of signed languages have typically been used to create transcriptions of signed languages, rather than for analyzing phonetic structure.

To resolve this issue, researchers devised transcription systems that employed detailed notations of physical elements, pictures, diagrams, and glosses in the local written language (for a complete description, see Hoiting & Slobin, 2001). Many of these systems are still in use, but either lack a standard approach to transcription or the ability to be represented using a standard keyboard. Additionally, while certain lexical items can be readily transcribed, the non-segmental articulations of signed languages are more problematic. Therefore, the transcription issues that occurred in the study of prosody in spoken languages are parallel to those in transcribing signed languages.

New technologies are providing the means to study signed language phonetic systems. ELAN is a linguistic annotation tool that was designed for the creation of text annotations to audio and video files (Crasborn, van der Kooij, Broeder, & Brugman, 2004). ELAN's first application was in the measurement of gesture that co-occurred with speech; however, in recent years it has increasingly been used in the study of signed languages (Broeder, Brugman, Oostdijk, & Wittenburg, 2004; Brugman, Crasborn, & Russell, 2004). Another tool, SignStream, was developed for analysis of signed language captured on video (Neidle, 2002). SignStream provides an environment for manipulating digital video and linking specific frame sequences to simultaneously occurring linguistic events encoded in a multi-level transcription tier. Programs such as ELAN and SignStream greatly simplify the transcription process and increase the accuracy of transcriptions for signed languages. In this way, software is beginning to provide a means to conduct phonetic analysis on signed languages.

The study of language across two distinct modalities provides a rich opportunity to investigate modality effects on grammar as well as identify linguistic characteristics that are universal. There have been a variety of approaches to the examination of signed language prosody; this literature review focuses on two aspects of research to that are particularly relevant

to the study reported here: (1) Studies that focus on the specific morphosyntactic functions of individual prosodic markers, and (2) models of signed language structure based on the theory of prosodic phonology.

Signed Language Prosody and Morphosyntactic Structure

As discussed in the earlier section on spoken languages, prosodic structure is distinct from, but associated with syntactic structure. The same is true for signed languages. Both spoken and signed languages use prosodic structure to emphasize selected constituents, and to communicate the discourse function of the sentence (Sandler & Lillo-Martin, 2001). This section provides an overview of research conducted on the association between prosody and morphosyntax in signed languages and assembles evidence that prosodic structure is an integral part of the linguistic systems.

Signed languages are frequently portrayed as manual languages, that is, produced solely by the signer's hands. The facial expressions used during the production of signed languages were initially thought to convey the signer's emotions, and little more. In the past several decades, however, linguistic research has demonstrated that non-manual components, produced by the signer's eyes, face, head, and torso, contribute to marking syntactic structure across a variety of signed languages (Baker-Shenk, 1985; Bergman, 1983; Lawson, 1983; Sorenson, 1979; Vogt-Svendsen, 1981; Woll, 1981).

It has been well established that particular facial expressions in ASL span syntactic constituents, such as yes–no questions, wh-questions, topicalized elements, and relative clauses (e.g., Aarons, Bahan, Kegl, & Neidle, 1992; Baker-Shenk, 1983; Coulter, 1979; Liddell, 1978, 1980; Petronio & Lillo-Martin, 1997). Further, Israeli Sign Language (ISL) has been shown to use facial expressions that correspond to the tonal melodies in spoken language in many ways (Nespor & Sandler, 1999).

The distinction between facial behaviors that convey affect and those that mark grammatical structures has been supported by brain studies indicating that affective expressions appear to be primarily mediated by the right hemisphere and linguistic expressions involve left hemisphere mediation (Corina, Bellugi, & Reilly, 1999). Affectual facial expressions are random and optional, but linguistic facial expressions are grammaticized, fixed, and systematic (Sandler & Lillo-Martin, 2001).

In a study of linguistic structure, Liddell (1978) pointed out that relative clauses are grammatically marked in ASL, not by function words

such as *that*, but by nonmanual grammatical markers consisting of raised brows, a backward head tilt, and a tensed upper lip. Differences in head movement were found to distinguish the signals for yes-no questions and topics (Liddell, 1980). It was later found that the signals for yes-no questions and wh-rhetorical questions differ in head movement and movement of the upper eyelid (Baker-Shenk, 1983).

