# Intonation

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## Introduction

Intonation is the tonal structure of linguistic expressions, which is not directly due to tones of the lexical items or to morpho-syntactic categories, and its realization together with paralinguistic effects. If tones come with the words or the morpho-syntactic categories, they are termed "lexical tones," and languages that have them are "tone languages." Intonational tones appear at the beginnings or ends of prosodic constituents (boundary tones) or on certain words (pitch accents). Tones at prosodic boundaries signal the relevant phrase structure, usually that of the intonational phrase. Pitch accents as well as boundary tones may be contrastive, in which case the different tone options signal discoursal meanings, like theme versus rheme, nonfinality, interrogativity, finality, etc. By the side of tone, structural intonation may include nontonal phonological elements, most strikingly quantity (vowel length), as has been found in West Greenlandic and Shekgalagari. European languages have various intonational pitch accent assignment rules, the most striking of which signal focus meanings ("information structure"). English for instance deletes pitch accents after the focus. Intonation systems vary in complexity, like any aspect of the linguistic structure. Intonation systems of West Germanic languages are among the most complex ever described. In addition to intonational tone structure, intonation includes the paralinguistic use of pitch. Often, paralinguistic intonation is more striking than structural intonation. Drawing the line between them is a long-standing issue, which is often believed will remain unresolved for some time to come. Languages may signal the same function either structurally or paralinguistically. For instance, Stockholm Swedish has been described as signaling the difference between questions and statements paralinguistically, while Norwegian is characterized as having different tones for statements and questions. Intonation is increasingly included in language descriptions. It is also often described in combination with a language's lexical tone structure. The way in which intonation interacts with the morphosyntax in expressing information structure is a widely debated issue in European languages in particular. The debate has tended to be conducted within either a phonological setting or a syntactic setting, although, more recently, work has appeared that attempts to bridge that gap. Discourse studies deal with the role of both structural and paralinguistic variation in duration and pitch in signaling speaker attitudes, cohesion, and turn management. We are indebted to Gorka Elordieta, Jörg Peters, and Tomas Riad for providing information on Basque, German, and Scandinavian, respectively. This work was supported by an Internationalization Grant awarded by the Netherlands Organisation for Scientific Research (*Forms and Functions of Prosodic Structure* NWO 236-70-002).

## Textbooks

A number of recent textbooks are available. Textbooks tend to have an orientation toward English, such as Cruttenden 1997, or they are specifically about (British) English, such as Wells 2006. A wide-ranging and very readable book is Ladd 2008. Half of Gussenhoven 2004 deals with general topics, the other half containing summary descriptions of languages.

**Cruttenden, A. 1997.** *Intonation*. **2d ed. Cambridge, UK: Cambridge Univ. Press.**

First edition 1986. Accessible textbook setting out the main concepts. It is written from the perspective of the British descriptive tradition, but it includes treatments of the autosegmental intonation model and a cross-linguistic chapter.

**Gussenhoven, C. 2004.** *The phonology of tone and intonation*. **Cambridge, UK: Cambridge Univ. Press.**

Phonetics and phonology of intonation, with an emphasis on the interaction between lexical and intonational tone. Contains an account of paralinguistic meaning ("biological codes"). With detailed exemplifications of Pierrehumbert's model for a number of languages, including French, Japanese, and English.

**Ladd, D. R. 2008.** *Intonational phonology*. **2d ed. Cambridge, UK: Cambridge Univ. Press.**

Sets out the issues arising from the introduction of the autosegmental-metrical model, both phonetic and phonological. There is a

treatment on pitch range in phonology and in phonetic implementation. Deals with focus and accentuation in different European languages. First edition published in 1996.

**Wells, J. C. 2006. *Intonation: An introduction*. Cambridge, UK: Cambridge Univ. Press.**

Brief and clear, with lots of illustrations of British English intonation (some of which are included in the CD), in the British descriptive tradition. Takes the place of J. D. O'Connor and G. Arnold, *Intonation of Colloquial English* (London: Longman, 1973) which is outdated.

## Tutorial Articles and Book Chapters

A large number of encyclopedia entries, handbook chapters, and tutorial articles are available, and selections from among these are cited here. These entries concern autosegmental phonology, sometimes with comparisons of different models, as in Arvaniti 2011. Representational issues are more prominent in Gussenhoven 2007 and Arvaniti 2011, acoustic issues more prominent in Shattuck-Hufnagel and Turk 1996, Beckman 1996, and Beckman and Venditti 2010, as well as Zerbian 2010, which discusses some less commonly reviewed languages. The discussion in Nolan 2006 is with reference to English, while Ladd 2001 treats a variety of topics, including sentence accent distributions in different languages. Practical support is provided in Boersma and Weenink 2009–2013.

**Arvaniti, A. 2011. The representation of intonation. In *Suprasegmental and prosodic phonology*. Vol. 2 of *The Blackwell companion to phonology*. Edited by M. van Oostendorp, C. J. Ewen, E. Hume, and K. Rice, 757–780. Malden, MA: Wiley-Blackwell.**

Summary of intonation modeling, including discussions of the distinction between sequential and superimposition models and the distinction between direct ("Gestalt") models and phonological models in which f0 contour shapes and function is mediated by a tonal grammar.

**Beckman, M. E. 1996. The parsing of prosody. *Language and Cognitive Processes* 11:17–67.**

Introduction to prosodic phrasing and intonation, aimed at psycholinguists.

**Beckman, M. E., and J. J. Venditti. 2010. Tone and intonation. In *The handbook of phonetic sciences*. 2d ed. Edited by W. J. Hardcastle, J. Laver, and F. E. Gibbon, 603–652. Malden, MA: Wiley-Blackwell.**

Phonetically oriented treatment of the phonetic parameters involved in pitch contours, whether representing lexical tone or intonation. Discussion of the usefulness or lack thereof of distinguishing lexical tone from intonation and of the status of functional aspects.

**Boersma, P., and D. Weenink. 2009–2013. PRAAT: Doing Phonetics by Computer.**

Widely used, freely available, and easy-to-use package of speech analysis, manipulation, synthesis and experimentation programs.

**Gussenhoven, C. 2007. Intonation. In *The Cambridge handbook of phonology*. Edited by P. de Lacy, 253–280. Cambridge, UK: Cambridge Univ. Press.**

Phonological representations in intonation, including tone association, secondary association, and phonetic alignment of tones. Also contains a section on language independent effects in phonetic implementation.

**Ladd, D. R. 2001. Intonation. In *Language typology and language universals: An international handbook*. Vol. 2. Edited by M. Haspelmath, E. Konig, W. Oesterreicher, and W. Raible, 1380–1390. Berlin: Mouton de Gruyter.**

Discussion of universalist views of intonation and a review of aspects of cross-linguistic variation of typological interest, such as deaccentuation, default accentuation, and melody in questions.

**Nolan, F. 2006. Intonation. In *The handbook of English linguistics*. Edited by B. Aarts and A. MacMahon, 433–456. Oxford: Blackwell.**

Accessible chapter on intonation with special reference to English.

**Shattuck-Hufnagel, S., and A. E. Turk. 1996. A prosody tutorial for investigators of auditory sentence processing. *Journal of Psycholinguistic Research* 25:193–246.**

Practical introduction to the role of prosodic structure in language processing, with a review of research results.

**Zerbian, S. 2010. Developments in the study of intonational typology. *Language and Linguistics Compass* 3:1–16.**

Wide-ranging cross-linguistic discussion of intonation, together with methodological considerations. Makes the point that the rapid developments of recent years are leading up to, but haven't yet reached, an intonational typology.

## Edited Collections

Collections vary in thematic coherence. Some works, such as Hirst and Di Cristo 1998 and Jun 2005, are devoted to illustrations of a specific analytical framework, while others feature a greater variety of topics within a general autosegmental framework, such as Horne 2000; Riad and Gussenhoven 2007; Gussenhoven and Riad 2007; and Frota, et al. 2011. Methodological issues are addressed in Sudhoff, et al. 2006 and Cutler and Ladd 1983.

**Cutler, A., and D. R. Ladd, eds. 1983. *Prosody: Models and measurements*. Berlin: Springer.**

Older work, but contains a number of contributions on modeling that are still relevant, such as the editors' introduction.

**Frota, S., G. Elordieta, and P. Prieto, eds. 2011. *Prosodic categories: Production, perception and comprehension*. Dordrecht, The Netherlands: Springer.**

Collection of articles on the phonology of prosodic phrasing; the relationship among phrasing, intonation, and information structure; and the relationship between prosodic structure and pitch accent distribution or rhythmic properties.

**Gussenhoven, C., and T. Riad, eds. 2007. *Tones and tunes*. Vol. 2, *Experimental studies in word and sentence prosody*. Berlin: Mouton de Gruyter.**

Reports of experiments in the processing, perception, and production of tone and intonation.

**Hirst, D., and A. Di Cristo, eds. 1998. *Intonation systems: A survey of twenty languages*. Cambridge, UK: Cambridge Univ. Press.**

Summary descriptions of languages in the context of the INTSINT model but often phrased in their own theoretical framework. Also contains an illustrated exposition of the INTSINT model.

**Horne, M., ed. 2000. *Prosody: Theory and experiment; Studies presented to Gösta Bruce*. Dordrecht, The Netherlands: Kluwer.**

Contains a number of contributions explaining as well as illustrating the indebtedness of the autosegmental model to the PhD dissertation on the word tones and intonation of Stockholm Swedish in Bruce 1977 (cited under Swedish), and surveys developments in intonational phonology, prosodic phrasing, production, and perception.

**Jun, S.-A., ed. 2005.** *Prosodic typology: The phonology and intonation and phrasing*. **Oxford: Oxford Univ. Press.**

Collection of papers with AM descriptions of various languages, including an account of the history of the ToBI enterprise.

**Riad, T., and C. Gussenhoven, eds. 2007.** *Tones and tunes*. **Vol. 1,** *Typological studies in word and sentence prosody*. **Berlin: Mouton de Gruyter.**

Collection of papers on phonological issues in tone and intonation.

**Sudhoff, S., D. Lenertová, R. Meyer, et al., eds. 2006.** *Methods in empirical prosody research*. **Language, Context, and Cognition 3. Berlin: Mouton de Gruyter.**

An up-to-date guide to various online and offline methods in prosodic research. The contributions include tutorial chapters ranging from experimental design and corpus construction to data analysis.

## Models

Many proposals have been made to model intonation contours. Two broad types are (1) those that model the f0 contour from numerical and mathematical primitives and (2) those that model it through the intermediary of symbolic categorical elements. Instead of a cut into two classes, one can also see a cline from numerical to symbolic. From the viewpoint of what is modeled this cline approximates the cline between phonetic pitch contours on the one hand and the linguistic algorithms that are held responsible for the generation and production of such contours. At the symbolic end is the mainstream phonological model introduced in Pierrehumbert 1980, also known as the autosegmental-metrical model, and at the numerical end, there is the model outlined in Fujisaki 1983. In this section, an attempt has been made at ordering the models along a numerical-symbolic scale. Numerical models tend toward the superimposition rather than the sequencing of elements. The best-known superimposition model is Fujisaki's general phrase-and-accent model and Gårding 1979 provides a good example of a language-specific superimposition model (Swedish). In IPO's grammar of Dutch ('t Hart, et al. 1990), contours are described as concatenations of five types of falls (symbolized 1 to 5) and five types of rises (symbolized A to D) superimposed on a declining grid, while Hirst and Di Cristo 1998 concatenate pitch levels and pitch movements without an embedding pitch contour. Pike 1945 is a sequential model with four level phonemes only. Bruce 1977 (cited under Swedish) uses two levels, H and L, in a sequential model, whereby the sequential nature was particularly striking because the phonemes included lexical tones as well as intonational tones, thus providing a sharp contrast with Gårding 1979. From here, a seminal step was taken in Pierrehumbert 1980, in which the author develops a sequential phonological model with two phonemes together with a phonetic implementation component for English. Xu 2004 is also sequential; his model uses contour shapes as primitive elements by the side of level elements and includes a phonetic implementation component to cope with time pressure.

**Fujisaki, H. 1983. Characteristics of voice fundamental frequency in speech and singing. In** *The production of speech*. **Edited by P. F. MacNeilage, 37–47. New York: Springer.**

Temporally restricted accent functions ride of the crest of a phrase contour component. It is, in principle, language independent and the contour shapes it can produce are unlimited. It is high in phonetic realism but may be less suitable for defining relations between linguistic structure and elements in the model.

**Gårding, E. 1979. Sentence intonation in Swedish.** *Phonetica* **36:207–215.**

A description of Swedish tone and intonation that produces a contour shape for the intonation phrase depending on discourse condition and superimposes the word accents of Swedish (i.e., the lexical tone patterns) on it.

**Hirst, D., and A. Di Cristo, eds. 1998.** *Intonation systems: A survey of twenty languages*. **Cambridge, UK: Cambridge Univ.**

**Press.**

INTSINT (INternational Transcription System for INTonation) is a language-independent system of levels (high, mid, low), up-movements, and down-movements, which are each linked to a phonetic specification. Since the declining trend is incorporated in the realization rules of the symbols, it is a sequential model. The INTSINT movements and targets differ from the tones of autosegmental descriptions in that their realization is generic rather than language specific.

**Pierrehumbert, J. B. 1980. The phonetics and phonology of English intonation. PhD diss., MIT.**

Seminal dissertation distinguishing the phonological tones from the phonetic realization of tonal representations. The intonational tone grammar defines what a possible intonation contour is and the implementation specifies its canonical phonetics. It helped to redefine the relation between phonology and phonetics, showing how phonetic implementation rules are language-specific and context-sensitive. "Phonetic underspecification" was adopted in segmental phonology, namely the absence of phonological specifications over certain stretches of surface structure.

**Pike, K. L. 1945. *The intonation of American English*. Ann Arbor: Univ. of Michigan Press.**

American English intonation in terms of four pitch phonemes, "1" (extra high) to "4" (or extra low). A degree symbol indicated accented pitch phonemes and a dash indicated interpolated stretches. A sequential, phonological description in name, but lacked a phonetic component. Famously criticized in Bolinger 1986 (cited under English) for failing to express generalizations or adequately capturing contrasts.

**'t Hart, J., R. Collier, and A. Cohen. 1990. *A perceptual study of intonation: An experimental-phonetic approach to speech melody*. Cambridge, UK: Cambridge Univ. Press.**

The sets of movements are phonetically defined for their pitch range, the timing with the syllable with which they are associated and whether they define an accent ("accent-lending pitch movement"). The movements are averages over functionally equivalent pitch movements in a corpus of close-copy stylized intonation contours. The movements were positioned within a grid of weakly declining high and low lines that defined the pitch range over phrasal units.

**Xu, Y. 2004. The PENTA model of speech melody: Transmitting multiple communicative functions in parallel. Paper presented at a conference at MIT, Cambridge, MA, 11–13 June 2004. In *From sound to sense: 50+ years of discoveries in speech communication*. Edited by J. Slifka, S. Manuel, and M. Matthies, C-91–C-96. Cambridge, MA: Research Laboratory of Electronics, MIT.**

Assigning elements like "fall," "high" to a lexical or intonational function, the author translates these elements to syllable-based phonetic targets that vary in the extent to which they require their canonical realization. Developed for the realization of Mandarin f0 contours, it is particularly good at modeling tonal crowding. For this purpose, it assigns strength indices to the elements, causing weaker elements to be retimed or undershot.

**EXTRACTION MODELS**

Numerical models may be based on, or are accompanied by, models that extract mathematical variables from acoustic data. Examples of extraction are Grabe, et al. 2007; Prom-on, et al. 2009; and Pfitzinger, et al. 2010.

**Grabe, E., G. Kochanski, and J. Coleman. 2007. Connecting intonation labels to mathematical descriptions of fundamental frequency. *Language and Speech* 50:281–310.**

Example of an extraction model with reconstruction of contours for varieties of English.

