

MIT OpenCourseWare  
<http://ocw.mit.edu>

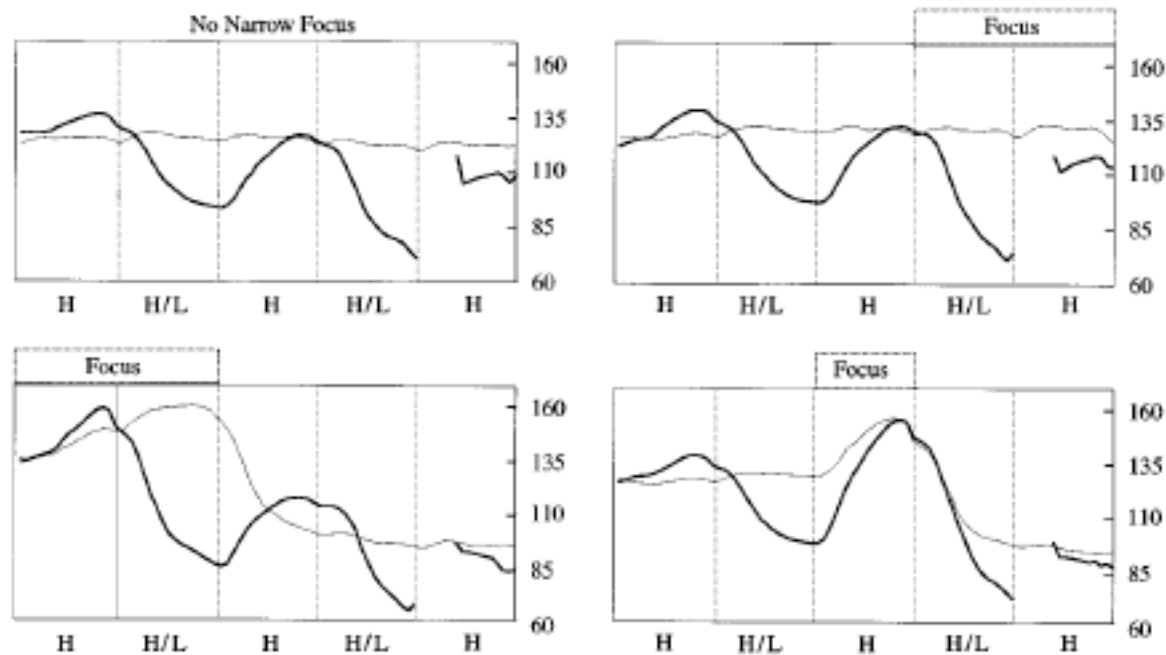
24.910 Topics in Linguistic Theory: Laboratory Phonology  
Spring 2007

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.

# 24.910

## Laboratory Phonology

# The Meaning of Intonation



Courtesy Elsevier, Inc., <http://www.sciencedirect.com>. Used with permission.

Source: Xu, Yi. "Effects of Tone and Focus on the Formation and Alignment of  $f_{sub\ 0}$  Contours." *Journal of Phonetics* 27 (1999): 55-105.

## Readings:

- ToBI tutorial 2.6, 2.7, Welby (2003)

## Assignments:

- ToBI transcription/investigating focus marking.
- Run 2 subjects for perception experiment.

# The meaning of intonation

- Pierrehumbert and Hirschberg (1990): intonation marks the way that the propositional content of an utterance relates to an evolving ‘discourse model’ or set of ‘mutual beliefs’
- This includes marking ‘information status’ of parts of an utterance
  - given/new
  - focus/background
  - contrast

## Given/New

- Given: previously mentioned (accessible).
- New: not previously mentioned (or less accessible).
- It is often suggested that New information tends to be accented, while Given information tends to be unaccented.

- (1)      a. I found an article for you in a German journal.  
            b. I don't READ German.

- (2) I brought her a bottle of whisky, but it turns out she doesn't LIKE whisky.