Signed languages have multiple articulators including the head, body, and hands, but these broad categories of articulators have smaller components that can behave independently in creating prosodic structures. For example, eye gaze has been shown to mark prominence of specific ideas in ASL discourse (Mather, 1989; Mather & Winston, 1995). Functions of eye gaze have been categorized into three types in a study of ASL narrative structure: gaze at audience, gaze of character, gaze at hands (Bahan & Supalla, 1995). Eye gaze coupled with head tilt expresses agreement by referencing the same spatial locations as manual marking; eye gaze marks the object and head tilt marks the subject (Bahan, Kegl, MacLaughlin, & Neidle, 1995). Studies of eye gaze by English speakers and non-native signers show that English speakers do not change their gaze to "imagine" objects in space; rather, they continue to look directly at the addressee, whereas non-native signers use eye gaze in a random fashion or by "overgeneralizing" where the eye gaze falls (Thompson & Emmorey, 2004).

Changes in eye gaze are not the only behavior that can serve as a marker at intonational phrase boundaries performed by the eyes during the production of signed languages. Eyes can perform several types of movements because the musculature that controls them can occur independently. Another area of study in signed languages has been eyeblinks. Baker and Padden (1978) brought eyeblinks to the attention of signed language researchers by suggesting their connection to conditional sentences. It has also been suggested that eyeblinks in signed languages have similar functions to breathing in spoken languages because both are physical actions using articulators distinct from the main language production mechanism; in addition, eyeblinks and breaths occur at intonational phrase boundaries (Nespor & Sandler, 1999). Wilbur (1994) suggested that there are two types of eyeblinks with linguistic purposes—inhibited involuntary eyeblinks, which can serve as boundary markers at intonational phrase boundaries, and voluntary eyeblinks that can be markers of emphasis as well as signal a marker of the final sign in a chunk of information.

There has been research that indicates that sections of the face may be described using categories of syntactic structure. For example, the

nonmanual markers performed by the upper part of the face and head occur with higher syntactic constituents (clauses, sentences), even if such constituents contain only a single sign (Wilbur, 2000). A head thrust typically occurs on the last sign of the first clause in conditionals (Liddell, 1986). Eyebrow raising and lowering has been claimed to signal rhetorical questions, yes-no questions, and conditionals in ASL (Coulter, 1979; McIntire, 1980). In Sign Language of the Netherlands (NGT), the position of the eyebrows and the whole head are involved in distinguishing sentence types, such as yes–no questions versus wh-questions (Coerts, 1992). The lower portion of the face has been shown to provide adverbial and adjectival information. Movements of the mouth, tongue and cheeks are associated with specific lexical items or phrases (Liddell, 1978, 1980).

As in spoken language, research has shown that lengthening is another behavior that can be used prosodically in ASL. Holding or lengthening of signs has been analyzed by Perlmutter (1992) as application of the Mora-Insertion rule in ASL. Miller (1996) followed with a similar study of lengthening in Langue des Signes Québécoise (Sign Language of Quebec). Sandler (1999c) discussed lengthening in Israeli Sign Language and claimed that lengthening of movement occurs at the right edge of a phonological phrase.

Signed languages also utilize the entire body as an articulator. The movement of the torso in space serves as a prosodic marker. Syntactically, torso leans have been attributed to linking units of meaning in discourse, including the inclusion or exclusion of related information, providing contrastive focus, and creating affirmation of larger chunks of discourse (Wilbur & Patschke, 1998).

In viewing the human capacity for language as a specialized behavior, the pervasiveness of rhythmic patterning in biological systems can be applied to language as an organizing principle of phonological structure. Nespor and Sandler, for example, describe head positioning as a "rhythmic cue" (1999, p. 165) in signed languages, although they do not specify which particular constituent is being cued. This proposal was strengthened by Boyes-Braem's (1999) study that described the occurrence of temporal balancing in Swiss German Sign Language. This behavior, similar to the balancing of unit size in Gee and Grosjean's (1983) study of speech, suggests that signers attempt to create equitable temporal partitions in their utterances. That is, the length of a spoken and signed utterance is determined in part, not by syntactic structure, but by a tendency to divide the utterance into equal parts using prosodic structure.