**Pfitzinger, H., H. Mixdorff, and J. Schwarz. 2010. Comparison of Fujisaki-model extractors and F0 stylizers. In *Tenth annual conference of the International Speech Communication Association 2009 (INTERSPEECH 2009)*. Vol. 5., 2455–2458. Red Hook,**

**NY: Curran.**

Four algorithms that extract parameters used in the Fujisaki model.

**Prom-on, S., Y. Xu, and B. Thipakorn. 2009. Modeling tone and intonation in Mandarin and English as a process of target approximation.** *Journal of the Acoustical Society of America* **125:405–424.**

PRAAT script (see Boersma and Weenink 2009–2013, cited under Tutorial Articles and Book Chapters) to extract parameters in the PENTA model, including one specifying the strength of other parameters.

## Discreteness

The structural approach to intonation analysis, in which intonation contours are strings of phonological tones divided over prosodic constituents, implies that discrete differences exist between one contour and the next since differences are expressed either in the tone string or in the phrasing. At the same time, each contour has widely different realizations when produced by different speakers or by the same speaker speaking in different styles, like bored, informal, emphatic, and so on. Since both structural (phonological) variation and phonetic variation have easily observable communicative effects, one of the persistent problems in intonation analysis is when to assign a difference that is responsible for some meaning difference to the structure and when to assign it to the implementation. A classic reference is Bolinger 1961. By the side of the Categorical Perception Paradigm, which has met with varied success (e.g., Ladd and Morton 1997), researchers have made use of imitation tasks in which naive speakers' imitations of contours may show a less distributed pattern than the contours to be imitated (Pierrehumbert and Steel 1989; Braun, et al. 2006) as well as of tasks involving semantic judgments (e.g., Frota 2012; Gili Fivela 2012). Gussenhoven 2006 discusses the merits of a number of techniques.

**Bolinger, D. 1961.** *Generality, gradience, and the all-or-none.* **The Hague: Mouton.**

States the problem and contains a discussion of discrete contours in English that are phonetically similar.

**Braun, B., G. Kochanski, E. Grabe, and B. S. Rosner. 2006. Evidence for attractors in English intonation.** *Journal of the Acoustical Society of America* **119:4006–4015.**

Version of the imitation task whereby subjects imitate randomly generated intonation contours plus their own imitations of them. This recursive procedure leads to convergence toward one of the discretely different contours of the language, each of which functions as an "attractor" in the imitation task.

**Frota, S. 2012. A focus intonational morpheme in European Portuguese: Production and perception. In** *Prosody and meaning.* **Edited by G. Elordieta and P. Prieto, 163–196. Berlin and New York: Mouton de Gruyter.**

Part of a collection of papers on communication through intonation from a variety of perspectives. Topics include socially motivated convergence in prosody, the extent to which words and intonation contours are collocated, prosody in German sign language, the perception of the focus marking H*+L contour in European Portuguese, the perception of prominence as a function of meaning as opposed to phonetics in English, the pervasive meaningfulness of melodic variation as opposed to meaningless variation in segmental articulation, and more. E-book and individual articles available online for purchase.

**Gili Fivela, B. 2012. Meanings, shades of meanings and prototypes of intonational categories. In** *Prosody and Meaning.* **Edited by G. Elordieta and P. Prieto, 197–237. Berlin and New York: Mouton de Gruyter.**

Report of a set of experiments designed to study the Perceptual Magnet Effect for intonational categories.

**Gussenhoven, C. 2006. Experimental approaches to establishing discreteness of intonational contrasts. In** *Methods in empirical prosody research.* **Edited by S. Sudhoff, D. Lenertová, R. Meyer, et al., 321–334. Language, Context, and Cognition 3.**

Berlin: Mouton de Gruyter.

Survey of experimental techniques that have been applied to the problem of how to establish discreteness in intonation.

**Ladd, D. R., and R. Morton. 1997. The perception of intonational emphasis: Continuous or categorical?** *Journal of Phonetics* **25.3: 313–342.**

Application of the categorical perception paradigm to plain and extra high accent peaks to signal ordinary and significant meanings. While the results show an S-curve from plain/ordinary to extra high/significant, these results can be interpreted as being due to the task, which gives two options. The correspondence with the discrimination function and the switch point was low.

**Pierrehumbert, J. B., and S. Steele. 1989. Categories of tonal alignment in English.** *Phonetica* **46.4: 181–196.**

Introduction of the imitation task, applied to an English contrast, whereby subjects are asked to imitate stimuli taken from a phonetic continuum between two extremes that represent canonical pronunciations of two contours that may or may not be discretely different. Discreteness is expected to be reflected in the inability of subjects to reproduce the continuum in their imitations, with their productions forming a binomial distribution.

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## Pitch Accent

There are four meanings of the term *pitch accent*. One usage is distributional and refers to the occurrence of at least one or maximally one tonal prominence in a word-like domain. For instance, the Japanese accentual phrase either contains no pitch accent or a single pitch accent, and the tones that constitute the accent are, therefore, contrastively present on some syllable (constituting a syntagmatic contrast with its absence on all other syllables in the domain) and contrastively present in the domain (constituting a paradigmatic contrast with an unaccented domain). Hyman 2009 argues that this usage refers to a particular distribution of tone and fails to define a coherent class of phenomena, or languages. A second usage, which may now be less current, refers to a lexical tone contrast in a syllable with word stress, as in the Accent 1 versus Accent 2 contrast of Norwegian and Swedish (cf. Sw *anden*, Acc1 "the duck" versus *anden*, Acc2 "the ghost"). A third usage is that of a word prominence solely cued by pitch, which term contrasts with "stress accent," where the prominence is also signaled by durational and spectral cues. To emphasize the more precise meaning of this term, Beckman 1986 proposes "non-stress accent" as an alternative for "pitch accent." A fourth usage is found in Bolinger 1958, in which the author uses the term to refer to the various pitch obtrusions that can be found in, and immediately around, accented syllables in English. His work emphasizes the separability in English of the pitch features cueing a prominence (i.e., the accented syllable) from the inherent durational and segmental properties of the accentable syllable (the stressed syllable). In this sense, the term has found its way into mainstream phonology through Pierrehumbert 1980 (cited under English). This fourth meaning is equivalent to the notion in Goldsmith 1979 of a tonal melody that is to be inserted in some lexically specified location, the accented syllable or mora. In this last sense, Japanese has a pitch accent that is inserted in some lexically specified location (the accented syllable), while English has a set of pitch accents one of which is inserted in each of the accented syllables of the sentence. Gussenhoven 2011 gives a comprehensive account of the pitch accent distribution in English.

**Beckman, M. E. 1986.** *Stress and non-stress accent.* **Dordrecht, The Netherlands: Foris.**

Investigation of the phonetics of the English accented syllable and the Japanese accented syllable, whereby the stress accent of English is shown to have amplitude and durational features in addition to pitch features, while the Japanese accented syllable has pitch features with negligible durational and amplitude effects.

**Bolinger, D. 1958. A theory of pitch accent in English.** *Word* **14:109–149.**

Argues on the basis of perception experiments with manipulated stimuli that English has intonational pitch morphemes, to be called "pitch accents," which are phonologically independent of word stress: ". . . a given stressed syllable . . . within a morpheme carries the potential for pitch accent" (p. 145). Reprinted in D. Bolinger, *Intonation: Selected Readings* (Harmondsworth, UK: Penguin, 1965, pp. 101–117).

**Goldsmith, J. A. 1979. *Autosegmental phonology*. New York: Garland.**

Main arguments for representing tone autosegmentally. Distributional restrictions on possible word tone patterns can be explained as rule-based associations of a limited set of lexical tone melodies, one of which is specified for any word, and the retention of tones after deletion of their tone bearing syllables can be explained as tone relinking to remaining neighboring syllables. Originally presented as a PhD thesis at MIT.

**Gussenhoven, C. 2011. Sentential prominence in English. In *Phonology across languages*. Vol. 5 of *The Blackwell companion to phonology*. Edited by M. van Oostendorp, C. J. Ewen, E. Hume, and K. Rice, 2778–2806. Malden, MA: Wiley-Blackwell.**

Comprehensive account of the differences among accented, stressed, and unstressed syllables and the history of phonological representations of English word prominence. The distinction between stressed and unstressed syllables in English has been phonologized, as a result of which it is largely segmentally defined. In addition, it gives an account of the accentuation rules of English, including those expressing information structure.

**Hyman, L. M. 2009. How (not) to do phonological typology: The case of pitch-accent. *Language Sciences* 31:213–238.**

Rejection of the distributional notion "pitch accent" and thus of a putative typological class "pitch accent language." Argues that typology should be concerned with identifying phonological features that may or may not be present in a language's grammar, such as "stress" (interpreted as an obligatory and culminative prominence on a syllable) and tone (interpreted as a pitch feature that forms part of the phonological representation of morphemes).

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# Phrase Accent

The meaning of *phrase accent* has undergone an evolution from its first use in Pierrehumbert 1980 (cited under English). The author's use was inspired by Gösta Bruce's "sentence accent." This is an H-tone in his description of Stockholm Swedish that marks the end of the focus constituent. It thus comes *after* the last pitch accent in a citation pronunciation of any (focused) word. The two Stockholm Swedish pitch accents are lexical, one representing Accent 1 and the other Accent 2, and Gösta Bruce's focus marking H is thus functionally equivalent to the pitch accents of English (see Swedish). The description of English in Pierrehumbert 1980 (cited under English) generally required a tone between the last pitch accent and the final boundary tone of the intonational phrase (IP). For instance, the fall-rise nuclear contour is analyzed as H* and the boundary tone H%, where the intervening L-tone is required to account for the low pitch between the accentual and boundary peaks. It was termed *phrase accent*, because it appeared between the pitch accent and the boundary tone. The authors of Beckman and Pierrehumbert 1986 reanalyze the phrase accent, which they felt was an anomaly in neither being a pitch accent nor a boundary tone, as a boundary tone of a newly introduced prosodic constituent, the intermediate phrase (ip). Finally, Grice, et al. 2000 reanalyzes the phrase accent as any tone occurring after the starred tone of the pitch accent (i.e., regardless of whether this is a trailing tone of a pitch accent, a phrase accent in Pierrehumbert's sense, or a boundary tone), provided it associates to a stressed syllable. This happens, for instance, in the English vocative chant (see Vocative Chants) and the Athenian Greek and Roermond Dutch question intonation contours. This means that the English L in H*LH%- is a phrase tone in the sense of Pierrehumbert 1980 (cited under English) because it appears between H* and H%, but not in the sense of Grice, et al. 2000, because it does not associate with any syllable, as Barnes, et al. 2010 shows for the left turning point in the valley of this fall-rise contour. A similar lack of phonetic alignment with stressed syllables was established for the right turning point of Dutch L before H% in van de Ven and Gussenhoven 2011.

**Barnes, J., N. Veuilleux, A. Brugos, and S. Shattuck-Hufnagel. 2010. Turning points, tonal targets, and the English L- phrase accent. *Language and Cognitive Processes* 25.4: 982–1023.**

The phonetic alignment of the low turning point after the accentual peak due to H* is best explained by the timing of the peak rather than by the metrical structure or word boundaries after the accented syllable, suggesting it is the realization of a trailing L in a H*+L pitch accent rather than a phrase accent.

**Beckman, M. E., and J. B. Pierrehumbert. 1986. Intonational structure in English and Japanese. *Phonology Yearbook* 3:255–**

309.

Introduces the "intermediate phrase" as constituent that brings the phrase accent as its right-edge boundary tone. Any intonational phrase, therefore, ends in two boundary tones, one phrase accent (H- or L-) and one boundary tone (H% or L%) in the original sense.

**Grice, M., D. R. Ladd, and A. Arvaniti. 2000. On the place of phrase accents in intonational phonology.** *Phonology* **17.2: 143–185.**

This article argues that a meaningful interpretation of "phrase accent" can be found in any postnuclear tone that associates with a Tone Bearing Unit in a postnuclear word. This makes the tone concerned behave somewhat like a pitch accent, which has a starred tone that associates with an accented syllable.

**van de Ven, M., and C. Gussenhoven. 2011. The timing of the f0 rise in falling-rising intonation contours in Dutch.** *Journal of Phonetics* **39.2: 225–236.**

Overview of claims that Standard Dutch and Standard English have "phrase accents" in the sense of postnuclear tones that associate to postnuclear stressed syllables, with a demonstration that this is not true for the L-tone in the fall-rising nuclear tune.

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# Phrasing

All languages appear to structure their expressions in a hierarchically nested set of phonological constituents, referred to as the "prosodic hierarchy" (Selkirk 1978, Nespor and Vogel 1986). The intonational structure frequently interacts with the larger of these constituents (Frota 2012). This may be so because the constituent comes with *boundary tones* or because it forms the domain of intonational phenomena, such as *downstep* (Beckman and Pierrehumbert 1986) or *pitch accent distribution* (Gussenhoven 2011, cited under Pitch Accent). For instance, the English intonational phrase may be closed by H% or L%, the Japanese intermediate phrase is a domain within which an accented accentual phrase reduces the pitch range of a following accentual phrase, and the phonological phrase is the domain for rhythmically induced pitch accent deletion in French. The relation between syntactic structure and the prosodic hierarchy is particularly relevant for the intonational phrase (Hirst 1993) and other constituents that come with boundary tones. An overview is given in Truckenbrodt 2007.

**Beckman, M. E., and J. B. Pierrehumbert. 1986. Intonational structure in English and Japanese.** *Phonology Yearbook* **3:255–309.**

Article introducing the intermediate phrase in English that accounts for the phrase accent as a boundary tone. It is not clear whether it forms a constituent between the IP and the phonological phrase or coincides with the phonological phrase. The description of Japanese includes a demonstration of iteration of downstep within the IP.

**Frota, S. 2012. Prosodic structure, constituents, and their implementation. In** *The Oxford handbook of laboratory phonology*. **Edited by A. C. Cohn, C. Fougeron and M. K. Huffman, 255–265. Oxford: Oxford Univ. Press.**

Overview of the constituents of the prosodic hierarchy, with special emphasis on different views of the relation between intonation and prosodic structure and on how intonation cues prosodic phrasing across languages and language varieties.

**Hirst, D. 1993. Detaching intonational phrases from syntactic structure.** *Linguistic Inquiry* **24:781–788.**

Account of the syntactic factor in intonational phrase formation in English, which stipulates that any intonational phrase should be followed by an intonational phrase that coincides with a syntactic constituent.

**Nespor, M., and I. B. Vogel. 1986.** *Prosodic phonology*. **Dordrecht, The Netherlands: Foris.**

Frequently cited survey of the prosodic hierarchy, with ample exemplification of their segmental and prosodic effects.

**Selkirk, E. 1978. On prosodic structure and its relation to syntactic structure. In *Nordic prosody 2*. Edited by T. Fretheim, 268–271. Trondheim, Norway: TAPIR.**

First full-scale treatment of the prosodic hierarchy.


**Truckenbrodt, H. 2007. The syntax phonology interface. In *The Cambridge handbook of phonology*. Edited by P. de Lacy, 435–456. Cambridge, UK: Cambridge Univ. Press.**

Brief overview of edge alignment of phonological and syntactic constituents, wrapping of syntactic constituents and phonological constituents, as well as prominence of phrases and rhythmic effects.