- More accurate: Given information can be unaccented.

## Information conveyed by prosody - Focus

- Focus - “the informative part of an utterance”.
- ‘the information in the sentence that is assumed by the speaker not to be shared by him and the hearer’ (Jackendoff 1972).
- Presupposition (aka Ground, Background): ‘the information in the sentence that is assumed by the speaker to be shared by him and the hearer’ (Jackendoff 1972).
  - NB substantial overlap with Given/New partition on this view.
- Focus is marked by accentuation.

# Focus

The focus/background distinction is clearest in answers to WH-questions:

- Question-answer congruence:
  - A. What newspaper do you read?
  - B. I read the DISPATCH.
  - C. \*I READ the Dispatch.
  
- 1. Who did Annabel marry?
- 2. Annabel married MALONEY.
  
- 1. Who married Maloney?
- 2. ANNABEL married Maloney.

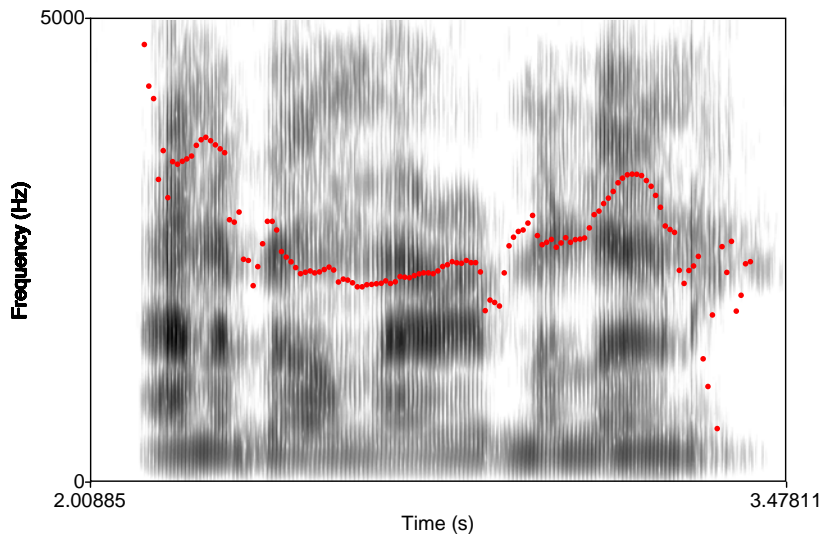
## Focus

- The same concept of focus is claimed to interact with the meaning of focus sensitive particles
  - A. John only gave Bill MONEY.
  - B. John only gave BILL money.
- Other focus sensitive particles: just, too, even, always.
- What is the prosody denoted by CAPITALIZATION? I.e. how is focus marked?




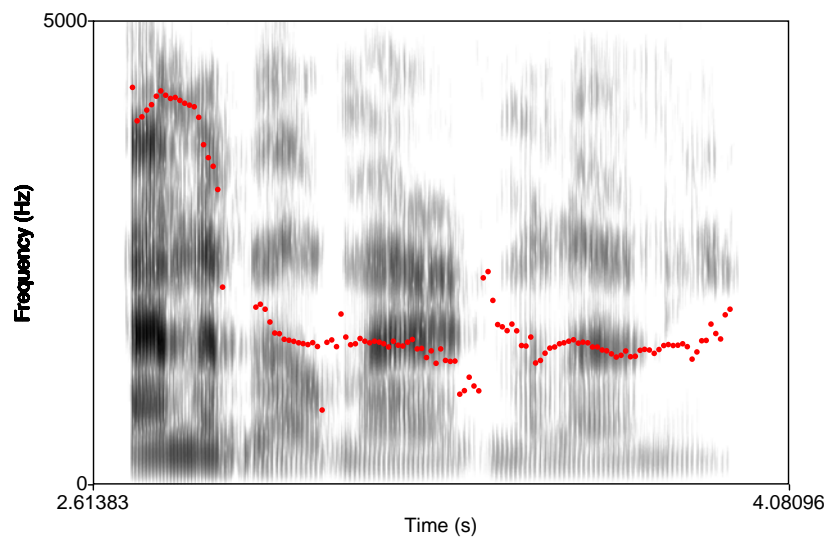
Broad focus:  
'what happened'