Increasingly, typological information on signed languages around the world is becoming available. Examination of grammatical patterns in multiple signed languages shows similar paths of development. A recent report on negation strategies of various signed languages finds that nonmanual negation is created by the use of head movements and facial expressions in many languages (Zeshan, 2004). A survey of 17 signed languages showed that raised eyebrows, a common nonmanual gesture used in signed languages around the world, developed from gesture, acquired new meaning, and grammaticized, thus becoming a linguistic element (MacFarlane, 1998).

As a final note, there is a category of behaviors in signed languages that are not a part of prosodic structure. These behaviors are sometimes labeled "extralinguistic" features and may be manifestations of internal states or external restrictions on the signer, such as nervousness or restricted signing space. These extralinguistic movements are not considered a part of the prosodic system. Additionally, a signer's idiolect must be considered in any linguistic analysis, including that of prosodic structure. Each signer may elect to use a combination of prosodic markers, which may vary based on the setting (Winston, 2000).

Hierarchical Organization of Prosodic Constituents in Signed Languages

The field of sign language phonology is new, yet there exist a variety of models of phonological structure for signed languages (e.g., Brentari, 1990, 1998; Corina, 1989; van der Hulst, 1993; Liddell, 1984; Liddell & Johnson, 1989; Sandler, 1989, 1993, 1996; Wilbur, 1993). Theories of a prosodic hierarchy in spoken languages have inspired the investigation of the phonological structure of signed languages. A range of studies have proposed that signed languages group syntactic constituents into hierarchical prosodic domains, comparable to the domains in spoken languages.

An early model of the phonological structure of signed languages was based on a proposal for a moraic theory of prosodic structure by Hayes (1989). Examining ASL and Langue des Signes Québécoise, Miller (1991) formulated a mora-based model of sign language. He argued that the structures and principles of prosody constitute an autonomous model within phonology. Miller suggests that moraic theory based on the syllable as the core unit is superior to other models of sign language

phonology that are based on the assumption that movement is the central element in sign segmentation.

Other researchers followed suit and developed models with more complex proposals for syllable structure in signed languages. Corina (1996) investigated the constraints on syllabic well-formedness and argued that ASL signs require at least one dynamic component realized as a sequenced articulation of a structural parameter. Analysis of these components supports a division into mono- and disyllabic signs. He further argues for the existence of constraints on possible syllable nuclei in ASL. A prosodic account is offered in which a limited set of moraic elements compose a sign syllable. This recognition of a prosodic level separate from melody allows categorization of possible nuclei expressed over different sign parameters.

Another model of prosodic constituency in signed languages emphasizes that prosodic structure may be identifiable by a number of behaviors and the timing relationships among those behaviors. Brentari's (1998) prosodic model suggests that two kinds of phonological features can be systematically identified in core lexical items: those that are necessary for describing a sign's movement (the prosodic features) and those that describe properties of the sign that do not participate in movement (the inherent features). One claim of this theoretical framework is that, because of signed language's visual-gestural phonetic basis, the consonant-like and vowel-like units are expressed simultaneously with one another, rather than sequentially as in spoken languages. A second claim is that movements operate as the most basic prosodic units of a signed language.

Nespor and Sandler (1999) examined Israeli Sign Language using prosodic phonology (Nespor & Vogel, 1986) as their theoretical basis. Nespor and Sandler argued that ISL sentences are divided into prosodic constituents, phonological phrases, and intonational phrases. Sandler argued that the prosodic system demarcates prosodic constituents by exploiting the non-dominant hand as a redundant element. Its handshape, location, and movement are severely restricted, giving it a subordinate role in the prosodic hierarchy, but allowing it to mark constituents. This work is now being extended to Sign Language of the Netherlands (NGT) and results from investigations of other sign languages (ASL, ISL, LSQ) will be compared in order to identify linguistic universals of hierarchical structure in phonology.