## Phonetic Implementation

Rules of phonetic implementation take phonological representations as input and create acoustic information as output. Phonetic implementation is, therefore, sensitive to the phonological context and is language-specific. This follows Pierrehumbert 1980 (cited under Models), which argues that between the phonological representation and the acoustic signal there is no "systematic phonetic representation"; that is, no representation of discrete phonetic elements that mediates between the surface phonological representation and the acoustic signal. Pierrehumbert 1980 draws a distinction between rules calculating targets (the "scaling" of tones) and rules calculating the trajectories between them (interpolation rules), in addition to introducing downstep as a phonetic implementation rule (see under Downstep). A fourth aspect, underplayed in the author's thesis, became the most widely studied aspect of phonetic implementation, namely, the synchronization of a tone's target with the segments (see under Alignment). Recent work on tune-text alignment has shown that, apart from phonological differences between associating tones, as in the case of the Stockholm Swedish lexical pitch accents H*L and HL* of Gösta Bruce, a variety of phonetic factors, such as tonal crowding (Silverman and Pierrehumber 1990; Prieto, et al. 1995), speech rate (Ladd, et al. 1999), and syllable structure (Rietveld and Gussenhoven 1995; Arvaniti, et al. 1998) influence the fine-grained patterns of F0 location in systematic ways. Likewise, work on tonal scaling has unraveled various factors that may determine F0 height (Truckenbrodt 2007). Other aspects of phonetic implementation concern duration increases as a function of the number of tones to be pronounced, the undershooting of targets, or the truncation of pitch movements due to lack of segmental time (Grabe, et al. 2000). Effects of phonetic implementation rules are usually distinguished from variation that is not, or less, dependent on the phonological representation, such as pitch range expansion for emphasis or surprise and the variation that is treated under "paralinguistic communication." Barnes, et al. 2012 introduces the idea of the Tonal Center of Gravity (TCoG) of a pitch movement or pitch contour, which is argued to be an important predictor of the perceptual scaling and timing of the pitch event. Finally, for models of intonation that recognize a distinction between phonological representations and phonetic realization, a central issue concerns the decision as to what part of the variation in the phonetic realization of F0 contours can be attributed to the phonological representation and what is to be attributed to systematic language specific details in its phonetic implementation (see Discreteness).

**Arvaniti, A., D. Ladd, and I. Mennen. 1998. Stability of tonal alignment: The case of Greek prenuclear accents. *Journal of Phonetics* 26:3–25.**

The prenuclear rise aligns with the first consonant in the consonant string to the left of the vowel in the accented syllable and ends with the end of the last consonant in the consonant string to the right of that vowel. This pattern gave rise to the term *segmental anchoring* (see next entry), there being no fixed reference point in the syllable.


**Barnes, J., N. Veuilleux, A. Brugos, and S. Shattuck-Hufnagel. 2012. Tonal center of gravity: A global approach to tonal implementation in a level-based intonational phonology. *Laboratory Phonology* 3.2: 337–383.**

Combines the contributions to perception by contour shape and by the height and alignment of turning points in the contour.


**Grabe, E., B. Post, F. Nolan, and K. Farrar. 2000. Pitch accent realization in four varieties of British English. *Journal of Phonetics* 28:161–185.**

Of the four varieties of British English investigated, the Leeds variety truncates rises and falls, while the varieties of Cambridge and Newcastle compress rises and falls. Belfast English has the some contour, a rise followed by a plateau, where the other varieties have rises and falls.

**Ladd, D. R., D. Faulkner, H. Faulkner, and A. Schepman. 1999. Constant "segmental anchoring" of f0 movements under changes in speech rate.** *Journal of the Acoustical Society of America* **106:1543–1554.**

This paper articulates the segmental anchoring hypothesis, which states that both the beginning and the end of rising or falling F0 movements are anchored to specific points in the segmental string.

**Ladd, D. R., and A. Schepman. 2003. "Sagging transitions" between high pitch accents in English: Experimental evidence.** *Journal of Phonetics* **31:81–112.**

Experimental research on the F0 transitions between two peaks showing that the sagging transition model fails to predict the alignment of the beginning of the rise, the scaling of the low dip, and the second peak. The findings have implications for the phonological analysis by pointing to the conclusion that the low dip corresponds to a phonological L tone.

**Prieto, P., J. van Santen, and J. Hirschberg. 1995. Tonal alignment patterns in Spanish.** *Journal of Phonetics* **23:429–451.**

The authors analyze the patterns of peak placement in rising pre-nuclear accents in Spanish and find that the location of the start of the F0 rise is fairly constant (generally at the onset of the accented syllable), while the position of the peak depends on the presence of upcoming pitch accents and boundary tones.

**Rietveld, T., and C. Gussenhoven. 1995. Aligning pitch targets in speech synthesis: Effects of syllable structure.** *Journal of Phonetics* **3:375–385.**

Perception experiment showing that the switch point between Dutch downstepped and nondownstepped falls is further left in syllables with longer onsets and further right in syllables with sonorant codas.

**Silverman, K. E., and J. B. Pierrehumbert. 1990. The timing of prenuclear high accents in English. In** *Papers in laboratory phonology I: Between the grammar and physics of speech.* **Edited by J. Kingston and M. E. Beckman, 72–106. Cambridge, UK: Cambridge Univ. Press.**

A classic paper examining the peak placement patterns in rising accents in English. The authors found that the location of fundamental frequency peaks (or H targets) is greatly affected by the right-hand prosodic context, in such a way that the peak is retracted before upcoming pitch accents and boundary tones in systematic ways.

**Truckenbrodt, H. 2007. Upstep of edge tones and of nuclear accents. In** *Experimental studies in word and sentence prosody.* **Vol. 2 of** *Tones and tunes.* **Edited by C. Gussenhoven and T. Riad, 349–386. Berlin: Mouton de Gruyter.**

Empirical study of scaling in German, showing that different prosodic constituents define different phonetic reference lines that establish the relative height of a tone. Thus, both downstep and upstep, as well as partial reset phenomena, support a model of scaling in which prosodic constituency plays a principled role in the assignment of phonetic reference lines that, in turn, determine tonal realization.

### DOWNSTEP

Downstep is a phonetic implementation rule that lowers H-tones in some specific context in many languages and is thus distinct from the contextless gradual lowering known as "declination," of which it can be seen as a phonologization (Ladd 1984). The phenomenon was first described in West African tone languages. Initially, it was kept distinct from "downdrift," whereby H-tones are lowered after each intervening L-tone, with "downstep" being restricted to situations in which no overt L-tone was present. Currently, the term *downstep* covers both these uses, which have been shown to be equivalent in languages in which an intervening floating L-tone can be motivated.

Pierrehumbert 1980 (cited under English) applied the notion to English intonation for contours that had been described as "terracing" in the British English literature. The output of a downstep rule is an acoustic value (see Phonetic Implementation) and, because the rule is iterative within a domain in which more than one instance of the relevant context may occur (Liberman and Pierrehumbert 1984), an infinite number of such values can be generated, rendering any effort to assign a phonological status to the output futile. It was shown to be iterative for Japanese in Pierrehumbert and Beckman 1988 (cited under Japanese). Downstep in English is like downstep in many tone languages as applying in some tonal context (applying to H* or H- after a bitonal pitch accent, following Beckman and Pierrehumbert 1986, cited under Phrase Accent). This has been followed for other languages; for example, for French in Post 2000, cited under French (H* after any H). Downstep in West Germanic languages has also been analyzed as a morpheme, since any contour with downstep has a pragmatically different status from one without (e.g., van den Berg, et al. 1992; Ladd 2008, cited under Textbooks). The issue of downstepped phrases as independent of downstepped H-tones is addressed in Ladd 1988 and van den Berg, et al. 1992.

**Ladd, D. R. 1984. Declination: A review and some hypotheses. *Phonology Yearbook* 1:53–74.**

Analytical separation of factors involved in downtrends: declination, downstep, and final lowering.

**Ladd, D. R. 1988. Declination "reset" and the hierarchical organization of utterances. *Journal of the Acoustical Society of America* 84.5: 538–544.**

Experimentally supported account of downstep as a nested phenomenon ("wheels-within-wheels") reflecting the syntactic phrase structure.

**Liberman, M., and J. Pierrehumbert. 1984. Intonational invariance under changes in pitch range and length. In *Language sound structure: Studies in phonology*. Edited by M. Aronoff and R. T. Oehrle, 157–233. Cambridge, MA: MIT Press.**

A classic paper reporting on experiments addressing the phonetic implementation of intonation under changes in overall pitch range and utterance length, with the goal of modeling F0 implementation. Results showed that the bottom of pitch range is constant, that final peaks are lower than time-order invariance would predict, and that increasing the pitch range raises the reference level and increases the height of initial peaks.

**van den Berg, R., C. Gussenhoven, and T. Rietveld. 1992. Downstep in Dutch: Implications for a model. In *Papers in laboratory phonology II: Gesture, segment, prosody*. Edited by G. Docherty and D. R. Ladd, 335–359. Cambridge, UK: Cambridge Univ. Press.**

Experimentally supported claim that "phrasal downstep" (i.e., of entire intonational phrases) represents a smaller step down than "accentual downstep" (of H*'s) in Dutch, and that these are independent and meaningful contour choices.

## Alignment

Two rather different meanings of the term *alignment* are found in intonation studies. One refers to the detailed phonetic timing of a tone, regardless of whether it is associated or floating, as a function of the segmental structure and the presence of boundaries and other tones. This usage is due to Bob Ladd, and the phenomenon was extensively studied in a variety of languages: "association" is the phonological linkage between a tone and a syllable or mora, as between the starred tone of a pitch accent and an accented syllable in English, while "alignment" is the detailed phonetic synchronization of a tone's target relative to the segments (e.g., Ladd, et al. 2009; D'Imperio 2012). The second usage derives from optimality theory (McCarthy and Prince 1993), where "alignment" is the general term for the specification of the location of any phonological or morphological element. In English, expletive *bloody* aligns its right edge with the left edge of a foot (*bloody-fantastic*, *fan-bloody-tastic*), plural [z] aligns its right edge with the right edge of a noun, boundary tone H% aligns its right edge with the intonational phrase, and so on. The notion was applied in Pierrehumbert 1993 for aligning the pitch accent with the foot head, in effect using it so as to replace the notion "association." As a notion distinct from association, phonological alignment was generalized in Gussenhoven 2000 for specifying the general location of any tone, including the tones flanking the starred tone of a pitch accent, which align their edges with the edges of the starred tone, or the alignment of a trailing tone with the first tone of the next pitch accent. Level pitch stretches are seen as due to the double alignment of a single tone, which, as a result, is pronounced twice, once at the beginning and once at the end of the level stretch. A more fine-grained interpretation of "association" will describe

tones as linked to specific locations inside the syllable (see Arvaniti 2012).

**Arvaniti, A. 2012. Segment-to-tone association. In** *The Oxford handbook of laboratory phonology*. **Edited by A. C. Cohn, C. Fougeron and M. K. Huffman, 265–275. Oxford: Oxford Univ. Press.**

An overview of how intonational elements are linked to the segmental string, focusing on the phonological association of tones with prosodic constituents.

**D'Imperio, M. 2012. Tonal alignment. In** *The Oxford handbook of laboratory phonology*. **Edited by A. C. Cohn, C. Fougeron and M. K. Huffman, 275–287. Oxford: Oxford Univ. Press.**

Recent overview of tonal target alignment dealing with production and perception and including a discussion of variability and stability of tonal alignment,

**Gussenhoven, C. 2000. The lexical tone contrast of Roermond Dutch in optimality theory. In** *Prosody: Theory and experiment; Studies presented to Gösta Bruce*. **Edited by M. Horne, 129–167. Dordrecht, The Netherlands: Kluwer.**

Account of the phonetics and phonology of tone and intonation in Roermond Dutch introducing the two-edged alignment of tones. Also found in Rutgers Optimality Archive 382.

**Ladd, D. R., A. Schepman, L. White, L. M. Quarmby, and R. Stackhouse. 2009. Structural and dialectal effects on pitch peak alignment in two varieties of British English.** *Journal of Phonetics* **37:145–161.**

Report of three experiments on phonetic alignment effects in varieties of English, plus summary of previous findings.

**McCarthy, J. J., and A. Prince. 1993. Generalized alignment. In** *Yearbook of morphology*. **Edited by G. Booij and J. van Marle, 79–153. Dordrecht, The Netherlands: Kluwer.**

Treatment of various uses of alignment in optimality theory.

**Pierrehumbert, J. 1993. Prosody, intonation, and speech technology. In** *Challenges in natural language processing*. **Edited by M. Bates and R. M. Weischedel, 257–280. Cambridge, UK: Cambridge Univ. Press.**

Discussion of alignment in optimality theory and introduction of the notion of alignment with prosodic heads.

## Rhythm

The import of intonation to rhythm has been established mainly in work on the rhythm rule in West Germanic languages (Horne 1990, Gussenhoven 1991, Shattuck-Hufnagel 1992). The link between prosodic phrasing and pitch accent distribution, however, has been investigated in many other languages and it may well be the case that pitch accent distribution affects the perception of rhythm across languages (Frota, et al. 2002; Hellmuth 2007; Dilley and McAuley 2008).

**Dilley, L. C., and J. D. McAuley. 2008. Distal prosodic context affects word segmentation and lexical processing.** *Journal of Memory and Language* **59:294–311.**

Experimental data on the role of nonlocal prosody in word segmentation and lexical processing of ambiguous sequences show that the patterns of pitch alternation induce perceptual rhythmic groupings that constrain both segmentation and processing.

**Frota, S., M. Vigário, and F. Martins. 2002. Language discrimination and rhythm classes: Evidence from Portuguese. In** *Proceedings of Speech Prosody 2002: Aix-en-Provence, France, 11–13 April 2002.* **Edited by B. Bel and I. Marlien, 315–318. Aix en Provence, France: Laboratoire Parole et Langage.**

Report on discrimination experiments that address the role of intonation in rhythmic contrasts. When European Portuguese is tested against Brazilian Portuguese, intonation is a crucial cue for discrimination.

**Gussenhoven, C. 1991. The English rhythm rule as an accent deletion rule.** *Phonology* **8:1–35.**

Proposes an analysis of the rhythm rule in English in terms of pitch accent distribution, whereby nonperipheral pitch accents are deleted within the phonological phrase. Accent deletion is thus responsible for the apparent rhythmic shift of prominence from the main stress position to a previous prominent position. In this way, the presence or absence of pitch accents is seen as a crucial contributor to rhythm.

**Hellmuth, S. 2007. The relationship between prosodic structure and pitch accent distribution: Evidence from Egyptian Arabic.** *Linguistic Review* **24:291–316.**

On the basis of data from Egyptian Arabic and from European and non-European languages reported in the literature, it is proposed that prosodic phrasing and pitch accent distribution interact closely and that languages vary in the domain for pitch accent distribution.

**Horne, M. 1990. Empirical evidence for a deletion analysis of the rhythm rule in English.** *Linguistics* **28:959–981.**

Focusing on phonetic data, the author presents evidence for the deletion analysis of the rhythm rule and supports the view that deletion of pitch prominence is the main factor behind the perceived stress shift in languages such as English.

**Shattuck-Hufnagel, S. 1992. Stress shift as pitch accent placement: Within word early accent placement in American English. In** *ICSLP 92 Proceedings: International conference on Spoken Language Processing, 12–16 October 1992, International Conference Centre, Banff, Alberta, Canada.* **Vol. 1, 747–750. Edmonton: Univ. of Alberta.**

In line with the pitch accent analysis of the rhythm rule, it is argued that the triggering factor for the perceived shift is not a clash in prominence but a preference to have a pitch prominence as early as possible in a prosodic phrase. Thus, both in its motivation and in the way it operates, the rhythm rule is basically seen as pitch accent distribution.