Audio: [1\\_broad.wav](#) 



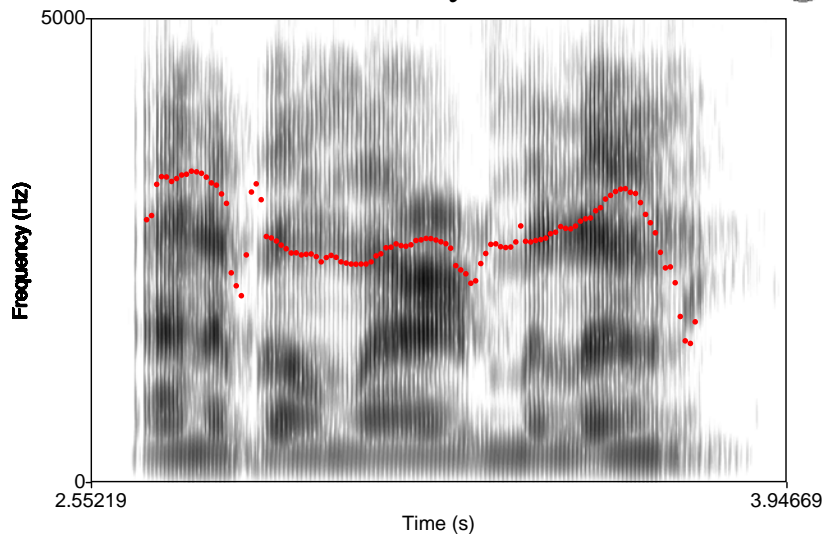
Subject focus:  
'who married Maloney?'

Audio: [1\\_subj.wav](#) 




Object focus:  
'Who did Annabel marry?'

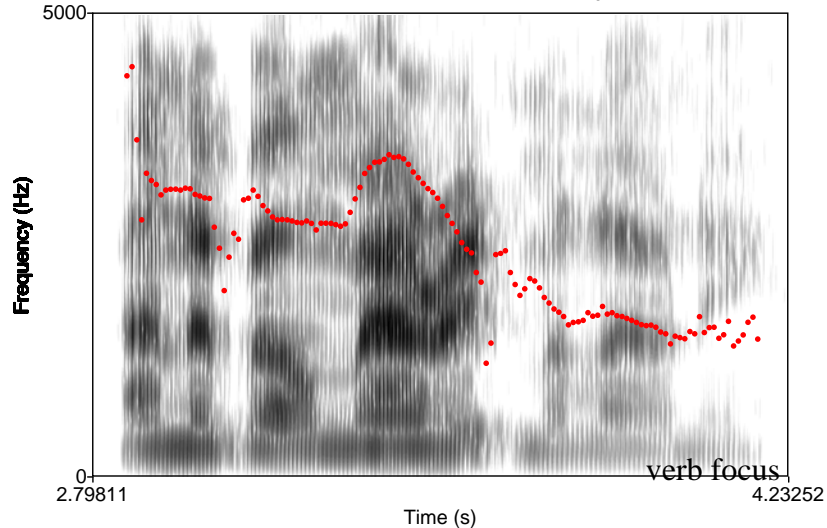
Audio: [1\\_obj.wav](#) 



Annabel married Maloney

Verb focus:  
'what did Annabel do to Maloney?'

Audio: [1\\_verb.wav](#) 



Annabel married Maloney

# Focus Marking

How is focus marked prosodically?

- It is clear that focused constituents contain pitch accents.
- But non-focused elements can bear pitch accents also.

Who did Annabel marry?

H\*                      H\*L-L%

Annabel married Maloney.