The above models suggest that spoken and signed languages share a similar phonological-syntactic organization, although their phonetic systems bear no physical similarity to one another (Nespor & Sandler,

1999). The models of signed language phonology contribute to the study of cross-modal linguistic patterns and demonstrate universals in prosodic structures despite the completely different phonetic mediums of signed and spoken languages.

Although this book is not investigating any particular theory of prosodic organization, the hierarchical nature of prosodic structure is relevant because it speaks to the nature of the linguistic structures under investigation. Theoretical studies support the notion that universally, the stream of language is broken up into prosodic constituents. This study focuses on what happens at the boundaries of constituents. The descriptive examination in this study will increase our understanding of how prosodic constituents are produced in signed languages.

Signed Language Prosody and Boundaries

Since phrasing is found so widely in spoken languages, the use of phrasing in signed languages comes as no surprise (Bahan & Supalla, 1995; Mather & Winston, 1995; Sandler, 1999; Wilbur, 1999). It has been suggested that, in the absence of pitch as a possible cue for phrasal boundaries, ASL uses eyeblinks and phrase final lengthening to mark the ends of phrases (Wilbur, 1999). To date, however, the use of prosodic markers to indicate boundaries in signed languages has not been widely studied. One study by Hansen and Hessman (2006) concluded that markers such as blinks, changes in eye gaze, duration of signs or transitions are "useful but not conclusive" for determining sentence boundaries in German Sign Language.

An intriguing study done in Britain examined the perception of sentence boundaries in signed languages unknown to the participants (Fenlon, Denmark, Campbell, & Woll, 2006). Six Deaf native signers and six hearing nonsigners were instructed to "mark the boundaries in the story" across three conditions:[3] when a fable was told in British Sign Language (BSL), Swedish Sign Language (SSL), and in silent English via a videotape of a person reading English aloud with no visual language input. The results indicated a consistency in people's responses, both Deaf and hearing, in the identification of boundaries, suggesting that both groups perceived similar movement cues of the individuals who told the fable. This finding supports the role of non-lexically-based prosody in boundary

3. The participants were not given specific instructions on the type of boundaries (syntactic, semantic, or prosodic) to be marked.

marking since the participants were not users of two of the languages for which they were marking boundaries, and yet they still had a high degree of agreement. The most frequent markers that occurred at the agreed-upon "boundary" points included sign lengthening in the signed language versions, head movement, head nodding, and shifts in eye gaze.

Prosody in Interpreting

Over the past 40 years, signed language interpreting in the United States has shifted from a part-time, volunteer activity into a rapidly growing professional pursuit. The national organization of signed language interpreters, the Registry of Interpreters for the Deaf (RID), has attempted to keep pace with the increasing demand for credentialed interpreters by upgrading their assessment process.

Presently, the RID recognizes two assessment measures for signed language interpreters, the National Interpreting Certification (NIC) and the Educational Interpreter Performance Assessment (EIPA). Both evaluations include knowledge and skills of ASL prosody as part of their criteria for certification. For example, the description of competencies needed for the NIC examination includes "knowledge of ASL sentence boundaries" and "comprehension of ASL discourse boundaries" (RID Website, 2007). The EIPA is an evaluation tool designed specifically for educational interpreters. One of the skills being evaluated in the EIPA is "prosodic information" with a specific focus on how the interpreter "marks sentence boundaries" (Schick & Williams, 2004, p. 191). Although the assessments state that prosody is a necessary skill, interpreters are left to master a skill with little available information on the topic.

One of the few studies that examined the use of prosody by signed language interpreters focused on the incidence of pausing in transliterated texts (Siple, 1993). The results suggested a correlation between the location of pauses in the English source language discourse and the pauses created in the transliterated text. Other studies have included prosody as one component in an examination of interpreters' work (Sofinski, Yesbeck, Gerhold, & Bach-Hansen, 2001; Siple, 1995); however, after Siple's (1993) investigation, there were no studies done specifically on prosody in interpretation for 10 years.