## ToBI

Pierrehumbert 1980 (cited under English) gave an impetus to the study of English intonation, but its phonological representations were widely felt to be too abstract for the practical characterization of speech and language data. A concerted response was launched as Tone and Break Indices (ToBI) in 1992 (Silverman, et al. 1992), which proposed a standardized annotation system that includes several annotation tiers, including a break index tier with five subjective labels for prosodic break strengths and a tonal tier that uses an adaptation of Pierrehumbert 1980 (cited under English) analysis. Of the original seven pitch accents H*+L, H+L*, H*+H, L*+H, L+H*, H*, and L*, pitch accent H*+H had been dropped in Beckman and Pierrehumbert 1986 (cited under English). In 1992, H+L*, which was implemented as a high target followed by a target as for downstepped H, was replaced with the more transparent H+!H* along with a decision to indicate downstep directly in the tone labels by "!," following a suggestion in Cutler and Ladd 1983 (cited under Edited Collections), instead of allowing to be derived from the tonal context (see Downstep). This also left H*+L without a role, as it was used solely as a trigger for downstepped H-tones. The five remaining pitch accents are, thus, H+!H*, L+H*, L*+H, H*, and L*, plus the three downstepped versions L+!H*, L*+!H, and !H*, two initial boundary tones (%H and %L, whereby %L is "default" and not marked), two phrase tones (L- and H-), and two final boundary tones (L% and H%). The intention was not just to provide a practically usable annotation system, but also to impose standards of good practice on the wider community of intonation researchers with regard to explicit annotation of speech data, the development of phonological analyses of other languages, and the use of acoustic data. This call has been widely followed (e.g., Jun 2005, cited under Edited Collections). A frequent misconception in the early days was that the ToBI tone label inventory had the status of a general system for the description of intonation in the languages of the world, comparable to the

phonetic alphabet proposed by the International Phonetic Association (REF). To counter that false impression, Beckman, et al. 2005 renamed the analysis of English "Mainstream American English ToBI," or MAE-ToBI. A more lasting effect is the tendency to analyze languages other than English in terms of the MAE-ToBI tone labels and their conventions, such as the use of H-L% for final mid pitch, and to equate an analysis with MAE-ToBI-like labels with the general notion of an autosegmental phonological analysis, thus avoiding a more comprehensive motivation for the representations that are proposed (Ladd 2008).

**Beckman, M. E., J. Hirschberg, and S. Shattuck-Hufnagel. 2005. The original ToBi system and the evolution of the ToBi framework. In *Prosodic typology: The phonology of intonation and phrasing*. Edited by S. Jun, 9–54. Oxford: Oxford Univ. Press.**

Discussion of the uses and interpretations of the ToBI system and the introduction of the term "MAE-ToBI" (Mainstream American English Tone and Break Indices).


**Ladd, D. 2008. Review of Sun-Ah (ed.) *Prosodic typology: The phonology of intonation and phrasing. Phonology* 25:372–376.**

Discussion of the ToBI enterprise, with the argument that tonal representations need to be motivated on the basis of generalizations holding within as well as across languages rather than on practices that happened to be introduced with ToBI.


**Silverman, K. E. A., M. Beckman, J. F. Pitrelli, et al. 1992. ToBI: A standard for labeling English prosody. In *ICSLP 92, Proceedings: International conference on Spoken Language Processing, 12–16 October 1992, International Conference Centre, Banff, Alberta, Canada*. Vol. 2. Edited by J. J. Ohala, T. M. Nearey, and B. L. Berwing, 867–870. Edmonton: Univ. of Alberta.**

First presentation of the ToBI system.

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# L1 Acquisition of Intonation

Research on the acquisition of intonation has recently seen a renewed interest as a result of advances in the understanding of the linguistic representation of prosody. Despite the considerable body of work on the development of F0 patterns, much of the early research has notably not been linguistically informed and, thus, it has failed to advance our understanding of the linguistic dimension in the development of intonation competence. On the other hand, most research has centered on very few, typologically similar languages (mostly Germanic), leaving claims of universality or language-specificity hard to test. The need to increase the number of languages investigated coupled with the need to carry out these investigations from theoretically and methodologically comparable perspectives (like the autosegmental-metrical framework) will, no doubt, lead to further advances in the study of the acquisition of intonation. Chen and Fikkert 2007; Chen 2011; Prieto, et al. 2011; and Lleó and Rakow 2011 study aspects of intonational development in different languages within the autosegmental-metrical framework. From a different perspective and focusing on English, the development of intonation in the second year of life is described in Snow 2006, and in older children in Wells, et al. 2004. DePaolis, et al. 2008 compares the acoustics of early prosody in different languages. The acquisition of intonation by bilinguals is a further topic of research that contributes to the understanding of the pace of intonational development (Gut 2000, also Lleó and Rakow 2011).

**Chen, A. 2011. The developmental path to phonological focus-marking in Dutch. In *Prosodic categories: Production, perception and comprehension*. Edited by S. Frota, G. Elordieta, and P. Prieto, 93–100. Dordrecht, The Netherlands: Springer.**

This paper examines how two- to eight-year-olds used pitch accent placement and pitch accent type to encode focus in Dutch. It is shown that the use of accent placement and accent type is acquired gradually, with two-year-olds mastering none, four-/five-year-olds using only adultlike accent placement, and seven-/eight-year olds using both accent placement and choice of accent type.


**Chen, A., and P. Fikkert. 2007. Intonation of early two-word utterances in Dutch. In *Proceedings of the 16th international congress of Phonetic Sciences, 6–10 August 2007, Saarbrücken, Germany*. Edited by J. Trouvain, 315–320. Saarbrücken, Germany: Univ. des Saarlandes.**

An analysis of the intonation contours of two-word utterances in Dutch-speaking children between sixteen and twenty-five months, within

the autosegmental-metrical framework, pointing to a correlation between intonational development and vocabulary size and showing that adultlike intonation is mastered only well after the onset of first words.

**DePaolis, R., M. Vihman, and S. Kunnari. 2008. Prosody in production at the onset of word use: A cross-linguistic study.** *Journal of Phonetics* **36:406–422.**

This investigation of the acoustic correlates of prosody in infant disyllabic vocalizations of children exposed to four different languages (American English, Finnish, French, and Welsh) at the onset of word use (from ten to eighteen months) shows that the use of acoustic prosodic cues (F0, duration, and intensity) at the onset of word use shows signs of consistency with the input signal.

**Gut, U. 2000.** *Bilingual acquisition of intonation*. **Tübingen, Germany: Niemeyer.**

The book describes the acquisition of intonation by three German/English bilingual children at ages ranging from two years and one month (2;1) to five years and six months (5;6). The production of the main pitch contour types is mastered as early as 2;1, but intonational phrasing is acquired much later (at 4;6), and mastery of the phonetic production of intonation contours is not yet completed at 5;6.

**Lleó, C., and M. Rakow. 2011. Intonation targets of** *yes/no* **questions by Spanish and German monolingual and bilingual children. In** *The development of grammar: Language acquisition and diachronic change; In honour of Jürgen M. Meisel*. **Edited by E. Rinke and T. Kupisch, 263–286. Hamburg Studies on Multilingualism 11. Amsterdam: John Benjamins.**

An analysis of the production of yes-no questions by German and Spanish monolinguals and German-Spanish bilinguals aged 2;0 and 3;0. Questions in German and Spanish exhibit comparable contours that differ in their alignment and scaling characteristics. Results show that while monolingual children rightly produce the alignment and scaling patterns before 3;0, bilinguals go behind in differentiating alignment and/or scaling patterns in the two languages.

**Prieto, P., A. Estrella, J. Thorson, and M. M. Vanrell. 2011. Is prosodic development correlated with grammatical development? Evidence from emerging intonation in Catalan and Spanish.** *Journal of Child Language* **39:221–257.**

The article presents an analysis of the development of intonation patterns in four Catalan-speaking children and two Spanish-speaking children between eleven and twenty-eight months of age within the autosegmental-metrical framework. Results show that children display an important knowledge of intonational grammar well before their first two-word utterances and coinciding with the presence of a small lexicon.

**Snow, D. 2006. Regression and reorganization of intonation between 6 and 23 months.** *Child Development* **77:281–296.**

A description of intonational development in English-speaking children between six and twenty-three months of age, showing that the major turning point toward nearly adultlike tonal shapes is around eighteen months and shortly before the onset of two-word combinations.

**Wells, B., S. Peppé, and N. Goulandris. 2004. Intonation development from five to thirteen.** *Journal of Child Language* **31:749–778.**

Research on the comprehension and production of intonation, phrasing, focus, and attitudinal meaning. Although these aspects are largely mastered at age five, children of that age tend to prefer small intonation phrases, have problems in using rising pitch accents to convey interactional meanings, and show a bias toward final position for focus accent placement. Overall, prosodic comprehension seems to lag behind children's production.

## L2 Acquisition of Intonation

In the last few years, there has been an increasing interest in the study of second language acquisition of prosody. Most studies agree that, similarly to what happens with segmental data, L2 speakers are often influenced by the intonation patterns of the native language also, and more advanced speakers produce more native-like intonation patterns than less advanced speakers (Chun 2002, Trouvain and Gut 2007). Research has concentrated on analyzing the patterns of interference between L1 and L2 and attempts have been made to adapt existing L2 speech models to account for both segmental and prosodic aspects of second language acquisition (Mennen 2004), although other factors are also at play (He et al. 2012). A growing body of work is devoted to describing intonational variation across different languages and language varieties and also on developing methods of teaching second language prosody (Gabriel and Lléo 2011).

**Chun, D. 2002.** *Discourse intonation in L2: From theory and research to practice*. **Amsterdam: John Benjamins.**

This book outlines the key role of prosody and, in particular, discourse intonation in the process of acquisition of a second language. It also presents a pedagogical approach to the teaching of discourse-based phonology and intonation in L2 instruction.

**Gabriel, C., and C. Lleó, eds. 2011.** *Intonational phrasing in Romance and Germanic: Cross-linguistic and bilingual studies*. **Amsterdam: John Benjamins.**

Volume of papers with an emphasis on phrasing differences between European languages.

**He, X., V. J. van Heuven, and C. Gussenhoven. 2012. The selection of intonation contours by Chinese L2 speakers of Dutch: Orthographic closure vs. prosodic knowledge.** *Second Language Research* **28:283–318.**

Shows that Chinese learners of Dutch are guided in their choice of intonation contour by closure punctuation, preferring contours with final rises only for orthographic sentences that end in a question mark.

**Mennen, I. 2004. Bi-directional interference in the intonation of Dutch speakers of Greek.** *Journal of Phonetics* **32:543–563.**

This study examines how advanced bilingual Greek and Dutch speakers realize cross-linguistic differences in the timing of a phonologically identical rise in the two languages. Results reveal that the timing patterns found in the bilingual speakers differed from the native control groups, which is taken as evidence for a bidirectional interference across the two languages.

**Trouvain, J., and U. Gut, eds. 2007.** *Non-native prosody: Phonetic description and teaching practice*. **Berlin: Mouton de Gruyter.**

This volume presents an overview of the state of the art in second language prosody learning and teaching. The first part consists of descriptions of non-native prosodic structures in a format that is accessible to language teachers. In the second part, teaching practitioners and developers present a variety of L2 teaching methods and exercises in the area of prosody.

## Meaning

Phrasing, pitch accent distribution, and melodic patterns encode meaning (Gussenhoven 2005). While the phrasing is linked to the morpho-syntactic phrasing structure of sentences, accent distribution and tone choice may contribute additional meanings. In English, accent distribution is determined by a number of different factors, from morphological compounding to postfocal deaccentuation, and, thus, the meaning of pitch accent distributions relates to the factors that are responsible for them. Determining the meaning of the melodic choices has remained an elusive endeavor. Some consensus has emerged that English intonational meaning is much like David Brazil's interactional meanings (Brazil, et al. 1980), such as "contributing information to discourse model," "referring to information already in the discourse model," that have found their way into later works (Gussenhoven 1984, Pierrehumbert and Hirschberg 1990). These meanings do not include more specific meanings like "command," "irony," "question," etc. Another issue in melodic meaning is the morphemic structure. Proposals have ranged from sentence-wide morphemes "contradiction contour," via tone structures consisting of pitch accent plus boundary tone, to fine-grained analyses in which every tone is a morpheme. An extensive treatment of communicative effects of prosody in English is Bolinger 1989 and a recent general volume is Elordieta and Prieto (Frota 2012, cited under

Discreteness).

**Bolinger, D. 1989.** *Intonation and its uses: Melody in grammar and discourse*. **Stanford, CA: Stanford Univ. Press.**

Extensive exemplification of meaning effects in English intonation on the basis of Bolinger's "profiles" (the forerunners of pitch accents), as well as accentuation. Meaning is interpreted in terms of degrees of force, indirectness, significance, appeal, and so on presented as independent of syntax. There is an introductory chapter on cross-linguistic variation and separate chapters on specific topics, such as questions.

**Brazil, D., M. Coulthard, and C. Johns. 1980.** *Discourse intonation and language teaching*. **London: Longman.**

Amply illustrated account of intonation discourse meaning, aimed at teachers of English.

**Gussenhoven, C. 1984. A semantic analysis of the nuclear tones of English. In** *On the grammar and semantics of sentence accents*. **Edited by C. Gussenhoven, 193–266. Berlin: de Gruyter.**

Proposal for the discourse meanings of the tones in the three-melody analysis of English. Assigns meaning to nuclear melodies, following work by David Brazil.

**Gussenhoven, C. 2005. Semantics of prosody. In** *Encyclopedia of language and linguistics*. **Vol. 11. Edited by K. Brown, 170–173. Article number 4319. Oxford: Elsevier.**

A concise statement of the aspects of the intonational structure that contribute to the interpretation, such as the phrasing and the pitch accent distribution in sentences.

**Pierrehumbert, J. B., and J. Hirschberg. 1990. The meaning of intonational contours in the interpretation of discourse. In** *Intentions in communication*. **Edited by P. Cohen, J. Morgan, and M. Pollack, 271–311. Cambridge, MA: MIT Press.**

Proposal for the discourse meanings of the tones in the Pierrehumbert-Beckman analysis of English intonation. Largely one tone = one morpheme, with meanings assigned to single tones.

## Information Structure

The most widely reported effect of intonation is the signaling of information structure. In many languages, this occurs through the compression of the pitch range over words after the focus constituent, which in West Germanic and other languages takes the form of the deletion of pitch accents after the focus. Accounts—such as Jackendoff 1972, Selkirk 1995, Gussenhoven 1992, Ladd 2008, and Calhoun 2010—vary. The pragmatic conditions under which deaccenting takes place vary across languages in Europe (e.g., Vallduví 1992; Swerts, et al. 2002). In Mandarin Chinese, the words after the focus constituent tend to have reduced pitch range, but the tonal structure appears to be intact. In other languages, such as Bengali (Hayes and Lahiri 1991, cited under Vocative Chants), Portuguese (Frota 2000 and Frota 2002, both cited under Portuguese), and Southern varieties of Italian (D'Imperio 2002 for Neapolitan Italian and Gili Fivela 2003 for Pisa Italian, both cited under Italian) there are distinct melodies (pitch accents with or without boundary tones) that signal narrow or contrastive focus. Xu, et al. 2012 suggests that Post-Focal Compression is an areal feature of Europe and North Asia. The prosodic expression of information structure may have more semantic dimensions than focus versus nonfocus, such as nonexhaustive focus (Elordieta and Irurtzun 2010). A volume taking a wider view of prosodic effects of information structure is Lee, et al. 2007.

**Calhoun, S. 2010. The centrality of metrical structure in signaling information structure: A probabilistic perspective.** *Language* **86:1–42.**

Focus in English is signaled through alignment with nuclear pitch accents and prosodic phrase structure, such that themes are less

prominent than rhemes. If a word is more prominent than expected as a result, its probability of being a narrow focus increases, and if it is less prominent than expected, its probability of being given increases, while the size of the theme and rheme will be given by the phrasing.

**Elordieta, G. and A. Irurtzun. 2010. The relationship between meaning and intonation in non-exhaustive answers: Evidence from Basque.** *Linguistic Review* **27:261–291.**

Demonstration that Non-Exhaustive Narrow Focus differs intonationally in Northern Bizkaian Basque from plain narrow focus in having a high pitch accent on the verb in addition to the pitch accent on the narrowly focused constituent. A nonexhaustive focus implies that the predication does not apply to alternatives to the narrowly focused constituent.