- Hypothesis: focus is marked by a nuclear pitch accent.
  - The last pitch accent in a phrase, followed by a phrase accent.

Who married Maloney?

H\*                      L-L%    H\*                      H\*L-L%

Annabel married Maloney.    ?Annabel married Maloney.

- But do *all* nuclear accents mark focus?

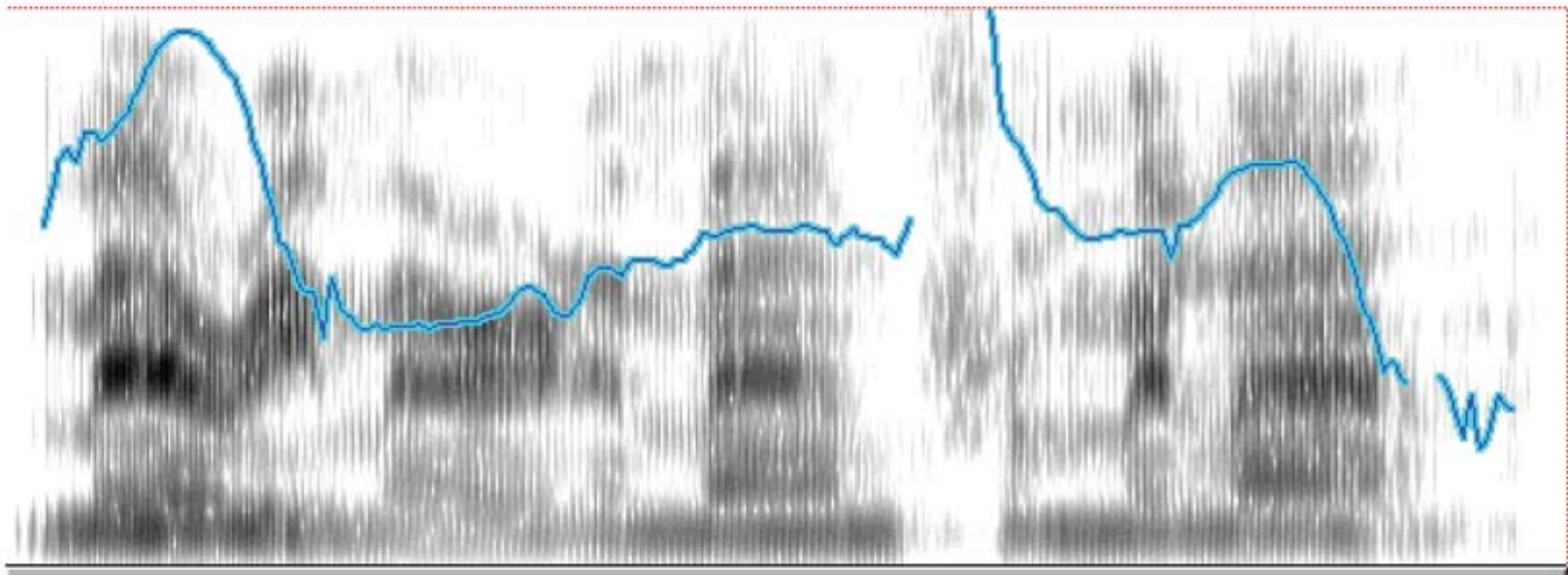
# Nuclear accents and focus

Who did Mary marry?

Mary married a man from Milan.



Listen:  
[8\\_mary.wav](#)