In 2003, a groundbreaking study by Winston and Monikowski addressed the use of prosody by interpreters, specifically how prosody marked topic boundaries in both interpretation and transliteration. The findings demonstrated that, although there were differences between the

production of prosody used in interpretation and transliteration, similar cues occurred in both. The study concluded that "ASL pausing and phrasing features such as using space for sentence boundaries, lengthening final holds for signs, and shifting of the head and torso are essential to clear segmenting of ideas and topics within a text" (p. 189). Bringing together the most current research on signed language prosody and discourse analysis, the study provided preliminary findings on how prosody and discourse interface in interpreted texts.

Prosody and Segmentation in ASL Interpretation

This chapter has provided an overview of research literature on spoken and signed language prosody, specifically the relation of prosody to morphosyntactic structure and the theory of prosodic phonology. The study of prosodic features in spoken and signed languages is an emerging area of linguistic investigation. Interest in prosody has grown over the past several decades, driven by new theories and increasing applications for the findings, all leading to a deeper understanding of prosody as an integral part of linguistic communication. Linguists are only beginning to explore questions about the use of prosody when two language modalities, speech and sign, occur in rapid succession during the process of interpreting.

The expression of prosody in signed language interpreting raises questions in a number of areas of inquiry. In spoken language linguistics, for example, studies have examined the differences in prosodic structure of planned speech compared to spontaneous speech (Brennan & Schober, 2001; Clark & Wasow, 1998; Thorsen, 1983). Prosody in interpretation contains elements of both planned and spontaneous communication, which makes it an interesting linguistic area for study. Interpreted communication is planned because the interpreter has, at the very least, a few seconds of processing time to prepare how to construct a message in the target language. At the same time, interpretation is a spontaneous speech act because each interpreter makes rapid decisions about how to construct that message and the result is personal and stylistic. Therefore, the study of the unique language-usage context of interpretation can provide interesting insights on how prosody is structured when two language modes are merged.

Another area of inquiry is the relationship between language and mental operations, including memory. Chafe (1994) states that, during the production and reception of language, the mind operates in one of three activation states: active, semiactive, or inactive. Although the boundaries between these states may not be strictly demarcated, this proposed

system may represent the cognitive tasks required of an interpreter who is moving rapidly from a source to target language. The notion of activation levels may be useful in studying how interpreters express prominence of concepts in the discourse that are active in the mind and create meaningful chunks within their interpretations.

Additionally, work has been done on "synchrony" in language. Synchrony is the study of the various, interlocking systems that occur in the context of communication and their dynamic operations. Synchrony argues for an embodiment of language, that is, that the body moves in synchrony to reflect language structures, including prosody (Condon, 1986). Signed languages are ideal systems to study synchrony since the language, by its very nature, is embodied through its articulators. Synchrony suggests that prosodic information in spoken languages is encoded in the body (Wiltshire, 1999). If so, signed languages, because of their physical articulators, provide a fertile venue for further exploration into the notion of synchrony.

The present study differs from earlier work in at least two ways: It examines the use of prosody in ASL interpretation rather than native signers' production of prosody, and it involves Deaf participants in the identification of boundaries in interpretation. Using locations that have been perceptually marked by language users, this study identifies those physical features that may be responsible for the perception. This research project takes the view that it is not the individual physical event, but the production of one event relative to a series of physical productions that creates the perception of stress, prominence, and focus. Prior work on prosody in signed language interpretation focused primarily on the occurrence of pausing in transliteration, whereas this study examines prosodic features in interpretation. In addition, this study examines the occurrence of 21 different prosodic markers at perceived boundary points in the interpreted discourse.

This book provides an investigation of prosodic cues that occur in signed language interpretation, at boundaries perceived by Deaf people who use interpreters. As stated by Winston and Monikowski, "Perhaps one day, interpreter educators can help our students better understand prosody and teach them to produce dynamically equivalent texts that 'look like' the ASL of the Deaf community" (2003, p. 219). Studying the types of prosodic cues that function to mark utterance boundaries in interpretation is a first step to achieving this goal and improving the teaching of prosody in interpreter education.