**Gussenhoven, C. 1992. Sentence accents and argument structure. In** *Thematic structure: Its role in grammar.* **Edited by I. M. Roca, 79–106. Berlin: Foris.**

This account of deaccentuation includes deaccentuation of eventive predicates under focus, and it extends an earlier account to complex sentences containing small clauses.

**Jackendoff, R. S. 1972.** *Semantic interpretation in generative grammar.* **Cambridge, MA: MIT Press.**

Significant work because of its definition of "focus" as the nonpresupposed part of sentences, in the wake of Noam Chomsky's brief discussion of the issue. A wh-question expresses the presupposition, the answer to it being the focus. Much subsequent work adopts the same distinction, even if cast in different terms.

**Ladd, D. R. 2008.** *Intonational phonology.* **2d ed. Cambridge, UK: Cambridge Univ. Press.**

Chapter 6 ("Patterns of Sentence Stress") offers an accessible discussion of the variation in accentuation rules in European languages, while chapter 7 ("Phonological Issues in Sentence Stress") deals with some frequently mooted conceptual issues.

**Lee, C., M. Gordon, and D. Büring. 2007.** *Topic and focus: Cross-linguistic perspectives on meaning and intonation.* **Dordrecht, The Netherlands: Springer.**

Many of these papers deal with prosodic effects of information structure.

**Selkirk, E. 1995. Sentence prosody: Intonation, stress and phrasing. In** *The handbook of phonological theory.* **Edited by J. Goldsmith, 550–569. Cambridge, MA: Blackwell.**

Uses both accentuation-to-focus rules and focus-to-newness rules. The double set is required after abandoning Jackendoff's conception of focus as the counterpart of presupposition and replacing it with "appropriateness" of the answer. Appropriate answers may give information other than what the question asked for, and thus other than the counterpart of the presupposition. Syntactic traces are included in the context of focus projection rules.

**Swerts, M., E. Krahmer, and C. Avesani. 2002. Prosodic marking of information status in Dutch and Italian: A comparative analysis.** *Journal of Phonetics* **30:629–654.**

Experimental demonstration that Dutch does, and Italian does not, signal presentational focus within the noun phrase through deaccenting, giving both production and perception data.

**Vallduví, E. 1992.** *The informational component.* **New York: Garland.**

Discussion of the nature of information status in languages, and a comparison between English and Catalan, where English comes out as prosodically malleable ("plastic language"), while retaining word order under changes in focus, and Catalan as relying more on word

order to express focus.

**Xu, Y., S.-W. Chen, and B. Wang. 2012. Prosodic focus with and without Post-Focus Compression (PFC): A typological divide within the same language family?** *Linguistic Review* **29:131–147.**

Compression of the pitch range after the focus constituent occurs in Beijing Mandarin but not in Taiwanese Mandarin. Post-Focus Compression (PFC) appears to be common in Europe and Asia with the exception of Southeast Asia, and looks like an areal feature.

## Discourse

Intonation interacts with a host of other factors in signaling conversational structure and meaning. This section includes studies of the meaning of intonation (see also Meaning), information structure (see also Information Structure), conversation analysis (Couper-Kuhlen and Selting 1996; Barth-Weingarten, et al. 2009), and pragmatics (Hirschberg 2005).

**Barth-Weingarten, D., N. Dehé, and A. Wichmann. 2009.** *Where prosody meets pragmatics***. Bingley, UK: Emerald Group.**

Collection of paper on a variety of topics involving prosody and communication, such as speaker stance, hesitation fillers, contrast, genre, discourse particles, and more.

**Couper-Kuhlen, E., and M. Selting. 1996.** *Prosody in conversation: Interactional studies***. Cambridge, UK: Cambridge Univ. Press.**

Collection of papers on the intonational features of a number of conversational acts, such as turn taking, *why-* reproaches, quotations, and more.

**Hirschberg, J. 2005. Pragmatics and intonation. In** *The handbook of pragmatics***. Edited by L. R. H. Horn and G. L. Ward, 215–236. Malden, MA: Blackwell.**

Accessible discussion of intonational meaning and pragmatic effects of phrase breaks and melodic aspects.

## Language Processing

The intonation of an utterance provides an important source of information for language parsing. Research includes both offline experiments, which often requires grammatical judgments upon the presentation of a stimulus, and online experiments, the most recent of which employ eye-tracking or neuro-imaging techniques to track the time-course and neural underpinnings of listeners' processing of linguistic structures. Cutler, et al. 1997 is the earliest and most comprehensive review on prosody in language processing. More recent reviews include Carlson 2009, which limits its attention mainly to the role of prosody in sentence processing, and Wagner and Watson 2010, which summarizes the recent research advances in the role of prosody in both speech production and comprehension.

**Carlson, K. 2009. How prosody influences sentence comprehension.** *Language and Linguistic Compass* **3.5: 1188–1200.**

A comprehensive and up-to-date review on the role of prosody in sentence processing.

**Cutler, A., D. Dahan, and W. van Donselaar. 1997. Prosody in the comprehension of spoken language: A literature review.** *Language and Speech* **40:121–201.**

A comprehensive review on the role of prosody in spoken language comprehension ranging from lexical access and sentence processing to discourse comprehension.

**Wagner, M., and D. G. Watson. 2010. Experimental and theoretical advances in prosody: A review. *Language and Cognitive Processes* 25:905–945.**

Comprehensive overview of studies on the role of prominence (accent) and phrasing in sentence parsing and of factors that affect prominence and phrase boundaries.

**PHRASING**

Research on phrasing has shown that prosodic cues are used for syntactic disambiguation (Price, et al. 1991) and do so at an early stage of sentence processing (Warren and Grabe 1995). There is an ERP component correlating with phrasing (Steinhauer, et al. 1999), including a specific phrase end effect known as the Closure Positive Shift (Steinhauer, et al. 2001; Pannekamp, et al. 2005). More global effects of sentence processing are shown in Clifton, et al. 2002.

**Clifton, C. J., K. Carlson, and L. Frazier. 2002. Informative prosodic boundaries. *Language and Speech* 45:87–114.**

This study provides evidence that the processing of a prosodic boundary depends on the presence and size of other prosodic boundaries in the sentence, arguing for a more global view of the effect of prosodic information in sentence comprehension.

**Pannekamp, A., U. Toepel, K. Alter, A. Hahne, and A. D. Friederici. 2005. Prosody-driven sentence processing: An event-related brain potential study. *Journal of Cognitive Neuroscience* 17:407–421.**

Shows that the Closure Positive Shift, a positive ERP component associated with completion of phrases, has a more general source than either prosody or syntax.

**Price, P., M. Ostendorf, S. Shattuck-Hufnagel, and C. Fong. 1991. The use of prosody in syntactic disambiguation. *Journal of the Acoustical Society of America* 90.6: 2956–2970.**

This study shows that, for a quite large variety of syntactic structures, naïve listeners can reliably disambiguate on the basis of prosodic differences, in particular phrasing information.

**Steinhauer, K., K. Alter, and A. Friederici. 1999. Brain potentials indicate immediate use of prosodic cues in natural speech processing. *Nature Neuroscience* 2:191–196.**

An influential neural imaging study that establishes that prosodic phrasing evokes a specific positive shift in the listeners' event-related brain potentials (ERPs) and it is sufficient to reverse syntactic parsing preferences.

**Steinhauer, K., and A. D. Friederici. 2001. Prosodic boundaries, comma rules, and brain responses: The Closure Positive Shift in ERPs as a universal marker for prosodic phrasing in listeners and readers. *Journal of Psycholinguistic Research* 30:267–295.**

First report of the Closure Positive Shift.

**Warren, P., and E. Grabe. 1995. Prosody, phonology and parsing in closure ambiguities. *Language and Cognitive Processes* 10:457–486.**

One of the first studies that show clearly that prosodic boundary information does influence decisions about syntactic structure at very early stages.

**PITCH ACCENT LOCATION**

Earlier research on pitch accent location centered mainly on the marking of pitch accent for information status (Terken and Nooteboom 1987) and how such an effect is constrained by syntactic structures (Birch and Clifton 1995). More recently, pitch accent location has also been shown to guide sentence processing (Schafer, et al. 2000) and reference resolution (Dahan, et al. 2002). The underlying neural processing of pitch accent location in discourse comprehension has been examined in Magne, et al. 2005.

**Birch, S., and C. J. Clifton. 1995. Focus, accent, and argument structure: Effects on language comprehension.** *Language and Speech* **38:365–391.**

This study investigates the effect of syntactic argument structure and pitch accent location in sentence comprehension and demonstrations that appropriate intonational marking of focus is crucial for the understanding of spoken discourse.

**Dahan, D., M. K. Tanenhaus, and C. G. Chambers. 2002. Accent and reference resolution in spoken-language comprehension.** *Journal of Memory and Language* **47.2: 292–314.**

The use of eye-tracking data reveals that listeners can make immediate and even predictive use of an intonational prominence to identify discourse referents. The use of accent in reference resolution involves interaction between prosodic information and discourse context.

**Magne, C., C. Astésano, A. Lacheret-Dujour, M. Morel, K. Alter, and M. Besson. 2005. On-line processing of "pop-out" words in spoken French dialogues.** *Journal of Cognitive Neuroscience* **17.5: 740–756.**

An ERP study that shows that listeners make online use of focal prominences to build coherent representations of the informational structure of the utterances.

**Schafer, A., K. Carlson, C. Clifton Jr., and L. Frazier. 2000. Focus and the interpretation of pitch accent: Disambiguating embedded questions.** *Language and Speech* **43:75–105.**

A study that shows that accent placement, just like prosodic phrasing, can play a central role in guiding syntactic parsing of otherwise ambiguous syntactic strings.

**Terken, J., and S. G. Nooteboom. 1987. Opposite effects of accentuation and deaccentuation on verification latencies for given and new information.** *Language and Cognitive Processes* **2:145–163.**

This study shows that compatibility of accentual status of a word and its information status is very important and leads to faster comprehension, suggesting that listeners process accented and unaccented words in different ways.

### MELODIC ASPECTS

Work on pitch accent types show that they do matter for online processing of information status (Chen, et al. 2007), but not always in a categorically distinct interpretive domains (Watson, et al. 2008). An effect of accent type has also been observed in natural, unscripted discourse speech (Ito and Speer 2008).

**Chen, A., E. den Os, and J. P. de Ruiter. 2007. Pitch accent type matters for online processing of intonation status: Evidence from natural and synthetic speech.** *Linguistics Review* **24.2: 317–344.**

An eye-tracking experiment on the role of different pitch accent types and deaccentuation in processing given versus new information with both natural and synthetic speech, results of which confirm that pitch accent type does matter for the online processing of the target word's information status.

**Ito, K., and S. R. Speer. 2008. Anticipatory effect of intonation: Eye movements during instructed visual search.** *Journal of*

*Memory and Language* 58:541–573.

Investigation showing that pitch accent type matters in evoking a contrast among alternatives for reference resolution in naturally occurring, unscripted speech.

**Watson, D., C. Gunlogson, and M. Tanenhaus. 2008. Interpreting pitch accents in on-line comprehension: H\* vs. L H\*.** *Cognitive Science* **32:1232–1244.**

This study addresses a deeper question with regard to accent type and information status by exploring the processing of presentational and contrastive pitch accents for new versus contrastive information. The results show that although listeners interpret these accents differently, their interpretive domains overlap.

## Vocative Chants

The English vocative chant consists of a high-level pitch starting at the nuclear syllable and a mid-level one starting at the last postnuclear stressed syllable if there is one, else the last syllable (including the nuclear one): *Aber-nathy*, *Pamela*, *Jo-ohn* (Liberman 1979, Ladd 1978). Variants of this contour have been reported for a number of languages (Hayes and Lahiri 1991, Gussenhoven 1993, Varga 2008).

**Gussenhoven, C. 1993. The Dutch foot and the chanted call.** *Journal of Linguistics* **29:37–63.**

Account of a Dutch variant of the vocative chant, in which the number of levels increases with each lexical word in the postfocal portion of the sentence. The contour is used as evidence for the foot.

**Hayes, B., and A. Lahiri. 1991. Durationally specified intonation in English and Bengali. In** *Music, language, speech and brain: Proceedings of an international symposium at the Wenner-Gren Center, Stockholm, 5–8 September 1990*. **Edited by J. Sundberg, L. Nord, and R. Carlson, 78–91. Basingstoke, UK: Macmillan.**

Phonological account of the vocative chants in English and Bengali. The first analysis of the durational properties of the English vocative chant, with prediction of neutralization of vowel quantity.

**Ladd, D. R. 1978. Stylized intonation.** *Language* **54:517–540.**

Semantic account of the English vocative chant. It establishes that, despite terms such as "calling contour" and "vocative chant," it, in fact, indicates "routineness."

**Liberman, M. Y. 1979.** *The intonational system of English*. **New York: Garland.**

Treatise that contains an extensive treatment of the English vocative chant, detailing the stress sensitive location of the second (mid) pitch level. Originally written in 1975 (PhD thesis, MIT).

**Varga, L. 2008. The calling contour in Hungarian and English.** *Phonology* **25:469–497.**

Surveys the literature on the English vocative chant and offers an analysis of the Hungarian counterpart, introducing a "zero" boundary tone.

## Features Other than F0

The discoursal meanings expressed by the melodic structure of some languages may be expressed by nonmelodic structural means in

others. Thus, West Greenlandic encodes questions by affixing a mora to the sentence-final intonational phrase as reported in Rischel 1974 (cited under West Greenlandic). A striking case was recently described in Hyman and Monaka 2011.

**Hyman, L. M., and K. C. Monaka. 2011. Tonal and non-tonal intonation in Shekgalagari. In *Prosodic categories: Production, perception and comprehension*. Edited by S. Frota, G. Elordieta, and P. Prieto, 267–289. Dordrecht, The Netherlands: Springer.**

It is shown that Shekgalagari (Botswana, Namibia), in which tone is used for lexical and grammatical distinctions, uses phrase-penultimate lengthening and phrase-final lengthening to express discourse meanings such as listing, hortatives, and vocatives.

## Paralinguistics

Following Ladd 2008 (cited under Information Structure), the term *paralinguistics* in spoken language refers to the nonphonological use of vocal sound to convey meaning. As such, it is equatable with systems of animal communication. Ethological explanations for the near-universal character of paralinguistic form-function relations in human voice pitch started with John Ohala's Frequency Code. While he made no distinction between grammar and paralinguistics, Ohala 1983 and Ohala 1994 have made a convincing case for connecting the variation between high and low pitch with the variation in larynx size as found within the human species. Intraspecies larynx size is subject to sexual dimorphism, with boys developing a somewhat lowered and greatly enlarged larynx during puberty. The ethologically determined signaling of large body size by means of the lowered pitch and raised formants as produced by the male larynx, along with the peripheral facial hair, is exploited metaphorically in paralinguistics, such that high pitches signal features associated with small creatures and, hence, vulnerability, submission and friendly disposition, while low pitches are associated with their opposites, that is, protection, dominance, and aggression. Gussenhoven 2004 extends this metaphorical "size" connection to a metaphorical connection between the degree of articulatory effort and significance (Effort Code) as well as that between the declining course of the breath group (the speech produced over one exhalation phase) and beginnings and endings of speech portions (the Production Code, renamed Respiratory Code in Nolan 2006, cited under Tutorial Articles and Book Chapters). Other accounts of quasi-universal effects rely on metaphorical interpretations of the pitch contour shapes themselves (Cruttenden 1981).

**Cruttenden, A. 1981. Rises and falls: Meanings and universals. *Journal of Linguistics* 17.1: 77–91.**

Falls express "closed" meanings, like finality and end of turn, and rises as "open" meanings, like questions and nonfinality, in the spirit of Dwight Bolinger's work. Meanings are attributed to pitch contour shapes rather than to physiological mechanisms underlying pitch features, as for Ohala. Thus, "interrogativity" and "nonfinality" have a common explanation in the Bolinger-Cruttenden account (rising shapes), but different explanations in the Ohala-Gussenhoven account (high pitch and non-low pitch, respectively).