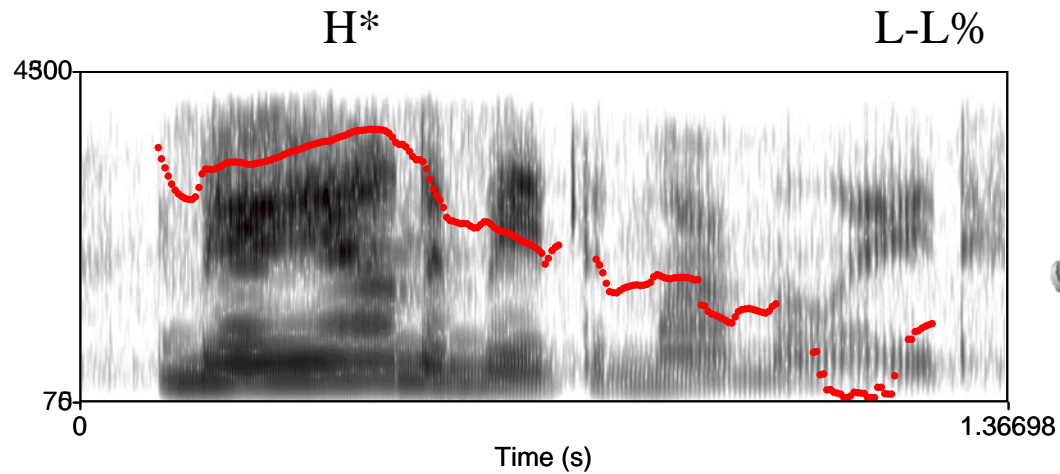
# Topic/Contrast

(L+)H\*L-                      H\*                      H\*L-L%

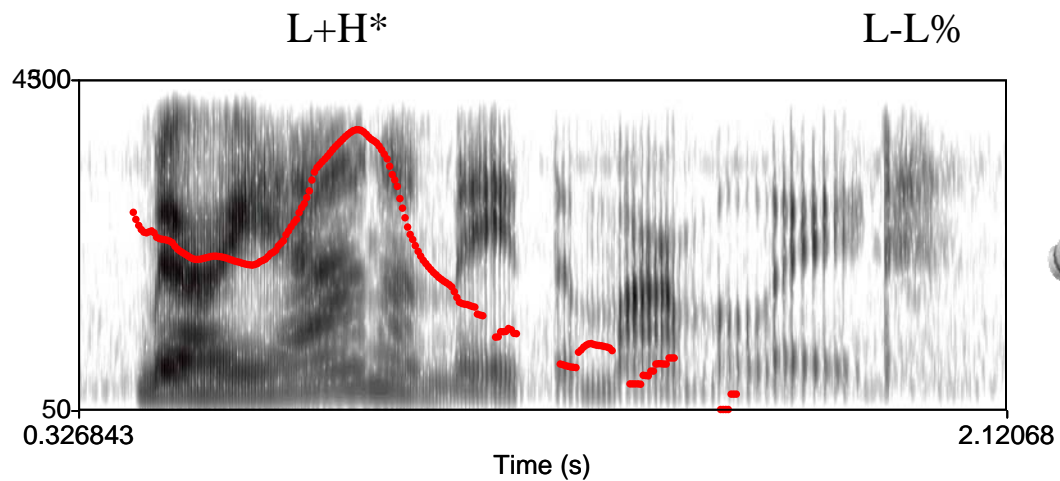
Mary married a man from Milan

- ‘Mary’ is Background and Given, so why does it get a nuclear accent?
- It has been suggested that accentuation is also used to mark Topics - the topic under discussion (cf. Jackendoff 1972).
  - ‘Mary’ is plausibly the topic here.
  - ‘What about Mary, who did she marry?’
- But not all topics get (nuclear) accents - see Obj & V focus above.
- Alternative hypothesis: Accent is used to mark contrast with particular alternatives (usually explicitly mentioned).
  - E.g. we’re talking about Jan’s daughters, Mary, Alex & Phyllis and who they got married to.
- Specifically claimed that L+H\* marks contrast (e.g. Pierrehumbert & Hirshberg 1990)

# Contrast



Listen:  
[8\\_marmelade2.wav](#)



Listen:  
[8\\_marmelade5.wav](#)