**Gussenhoven, C. 2004. *The phonology of tone and intonation*. Cambridge, UK: Cambridge Univ. Press.**

Chapter 4 discusses the relation between paralinguistic meaning and intonational structure and extends the idea behind Ohala's Frequency Code to the Effort Code (a relation between hyperarticulation and hypoarticulation of pitch movements and degrees of significance) and the Production Code (a relation between discourse continuation and low-phrase beginnings or high-phrase endings).

**Ohala, J. J. 1983. Cross-language use of pitch: An ethological view. *Phonetica* 40.1: 1–18.**

Ethological explanation of high and rising pitch as signals for interrogativity, along with powerless meanings like submission and friendliness. Ohala termed the relation between "small meanings" and high pitch the Frequency Code and explained its existence on the basis of the relation between small size of the vocal folds (and, hence, the larynx and, hence, the body) and high pitch.

**Ohala, J. J. 1994. The Frequency Code underlies the sound symbolic use of voice pitch. In *Sound symbolism*. Edited by L. Hinton, J. Nichols, and J. J. Ohala, 325–347. Cambridge, UK: Cambridge Univ. Press.**

Summary of the 1983 account, plus a discussion of iconic effects in language that can be related to the Frequency Code.

## Specific Language Descriptions

Exhaustive, or nearly exhaustive, descriptions of intonation systems exist for only a small number of languages. A number of languages are listed in the following subsections with brief indications of their prosodic features and main sources.

### BASQUE

Varieties of Basque have received considerable attention because of the Japanese style lexical pitch accent in the northern Bizkaian dialects, which have accented and unaccented words, like Tokyo Japanese, and express focus through pitch range variation (Elordieta 2003, Elordieta 2007). In these dialects, the pitch accent is realized by pitch only (Elordieta and Hualde 2003). The more southern dialects have developed a Spanish-style stress system (Hualde, et al. 2002). Recently, a Navarrese dialect has been described as having a combination of contrastive stress and lexical tone, as in Serbo-Croatian (Hualde, et al. 2008).

**Elordieta, G. 2003. Intonation. In *A grammar of Basque*. Edited by J. I. Hualde and J. O. de Urbina, 72–113. Berlin: Mouton de Gruyter.**

Descriptive chapter in a reference grammar of Basque, which is neutral about analytical treatments, and that provides a comparison of the intonation of three dialects.

**Elordieta, G. 2007. A constraint-based analysis of the intonational realization of focus in Northern Bizkaian Basque. In *Typological studies in word and sentence prosody*. Vol. 1 of *Tones and tunes*. Edited by T. Riad and C. Gussenhoven, 199–232. Berlin: Mouton de Gruyter.**

Optimality-theoretic account of the expression of focus in Lekeitio Basque, which differs in interesting ways from the Japanese case.

**Elordieta, G., and J. I. Hualde. 2003. Tonal and durational correlates of accent in contexts of downstep in Lekeitio Basque. *Journal of the International Phonetic Association* 33:195–209.**

Investigation of the phonetic properties of a Northern Bizkaian pitch accented syllables, showing that it is distinguished from unaccented syllables only by pitch.

**Hualde, J., G. Elordieta, I. Gaminde, and R. Smiljanić. 2002. From pitch accent to stress-accent in Basque. In *Laboratory phonology*. Vol. 7. Edited by C. Gussenhoven and N. Warner, 547–584. Berlin: Mouton de Gruyter.**

Phonetically informed reconstruction of the development from a Japanese-type pitch accent to a Spanish-type stress word prosodic system in the more southern dialects.

**Hualde, J. I., O. Lujanbio, and F. Torreira. 2008. Lexical tone and stress in Goizueta Basque. *Journal of the International Phonetic Association* 38:1–24.**

Typologically significant case of a Western Navarrese Basque dialect that combines a contrastive stress system (initial versus peninitial), cued by duration and intensity, with lexical tone as in the accented/unaccented systems of the Northern Bizkaian Basque dialects.

### BENGALI

Calcutta Bengali exemplifies the existence of boundary tones at different levels of the prosodic hierarchy, the presence of a single prenuclear contour as compared to eight nuclear ones, the OCP as a constraining principle within the intonation phrase in an intonation language (Hayes and Lahiri 1991a), a vocative chant (Hayes and Lahiri 1991b), and a tonally marked focus particle (Lahiri and Fitzpatrick-Cole 1999).

**Hayes, B., and A. Lahiri. 1991a. Bengali intonational phonology.** *Natural Language and Linguistic Theory* 9:47–96.

Instructive description of the intonation system in AM framework.

**Hayes, B., and A. Lahiri. 1991b. Durationally specified intonation in English and Bengali. In** *Music, language, speech and brain: Proceedings of an international symposium at the Wenner-Gren Center, Stockholm, 5–8 September 1990*. **Edited by J. Sundberg, L. Nord, and R. Carlson, 78–91. Basingstoke, UK: Macmillan.**

Accounts for the Bengali vocative chant, comparatively with English.

**Lahiri, A., and J. Fitzpatrick-Cole. 1999. Emphatic clitics and focus intonation in Bengali. In** *Phrasal phonology*. **Edited by W. Zonneveld and R. Kager, 119–144. Nijmegen, The Netherlands: Nijmegen Univ. Press.**

This chapter demonstrates that the language has H*-marked focus particles, which enforce deletion of adjacent H-tones in the intonation contour.

## CATALAN

Most of the work on Catalan prosody has been conducted within the autosegmental metrical approach. It has focused on production and perception data, with the goal of analyzing a variety of issues related to the typology of pitch accents, boundary tones, and tonal contrasts in Catalan and its dialectal varieties. Like other Romance languages, Catalan displays a three-way phonologicsal contrast in scaling both at the pitch accent and at the boundary tone level. Recent work has focused on the interaction between intonation and pragmatics (CatToBI Training Materials) and between intonation and syntax (Feldhausen 2010, Astruc-Aguilera and Nolan 2007) as well as in trying to understand how the patterns of tonal alignment and scaling of F0 contours have an impact on meaning (Estebas-Vilaplana 2009).

**Astruc-Aguilera, L., and F. Nolan. 2007. Variation in the intonation of extrasentential elements. In** *Segmental and prosodic issues in Romance phonology*. **Edited by P. Prieto, J. Mascaroó, and M.-J. Solé, 84–107. Amsterdam: John Benjamins.**

Presents an analysis of the prosodic and syntactic properties of extra-sentential elements in English and Catalan. It covers the role of phrasing as well as tonal cues, such as the reduction in pitch span leading to total deaccentuation and tonal reduplication.

**CatToBI Training Materials.**

The website contains the training materials for the most up-to-date CatToBI transcription system, which is based on the analysis of production data and also on the results of perception experiments. It contains examples of labeled utterances and labeling exercises exemplifying a catalogue of distinctive tunes in Catalan as it is intended to be a practical tool for learning how to label Catalan data prosodically.

**Estebas-Vilaplana, E. 2009.** *The use and realisation of accentual focus in Central Catalan with a comparison to English*. **Munich: Lincom Europa.**

This thesis presents an analysis of the intonational patterns found in nuclear and pre-nuclear contours in Catalan and English statements. The focus realization strategies are analyzed from both a phonetic and a phonological point of view.

**Feldhausen, I. 2010.** *Sentential form and prosodic structure of Catalan*. **Amsterdam: John Benjamins.**

Intonational phrasing is analyzed across different sentence types, including SVO structures and structures involving clitic left- and right-dislocations, and the importance of syntactic and prosodic constraints and their mutual interactions is assessed. Phrasing decisions depend both on syntactic factors and on factors such as topic-hood and prosodic binarity.

**CHICKASAW**

This is a rare case of a language with rising intonation for statements and falling intonation for questions (Gordon 2003). While accentuation is stress-sensitive, as in English, the nuclear melody for the statement begins on a syllable closer to the IP-end from that of the question.

**Gordon, M. 2003. The phonology of pitch accents in Chickasaw. *Phonology* 20:173–218.**

Account of the intonation of Chickasaw, showing falling questions and rising statements and variation in the location of the accented syllable as a function of the inserted melody.

**CHINESE**

Work on Chinese intonation has mainly focused on Beijing Mandarin or Standard Chinese. As fundamental frequency changes are also used for lexical tone contrasts, sentence intonation in Chinese is manifested mainly as two effects: local modification of lexical tonal contours and more global effect of tonal realization within different pitch registers (Shen 1990, Liu and Xu 2005). Modification of lexical tones to convey information structure is often accompanied by the expansion and compression of pitch range (Xu 1999) and varies according to different focus domains (Jin 1996). Chen and Gussenhoven 2008 shows that the pitch range modification of lexical tone to encode information structure is constrained and, together with other prosodic cues, enhances the distinctiveness of the lexical tonal contrasts, analogously to the hyperarticulation of vowels. Different proposals have been made on how to model intonation, such as Yuan 2004 and Prom-on, et al. 2009.

**Chen, Y., and C. Gussenhoven. 2008. Emphasis and tonal implementation in Standard Chinese. *Journal of Phonetics* 36:724–746.**

A study on the durational and f0 adjustments to encode corrective focus which argues for a hyperarticulation account of lexical tonal realization under focus.

**Liu, F., and Y. Xu. 2005. Parallel encoding of focus and interrogative meaning in Mandarin intonation. *Phonetica* 62:70–87.**

A study examining the joint effects of focus and interrogative meaning on Mandarin intonation.

**Jin, S. D. 1996. An acoustic study of sentence stress in Mandarin Chinese. PhD diss., Ohio State University.**

The first systematic study on the production and perception of sentence stress with varying focus domains.

**Prom-on, S., Y. Xu, and B. Thipakorn. 2009. Modeling tone and intonation in Mandarin and English as a process of target approximation. *Journal of the Acoustical Society of America* 125:405–424.**

A new model of Mandarin intonation, proposed within the context of cross-linguistic comparisons to English, that has a different prosodic system.

**Shen, X. 1990. *The prosody of Mandarin Chinese*. Berkeley: Univ. of California Press.**

The first systematic experimental study on Mandarin intonation.

**Xu, Y. 1999. Effects of tone and focus on the formation and alignment of f0 contours. *Journal of Phonetics* 27:55–105.**

A comprehensive study on the formation and alignment of f0 contours under different lexical tones and focus.

**Yuan, J. 2004. Intonation in Mandarin Chinese: Acoustics, perception, and computational modeling. PhD diss., Cornell University.**

This study offers not only acoustic and perceptual data but also computational modeling.

**DANISH**

Danish has a single rising pitch accent, with questions being different from statements in pitch range (Grønnum 1992). The language has a plain versus glottalized contrast on the second half bimoraic syllables (the "stød"), which is historically related to Accent 1 of Norwegian and Swedish. Varieties of Danish are treated in Grønnum 1990.

**Grønnum, N. 1990. Prosodic parameters in a variety of regional Danish standard languages, with a view towards Swedish and German.** *Phonetica* **47:182–214.**

Six regional varieties of Danish are compared with each other as well as with Swedish and German to see whether one ("global cue") or more than one ("local cues") pitch accent is used. Danish signals focus by pitch range reduction of the nonfocal parts.

**Grønnum, N. 1992.** *The groundworks of Danish intonation***. Copenhagen: Museum Tusculanum Press.**

Summary of work on Standard Danish and some regional varieties.

**DUTCH**

The intonation system is very similar to that of English and German. The first description was the IPO grammar ('t Hart, et al. 1990). The authors' notation is still used, informally if not in published work. The description was criticized for collapsing contrasts (Gussenhoven 1988, Gussenhoven and Rietveld 2000). An AM description was developed by Gussenhoven and colleagues, which was implemented in an interactive transcription course with a contour synthesis program (Gussenhoven 2005). Peters 2010 contains contrastive information on a number of regional varieties of Dutch.

**Gussenhoven, C. 1988. Adequacy in intonation analysis: The case of Dutch. In** *Autosegmental studies on pitch accent***. Edited by H. van der Hulst and N. Smith, 95–121. Dordrecht, The Netherlands: Foris.**

This publication pointed out a number of contrasts that were not covered by the IPO grammar, providing resynthesized versions of original examples for which a second contour was available in the language that had the same analysis in the IPO grammar. It also provided an AM analysis of those contrasts.

**Gussenhoven, C. 2005. Transcription of Dutch intonation. In** *Prosodic typology: The phonology and intonation and phrasing***. Edited by S.-A. Jun, 118–145. Oxford: Oxford Univ. Press.**

AM analysis of Dutch with contour-by-contour comparisons with the IPO grammar and MAE-ToBI analyses. The ToDI second edition website includes an interactive course.

**Gussenhoven, C., and T. Rietveld. 2000. The behavior of H\* and L\* under variations in pitch range in Dutch rising contours.** *Language and Speech* **43:183–203.**

The "high rise" and "low rise" were shown to be distinct in a semantic task in which listeners rated the degree of surprise expressed by rising contours. Low beginnings (L\*) need to be lower and mid beginnings (H\*) higher to express more surprise.

**Peters, J. 2010. Tonal variation of West Germanic languages. In** *Linguistik im Nordwesten: Beiträge zum 1: Nordwestdeutschen Linguistischen Kolloquium, Bremen, 10–11 Oktober 2008***. Edited by T. Stolz, E. Ruigendijk, and J. Trabant, 79–102. Bochum, Germany: Brockmeyer.**

Includes information on intonational contour properties in Dutch dialects along with those of dialects spoken in northwestern Germany.

**'t Hart, J., R. Collier, and A. Cohen. 1990.** *A perceptual study of intonation: An experimental-phonetic approach to speech melody.* **Cambridge, UK: Cambridge Univ. Press.**

Summary of research based on analysis-by-synthesis. If standardized versions of natural contours (see under Models) are perceptually equivalent to the original contours in some corpus, no intonational contrasts could be missed. The test functioned as a heuristic tool in intonation analysis. Since the advent of an easy-to-use F0 manipulation program in PRAAT (see Boersma and Weenink 2009–2013, cited under Tutorial Articles and Book Chapters), this technique has been used more widely.

### ENGLISH

English is without doubt the most intensively described language in the world, which is eminently true for intonation. Until Pierrehumbert 1980, British and American descriptions were produced in mutually exclusive research traditions. The British descriptions were, in part, pedagogically motivated, and they were couched in contour elements such as "rising head" and "high fall nucleus," while those produced in the United States were theoretically motivated, with pitch phonemes in the shape of levels (high, mid-high, mid-low, low). This difference was characterized by Dwight Bolinger as one between "Levels" and "Configurations" (Bolinger 1986). Currently, the traditions have merged in the autosegmental-metrical framework, but in a sense the differences are still present in the shape of two analyses. The analysis in Pierrehumbert 1980 and Beckman and Pierrehumbert 1986, which is widely available in its ToBI version, made a number of analytical choices that ran counter to the British-style analyses. Most importantly, accentual pitch peaks were analyzed as rises followed by an L-tone occurring either in the next pitch accent or in the next "phrase accent" (see Phrase Accent), while the British tradition analyzed these as falls, preceded by a boundary L-tone ("low prehead") or by the low target from a preceding pitch accent ("falling head"). Gussenhoven 1984 (cited under Meaning) took the British tradition as its starting point (e.g., O'Connor and Arnold 1973), and the author analyzed falling heads and falling nuclei alike, as H*L pitch accents, while the same goes for rising heads and nuclear tunes and L*H. As a result, West Germanic languages are described in terms of either an "on ramp" (Pierrehumbert 1980) or an "off ramp" (Gussenhoven 2004) model: on-ramp analyses have intermediate phrases, obligatory boundary tones of the intermediate phrase and the intonational phrase (L-L%, L-H%, H-L%, H-H%), fixed timing between the tones in a pitch accent, pitch accents with leading tones and pitch accent with trailing tones (see Grice 2005), and single-target pronunciations of all tones. Off-ramp analyses have, or are likely to have, (1) no intermediate phrase, (2) optional boundary tones of the intonational phrase (L%, H% and no tone, variously notated as %, 0%, or Ø), (3) rightward displacement of trailing tones of prenuclear pitch accents (cf. "heads") versus immediate pronunciation of trailing tones in nuclear pitch accents, and—except for the leading H-toned pitch accents described in Grice, et al. 2000 (cited under Phrase Accent)—pitch accents with trailing tones only. Recently, interest has grown in nonstandard varieties.

**Beckman, M. E., and J. B. Pierrehumbert. 1986. Intonational structure in English and Japanese.** *Phonology Yearbook* **3:255–309.**

Contains a modification of Pierrehumbert 1980. The phrase accent was redefined as a boundary tone, which implied the introduction of a new prosodic constituent, an intermediate phrase. Also, the H*+H pitch accent was dropped. Since the trailing H was originally meant to prevent a pitch slump after H*, it implied that an earlier implementation rule creating a sagging realization of the pitch between H*-tones was abandoned.

**Bolinger, D. 1986.** *Intonation and its parts: Melody in spoken English.* **Stanford, CA: Stanford Univ. Press.**

Extensive discussion of the function of "profiles," effectively pitch accents with either a trailing tone (e.g., "Profile A") or a leading tone (e.g., "Profile C"), except that two of them can mark a single accent (e.g., "Profile BC").

**Grice, M. 2005. Leading tones and downstep in English.** *Phonology* **12:183–233.**

Discussion of pitch accents with leading H in English, their downstepping effect on the H* in the same pitch accent, and the distinctness of this downstepped H* from L*. Also contains a proposal for a metrical structure of pitch accents.

**Gussenhoven, C. 2004.** *The phonology of tone and intonation.* **Cambridge, UK: Cambridge Univ. Press.**

Chapter 15 offers an autosegmental description in the "British" tradition, in which nuclear tunes such as "level," "high fall," and so on, are analyzed as pitch accents plus with or without boundary tones of the intonational phrase. For instance, H*L L% is the "high fall," as opposed to L+H* L-L% in Pierrehumbert 1980. Tones may have two targets, allowing level stretches (see under Alignment). Trailing tones are pronounced late in prenuclear accents and early in nuclear ones.

**O'Connor, J., and G. Arnold. 1973. *Intonation of colloquial English*. 2d ed. London: Longman.**

Pedagogically oriented example of the British tradition of intonation analysis. For practical purposes, it has been replaced by Wells 2006 (cited under Textbooks).

**Pierrehumbert, J. B. 1980. The phonetics and phonology of English intonation. PhD diss., MIT.**

The 1980 description of English contained pitch accents H*, L*, H*+L, L*+H, H+L*, L+H*, and H*+H, the phrase accents H- and L-, and the boundary tones H% and L%. Revised in Beckman and Pierrehumbert 1986 by dropping H*+H and introducing the intermediate phrase as the prosodic constituent that brings in the phrase accents.

## British English

For work by Esther Grabe and colleagues, which addresses IP-final truncation in a number of dialects, see Grabe, et al. 2000 (cited under Phonetic Implementation). Van Leyden and van Heuven 2006 compares two insular dialects in Scotland.

**van Leyden, K., and V. J. van Heuven. 2006. On the prosody of Orkney and Shetland dialects. *Phonetica* 63:149–174.**

Experimentally supported comparison between Shetland English and Orkney English, whereby Orkney has very late timings of peaks.

## New Zealand English

The interest in New Zealand intonation has been largely in the HRT (High Rise Terminal), as in Warren 2005.

**Warren, P. 2005. Patterns of late rising in New Zealand English: Intonational variation or intonational change? *Language Variation and Change* 17:209–230.**

Investigation showing the spread of the HRT in New Zealand.

## Australian English

The interest in Australian English intonation has focused on the HRT (High Rise Terminal) (see Fletcher and Harrington 2001).

**Fletcher, J., and J. Harrington. 2001. High-rising terminals and fall-rise tunes in Australian English. *Phonetica* 4:215–229.**

The Australian HTR as used in statements is a low rise, that is, a rise from low, rather than a high (mid) rise, as used in questions. Instead of a low rise, a high narrow-range fall-rise may be used.

### FRENCH

The literature on French intonation is vast (e.g., Mertens 1990, Di Cristo 1998). The language has no lexical stress (Dupoux, et al. 2010) and places pitch accents in locations that are derivable from the phrasing (Post 2000). Initial accents may be used for contrastive focus. There are fewer melodic patterns than in West Germanic; French has no monosyllabic fall-rise, for instance. There are two descriptions

in the AM model (Jun and Fougeron 2000, Post 2000).

**Di Cristo, A. 1998. Intonation in French. In *Intonation systems: A survey of twenty languages*. Edited by D. Hirst and A. Di Cristo, 195–218. Cambridge, UK: Cambridge Univ. Press.**

Description in terms of INTSINT labels (see also under Models), assuming two levels of phrasing. A basic melodic pattern is distinguished from more expressive melodies.

**Dupoux, E., S. Peperkamp, and N. Sebastián-Gallés. 2010. A robust method to study stress deafness. *Journal of the Acoustical Society of America* 110:1606–1618.**

Compared to speakers of Spanish and other languages, French subjects perform poorly in identifying the stress locations of nonsense words in short-term memory tasks. The results are seen as evidence that French words have no lexical specification for stress.

**Jun, S.-A., and C. Fougeron. 2000. A phonological model of French intonation. In *Intonation: Analysis, modelling and technology*. Edited by A. Botinis, 209–242. Dordrecht, The Netherlands: Kluwer.**

AM description with both H* and L*, treating the accentual phrase as having a melody LHLH, with instantiation depending on the number of available syllables. Initial accents are described as boundary tones rather than pitch accents. The phrasing account postulates three levels of intonational constituents and is provided in the second publication.

**Mertens, P. 1990. Intonation. In *Le français parlé: Études grammaticales*. Edited by C. Blanche-Benveniste, M. Bilger, C. Rouget, and K. van der Eynde, 159–176. Sciences du langage. Paris: Éditions du Centre National de la Recherche Scientifique.**

Treatment of melodic structure in which every syllable is specified for tone, lower case h, l for unaccented syllable and upper case H+, H, L, and L- for accented ones, in addition to a raising diacritic. Final accents can have more than one tone. The description amounts to a systematic narrow transcription.

**Post, B. 2000. *Tonal and phrasal structures in French intonation*. The Hague: Thesus.**

AM description of the variation in phrasing in optimality theory and a tonal grammar that has no L*, but obligatory downstep after H.

**GERMAN**

The general structure of the language is very similar to that of English and Dutch, for instance in contrasting downstepped falls with leading H, nondownstepped falls, and late peaks (Kohler 1987). National varieties of German as well as regional varieties have recently been investigated and both ToBI German (Grice, et al. 2005; Baumann 2006; Truckenbrodt 2002) and "British style" autosegmental descriptions are available (Féry 1993, Grabe 1998, Peters 2006, Kügler 2007).

**Baumann, S. 2006. *The intonation of givenness: Evidence from German*. Tübingen, Germany: Niemeyer.**

Analysis of information structure in terms of degrees of informational salience, with production and perception data showing correspondences with phonological and phonetic variation in prominence. Downstepped accents are seen as in between non-downstepped accents and deaccentuation.

**Féry, C. 1993. *German intonational patterns*. Tübingen, Germany: Niemeyer.**

Comprehensive treatment, and first autosegmental description of German intonation, using the British-style, on-ramp analysis.

**Grabe, E. 1998. Comparative intonational phonology: English and German. PhD diss., Univ. of Nijmegen.**

Comparison of the realization of downstep in nuclear syllables in English and German and of the realization of intonation-phrase final falls and rise under adverse segmental conditions, leading to truncation of falls in German but not in English. Published in Max Planck Institute Series in Psycholinguistics.

**Grice, M., S. Baumann, and R. Benzmüller. 2005. German intonation in autosegmental phonology. In *Prosodic typology: The phonology of intonation and phrasing*. Edited by S.-A. Jun, 55–84. Oxford: Oxford Univ. Press.**

Analysis of German intonation along the lines of MAE-ToBI.

**Kohler, K. J. 1987. Categorical pitch perception. In *Proceedings of the 11th International Congress of Phonetic Sciences, 1–7 August 1987, Tallinn, Estonia*. Vol. 5. Edited by U. Viks, 331–333. Tallinn, Estonia: Academy of Sciences.**

Demonstration of three-way contrast in pitch peak location in and around a nuclear syllable, preaccentual, accentual, and postaccentual.

**Kügler, F. 2007. *The intonational phonology of Swabian and Upper Saxon*. Tübingen, Germany: Niemeyer.**

Phonetic and phonological comparative account of the regional dialects of the Swabian Stuttgart dialect, with a distinction between two rise-fall nuclear tunes, and the Upper Saxon Leipzig dialect, with a distinction between a fall and a rise-fall.

**Peters, J. 2006. *Intonation deutscher Regionalsprachen*. Linguistische Impulse und Tendenzen 21. Berlin: Walter de Gruyter.**

Analyses of a number of varieties spoken in Germany using an on-ramp autosegmental framework (Berlin, Cologne, Duisburg, Freiburg, Hamburg, Mannheim). Contains a description of Standard German, which is also available in the grammatical volume of the *Duden* (Band 4, 2005).

**Truckenbrodt, H. 2002. Upstep and embedded register levels. *Phonology* 19:77–120.**

Investigation of the suspension of serial downstep on the nuclear syllable in German and the relation of the nondownstepped peak to the pitch range of the intonation phrase.

### HAUSA

Although one of the best described Chadic languages, the intonational properties of Hausa are still not as well understood as most Germanic and Romance languages (Jaggar 2001). Descriptive studies are Miller and Tench 1980 and Miller and Tench 1982. Question intonation is treated in Inkelas and Leben 1990.

**Inkelas, S., and W. Leben. 1990. Where phonology and phonetics intersect, the case of Hausa intonation. In *Papers in laboratory phonology I: Between the grammar and physics of speech*. Edited by J. Kingston and M. E. Beckman, 17–34. Cambridge, UK: Cambridge Univ. Press.**

Position of interrogative H tone on separate register. The most theoretically informed and probably most influential work on the phonetics and phonology of Hausa intonation.

**Jaggar, P. J. 2001. *Hausa*. Amsterdam: John Benjamins.**

Chapter 2 contains a review of Hausa intonation studies.

**Miller, J., and P. Tench. 1980. Aspects of Hausa intonation, 1: Utterances in isolation.** *Journal of the International Phonetic Association* **10:45–63.**

A descriptive study on the intonation of isolated Hausa sentences.

**Miller, J., and P. Tench. 1982. Aspects of Hausa intonation, 2: Continuous text.** *Journal of the International Phonetic Association* **12:78–93.**

A descriptive study on Hausa intonation, focusing on connected texts.

## ITALIAN

Quantitative as well as qualitative analyses of the intonation of regional varieties of Italian (mainly the southern varieties) have been undertaken within the autosegmental metrical approach to intonational phonology (see the review articles Grice, et al. 2005 and D'Imperio 2002). Bitonal accents are especially frequent in the tonal inventory of southern varieties of Italian. Contrasts in tonal association characterize both falling and rising accents (H+L*, H*+L, L*+H, L+H*), with H+L* as the declarative broad focus accent across varieties. Broad and narrow focus are signaled by a different accent type in statements and questions (Grice and Savino 2003, and Gili Fivela 2003 for Pisa Italian). Two levels of phrasing are usually considered relevant for intonation structure, although evidence for the intermediate phrase and the phrase accent is subject to some debate. Southern varieties show truncation of phrasal tones if the final syllable of the phrase is the stressed syllable.

**D'Imperio, M. 2002. Italian intonation: An overview and some questions.** *Probus* **14:37–69.**

The article starts with a review of the work on Italian intonation and its varieties. It also presents production and perception experimental data from Neapolitan Italian that show that narrow focus statements and broad focus statements are signaled by different pitch accents, a rising accent in the first case and a falling accent in the second.

**Gili Fivela, B. 2003. The phonetics and phonology of intonation: The case of Pisa Italian. PhD diss., Scuola Normale Superiore, Pisa.**

This dissertation describes the phonetics and phonology of Pisa Italian intonation. One of the important contributions is the phonetic and phonological description of the alignment contrast found between broad focus and contrastive focus pitch accents.

**Grice, M., M. D'Imperio, M. Savino, and C. Avesani. 2005. Strategies for intonation labelling across varieties of Italian. In** *Prosodic typology: The phonology of intonation and phrasing.* **Edited by S.-A. Jun, 362–389. Oxford: Oxford Univ. Press.**

Description of the intonation of four Italian varieties (Naples, Bari, Palermo, and Florence), within the autosegmental-metrical framework. The cross-variety perspective raises crucial questions on the details of the tonal structure of contrastive accents and on the presence/absence of a phrase accent in the intonation system.

**Grice, M., and M. Savino. 2003. Map tasks in Italian: Asking questions about given, accessible and new information.** *Catalan Journal of Linguistics* **2:153–180.**

Presents an analysis of Map Task data in Bari Italian, showing an intonational distinction between information-seeking yes-no questions and confirmation-seeking yes-no questions (or checks). Intonational variation in questions is thus found to be related to the degree of speaker confidence in the potential response to the question.

## JAPANESE

Japanese is a time-hallowed example of a "pitch accent language." Lexemes are either unaccented or accented, and, depending on lexis, Japanese accentual phrases either have no pitch accent or have a pitch accent on one of its syllables (Kubozono 1993).

Unaccented accentual phrases fall gradually from the second syllable, while accented accentual phrases have a pitch fall from the first mora in the accented syllable. Within the intermediate phrase, accentual phrases are downstepped after accented accentual phrases, and the intonational phrase ends either in L% or H%, the latter being interrogative (Pierrehumbert and Beckman 1988, Sugahara 2003). While focus is is widely assumed to co-determine the phrase structure, Ishihara 2011 argues that it is independent of prosodic phrasing.

**Ishihara, S. 2011. Japanese focus prosody revisited: Freeing focus from prosodic phrasing.** *Lingua* **121.13: 1870–1889.**

Argues that focus is not expressed through modification of the prosodic phrasing structure.

**Kubozono, H. 1993.** *The organization of Japanese prosody*. **Tokyo: Kurosio.**

Complete overview of phrasing, accentuation, and phrasing-sensitive downstep.

**Pierrehumbert, J. B., and M. E. Beckman. 1988.** *Japanese tone structure*. **Cambridge, MA: MIT Press.**

Autosegmental account of Tokyo Japanese tone and intonation, plus a section on Osaka Japanese. Contains a number of notable theoretical points that are argued for on the basis of production data, such as the iterative nature of downstep and the surface underspecification of tonal features in stretches of speech over f0 is interpolated.

**Sugahara, M. 2003.** *Downtrends and post-focus intonation in Tokyo Japanese*. **Amherst, MA: GLSA.**

Tokyo Japanese tone and intonation, with an emphasis on postfocal dephrasing as a function of the accentedness of the focused and postfocal accentual phrases.

**KOREAN**

Standard Korean is a typologically interesting language as it has only boundary tones with a large number of options finally in the intonational phrase. It also has a segment-dependent tone effect in the Chonnam variety, which is similar to that of Seoul (Jun 1996). If the phrase initial consonant is fortis or aspirated obstruent, the first tone is H, else L. A number of eastern varieties have lexical tone, usually analyzed as word initial melodies (Kenstowicz and Park 2006).

**Jun, S.-A. 1996.** *The phonetics and phonology of Korean prosody: Intonational phonology and prosodic structure*. **New York: Garland.**

A version of Jun's 1993 dissertation, which gives a phonetically sophisticated description of Seoul and Chonnam Korean.

**Kenstowicz, M., and C. Park. 2006. Laryngeal features and tone in Kyungsang Korean: A phonetic study.** *Studies in Phonetics, Phonology and Morphology* **12:247–264.**

Phonetic description of a southeastern variety with lexical tone.

**CENTRAL FRANCONIAN (INCLUDING LIMBURGISH)**

The Dutch-German dialect area in which the Central Franconian tone occurs consists of the northern half of Rhineland-Palatinate and the southern half of North Rhineland-Westphalia in Germany, the larger part of the Belgian province of Limburg (B), and the southern half of the Dutch province of Limburg (NL) (Schmidt 1986). There is no standard language and the differences among the dialects that have been described are large, to the extent that the tones in the declarative of one dialect may be the reverse of those in another (Köhnlein 2011). They all appear to have a privative lexical tone contrast, TA1 (TonAkzent1) versus TA2 or Accent 1 versus Accent 2, which combines with an intonation system. The contrast is located in the stressed syllable of words, but, other than in Scandinavian, the Central Franconian tone is also contrastive in word final stressed syllables (Bruce and Hermans 1999). The dialects are endangered in Belgium and Germany, while in the Netherlands the position of the dialects is relatively strong. A number of dialects have been analyzed

in an AM framework, such as Gussenhoven and van der Vliet 1999, Gussenhoven and Peters 2004, Peters 2008, and Gussenhoven 2012. De Vaan 2006 is a volume of papers on the topic.

**Bruce, G., and B. Hermans. 1999. Word tone in Germanic. In** *Word prosodic systems in the languages of Europe*. **Edited by H. van der Hulst, 605–658. Berlin: Mouton de Gruyter.**

Distributional and tonal properties of the tone contrast in East Limburgish in an autosegmental analysis, discussed against the background of the word prosodies of Swedish, Norwegian, and Danish.

**de Vaan, M., ed. 2006.** *Germanic tone accents: Proceedings of the first international workshop on Franconian tone accents, Leiden, 13–14 June 2003*. **Stuttgart: Steiner.**

Volume of papers on the Central Franconian tonal accents and related topics.

**Gussenhoven, C. 2012. Asymmetries in the intonation system of the tonal dialect of Maastricht Limburgish.** *Phonology* **29:37–77.**

There are four intonation contours but only three exist if the nuclear pitch accent occurs on a word with Accent 2. With Accent 1, two intonation contours exist in IP-final syllables, three in IP-penultimate syllables and four in earlier nuclear syllables. The account is in OT.

**Gussenhoven, C., and J. Peters. 2004. A tonal analysis of Cologne** *Schärfung*. *Phonology* **22.2: 251–285.**

Argues that the opposition between Accent 1 and Accent 2 is tonal in the Cologne dialect (D), despite strong enhancement by lengthening of Accent 2 syllables. With a moraic TBU and an underlying unspecified lexical tone.

**Gussenhoven, C., and P. van der Vliet. 1999. The phonology of tone and intonation in the Dutch dialect of Venlo.** *Journal of Linguistics* **35:99–135.**

First description in the AM-framework that separates the intonational component from the lexical tone. The dialect (Venlo, NL) has four intonation contours and a lexical H-tone.

**Köhnlein, B. 2011.** *Rule reversal revisited: Synchrony and diachrony of tone and prosodic structure in the Franconian dialect of Arzbach*. **Utrecht, The Netherlands: LOT.**

Description of the dialect of Arzbach (D), just east of the Rhine, which clarifies an observation by Adolf Bach in 1921 that the distribution of Accent 1 and Accent 2 over the words of the language is the reverse (Wiesinger's Rule B) of that found in the larger central area (Rule A). This is confirmed for declarative data only.

**Peters, J. 2008. Tone and intonation in the dialect of Hasselt.** *Linguistics* **46:983–1018.**

Description of the dialect of Hasselt (B), which has the lexical tone (a L-tone) before the intonational pitch accent and has a single intonation contour with the syllable as the TBU. Typologically, this dialect is the closest in the Central Franconian group to Stockholm Swedish.

**Schmidt, J. E. 1986.** *Die Mittelfränkischen Tonakzente: Rheinische Akzentuierung*. **Stuttgart: Franz Steiner.**

Contains a phonetically detailed description of the dialect of Mayen (D), covering both interrogative and declarative contours. Importantly, it charts out the southern boundary of the tonal area on the basis of perception data. Contains a thorough introduction and survey of previous work.

## NORWEGIAN

The interesting feature of Norwegian and Swedish is the combination of a limited lexical tone system with intonation. In research on modern Norwegian, the focus has predominantly been on the pragmatics of intonation, primarily in the work of Thorstein Fretheim and colleagues (Nilsen 1992, Fretheim and Nilsen 1989). The Norwegian and Swedish research traditions are somewhat national, but the varieties are part of the same dialect continuum and research on Swedish can profitably be read also for the understanding of Norwegian.

**Fretheim, T., and R. A. Nilsen. 1989. Terminal rise and rise-fall tunes in East Norwegian intonation.** *Nordic Journal of Linguistics* **12:155–181.**

Presentation of the Trondheim model of intonation, with particular focus on terminal contours in East Norwegian.

**Nilsen, R. A. 1992.** *Intonasjon i interaksjon: Sentrale spørsmål i norsk intonologi.* **Trondheim, Norway: Lingvistisk institutt, Univ. i Trondheim.**

General description of intonation in the best studied variety of Norwegian.

## NUBI

Arabic-lexified creole with a H* pitch accent on one of the three last syllables of the word, with predicate deaccenting due rhythmic accent shift on adjectives and accent templates in verb morphology (Gussenhoven 2006).

**Gussenhoven, C. 2006. The word prosody of Nubi: Between stress and tone.** *Phonology* **23:193–223.**

While there are many stress-like features, such as the rhythm rule and a three-syllable window, this AM account shows that accent deletion is neutralizing between accented and unaccented syllables. Default L appears between H-tones.

## PALENQUERO

Spanish-lexified creole spoken in Colombia with a H-tone on syllables that have word stress in Spanish (Hualde and Schwegler 2008).

**Hualde, J. I. and A. Schwegler. 2008. Intonation in Palenquero.** *Journal of Pidgin and Creole Languages* **23:1–31.**

Words have one H-tones syllable, other syllables being L-toned. Description of pitch contours for declarative and interrogative intonation, including an account of the Spanish and African origins of the system.

## PAPIAMENTU

Portuguese-lexified tonal creole spoken in Curaçao and Bonaire, combining stress and tone contrasts (Remijsen and van Heuven 2005).

**Remijsen, B., and V. J. van Heuven. 2005. Stress, tone and discourse prominence in the Curaçao dialect of Papiamentu.** *Phonology* **22:205–235.**

Papiamentu words have final, penultimate, or, more rarely, antepenultimate stress. In penultimate stressed syllables, a binary tone contrast distinguishes base forms and participle forms of verbs.

## PORTUGUESE

Portuguese intonation exhibits a tonal inventory with monotonal and bitonal pitch accents and boundary tones and no phrase accent. Tonal alignment is used distinctively in the contrast between H+L* (neutral declarative nucleus) and H*+L (focused declarative nucleus).

Focus is thus signaled by choice of pitch accent together with post-focal pitch range compression in the early focus cases (Frota 2000). Under tonal crowding, bitonal boundary tones (e.g., LH%) never truncate, but the segmental string is extended to accommodate tonal realization (Frota 2002). The language is characterized by a sparse pitch accent distribution with no deaccenting and long intonational phrases when compared to other Romance languages, including Brazilian Portuguese (Vigário and Frota 2003; Elordieta, et al. 2005; Fernandes 2007).

**Elordieta, G., S. Frota, and M. Vigário. 2005. Subjects, objects and intonational phrasing in Spanish and Portuguese.** *Studia Linguistica* **59.2: 110–143.**

Investigation of the role of prosodic length and syntactic complexity on the intonational phrasing patterns of Portuguese in comparison to Spanish, showing the relevance of prosodic weight in number of syllables for Portuguese phrasing.

**Fernandes, F. 2007. Tonal association in neutral and subject-narrow-focus sentences in Brazilian Portuguese: A comparison with European Portuguese.** *Journal of Portuguese Linguistics* **5.2–6.1: 91–115.**

Description of the intonation contours in neutral and narrow focus sentences in Brazilian Portuguese, including pitch accent types, pitch accent distribution, and prosodic phrasing.

**Frota, S. 2000.** *Prosody and focus in European Portuguese.* **New York: Garland.**

A detailed analysis of intonation and prosodic phrasing, including the treatment of topic and focus.

**Frota, S. 2002. Nuclear falls and rises in European Portuguese: A phonological analysis of declarative and question intonation.** *Probus* **14:113–146.**

Description of the tonal structure of nuclear contours in declarative and question intonation.

**Vigário, M., and S. Frota. 2003. The intonation of Standard and Northern European Portuguese.** *Journal of Portuguese Linguistics* **2.2: 115–137.**

The first comparative study of the intonation of varieties of European Portuguese. It compares Standard and Northern varieties with respect to the tonal inventory, pitch accent distribution, and intonational phrasing.

## SPANISH

Recent research on Spanish intonation has focused on production and perception data from a variety of sources (see Prieto and Roseano 2010 and Hualde 2002). A fair amount of work has concentrated on three issues: (1) the prosodic strategies to convey focus, (2) intonational phrasing, and (3) the phonological analysis of pitch accents. As in other Romance languages, focus is realized with distinct pitch accentuation (Face 2001). Phrasing analyses generally recognize two intonation domains. While most of the work on the phonological analysis of tunes has centered on the analysis of Central Peninsular Spanish (e.g., Prieto, et al. 1996), dialectal varieties are beginning to be analyzed with the help of a common framework of analysis (SpToBI) (Beckman, et al. 2002; Prieto and Roseano 2010).

**Beckman, M. E., M. Díaz-Campos, J. T. McGory, and T. A. Morgan. 2002. Intonation across Spanish, in the tones and break indices framework.** *Probus* **14:9–36.**

The article presents the first attempt to propose a ToBI transcription system for Spanish. It tackles some of the more salient intonational phenomena of Spanish, such as the realization of stress and the anchor point for pitch accents, phrasing levels and their realization, tonal contrasts, and the realization of focus.

**Face, T. L. 2001. Focus and early peak alignment in Spanish intonation.** *Probus* **13.2: 223–246.**

This study shows that rising accents with an early peak, that is, with the F0 maximum on the tonic syllable, correspond to a focal pitch accent in Spanish. The paper also describes other strategies to mark focus, such as F0 peak height.

**Hualde, J. I. 2002. Intonation in Spanish and the other Ibero-Romance languages: Overview and status quaestionis. In** *Romance phonology and variation: Selected papers from the 30th linguistic symposium on Romance Languages, Gainesville, Florida, February 2000.* **Edited by C. R. Wiltshire and J. Camps, 101–115. Amsterdam: John Benjamins.**

This is a summary of the literature on the analysis of Spanish and Romance intonation, focusing on three phenomena that are particularly relevant for comparing intonation across the Ibero-Romance languages, the phonological analysis of rising pitch accents, the phonological characterization of nuclear configurations in statements, and intonational phrasing.

**Prieto, P., S. Chilin, and H. Nibert. 1996. Pitch downtrend in Spanish.** *Journal of Phonetics* **24.4: 445–473.**

The scaling of H peaks in Spanish downstepping contours is examined as a function of phrasal length, temporal distance between pitch accents, phrasal position, and F0 value of preceding peak. Results show that pitch downtrends are governed by local factors (i.e., the value of the preceding peak), as neither phrasal length nor distance between pitch accents has a significant effect on peak height.

**Prieto, P., and P. Roseano, eds. 2010.** *Transcription of intonation of the Spanish language.* **Munich: Lincom Europa.**

The book provides an autosegmental description of the main Spanish dialects. Ten Spanish dialectal areas are included as chapters (Castilian and Cantabrian, Canarian, Dominican, Puerto Rican, Venezuelan Andean, Ecuadorian Andean, Chilean, Argentinean, and Mexican). A common elicitation procedure and a common transcription tool are used throughout.

SWEDISH

The particular interest of Swedish and Norwegian for the study of intonation is the presence of a limited lexical tone system. Beyond the inherent interest in how the lexical and intonational tones are negotiated in the output, the existence of two tone categories (Accent 1 and Accent 2) for each intonational category provides a rich empirical base for claims about the intonation component, compared to nontonal Germanic languages (Bruce 1977, Bruce 2007, Gårding 1979, Engstrand 1997, Myrberg 2010). The origin of the lexical tone contrast (e.g., Riad 1998) has been long debated. A comparison with German is provided in Ambrazaitis 2009. Literature on Norwegian can profitably be read also for an understanding of Swedish intonation. The research traditions are somewhat national, but the varieties are part of the same dialectology.

**Ambrazaitis, G. 2009.** *Nuclear intonation in Swedish: Evidence from experimental-phonetic studies and a comparison with German.* **Travaux de l'Institut de linguistique de Lund 49. Lund, Sweden: Department of Linguistics and Phonetics, Centre for Languages and Literature, Lund Univ.**

Swedish is often taken as having a rather simple intonation system, kept in check by the word accents. This is challenged by Ambrazaitis. Swedish is systematically compared with German.

**Bruce, G. 1977.** *Swedish word accents in sentence perspective.* **Lund, Sweden: Liber Läromedel.**

In many respects, this work is a forerunner to modern autosegmental descriptions of intonation, in particular in its sequential conception of the lexical tones and the intonation tones. Gives a basic and insightful description of the two word accents and how they are realized in two intonational conditions (called accented and focal).

**Bruce, G. 2007. Components of a prosodic typology of Swedish intonation. In** *Typological studies in word and sentence prosody.* **Vol. 1 of** *Tones and tunes.* **Edited by T. Riad and C. Gussenhoven, 114–145. Berlin: Mouton de Gruyter.**

Description of several varieties of Swedish, with a typology of Swedish prosody.

**Engstrand, O. 1997. Phonetic interpretation of the word accent contrast in Swedish: Evidence from spontaneous speech.** *Phonetica* **54:61–75.**

Contribution to the discussion of the markedness and tonal representation of word accents. Critical of Bruce's equipollent representation.

**Gårding, E. 1979. Sentence intonation in Swedish.** *Phonetica* **36.3: 207–215.**

Early study of Swedish sentence intonation using accent contours superimposed on f0 grids focusing on the difference between statements and questions.

**Myrberg, S. 2010.** *The intonational phonology of Stockholm Swedish.* **Acta Universitatis Stockholmiensis, Stockholm studies in Scandinavian philology 53. Stockholm: Stockholm Univ.**

The most complete analysis of Swedish intonation and its relation to syntax. Myrberg discusses the initiality accent and the head accents in two prominence levels (corresponding to Bruce's accented and focal).

**Riad, T. 1998. The origin of Scandinavian tone accents.** *I: Diachronica* **15.1: 63–98.**

Proposal about the origin of the Scandinavian lexical tone contrast, which is based on a reinterpretation as lexical tone of a pitch peak originally due to post-primary secondary stress.

**WEST GREENLANDIC**

West Greenlandic exhibits a typologically significant expression of interrogative intonation through phrasal suffix in the form of a mora (Rischel 1974). Phonetic details are given in Jacobsen 2000.

**Jacobsen, B. 2000. The question of "stress" in West Greenlandic: An acoustic investigation of rhythmicization, intonation, and syllable weight.** *Phonetica* **57.1: 40–67.**

Gives the phonetic details, while keeping the issue open between a durational and a tonal analysis.

**Rischel, J. 1974.** *Topics in West Greenlandic phonology.* **Copenhagen: Akademisk Forlag.**

Analysis of interrogative intonation as a phrase-level suffix consisting of a mora. The tone associations shift one mora to the right relative to declarative intonation as a result, causing surface differences in pitch contour.

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