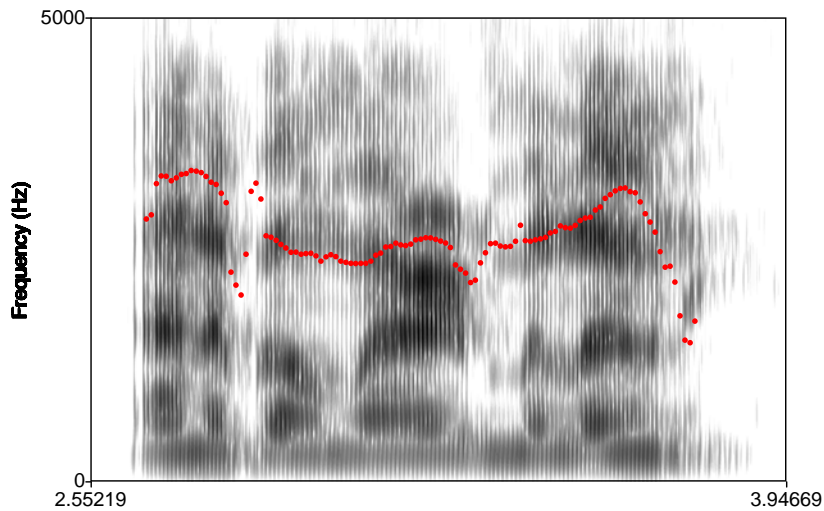
## Focused constituents

- Semantically, focus can be a constituent, not just a word.  
Q1: How do you keep up with the news?  
Q2: What newspaper do you read?  
A: I [read the [DISPATCH.]<sub>F2</sub>]<sub>F1</sub>
- It is often claimed that a constituent is marked as focused by placing a pitch accent on the strongest stress in the phrase - usually the last content word (cf. Jackendoff 1972, Selkirk 1995).
  - ‘focus projection’
  - in particular, a transitive VP can be marked as focused by placing a (nuclear) pitch accent on the object.
- So a sentence like A should be ambiguous with respect to the scope of focus (object vs. VP (vs. sentence?)).

# Focused constituents

Object focus:

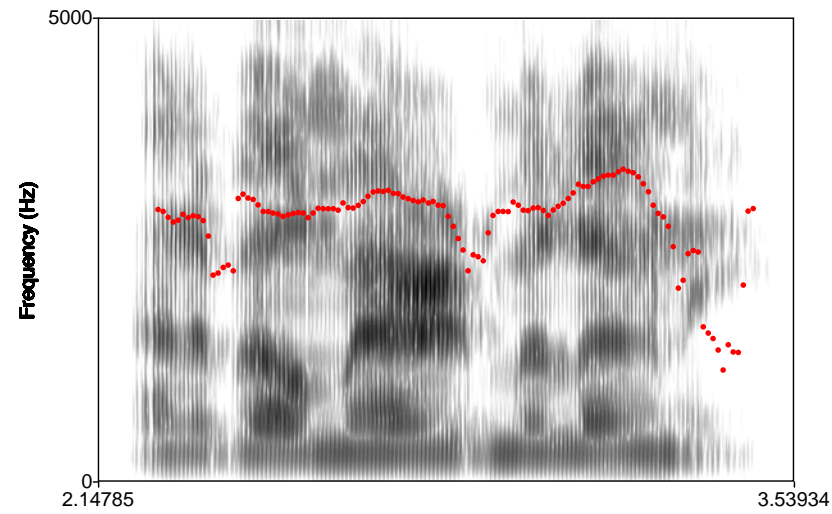
‘Who did Annabel marry?’



Listen:  
[1\\_obj.wav](#)

VP focus:

‘what did Annabel do?’



Listen:  
[8\\_vp.wav](#)

## Summary of hypotheses

- Focus is marked by pitch accents.
  - Focus is marked by a nuclear accent.
    - Prenuclear accents do not mark focus.
    - All nuclear accents mark focus.
    - Can all types of pitch accents mark focus?
  - Focus projection: accenting an object can mark the whole VP as focussed.
- (Explicit) contrast is marked by L+H\*
- Only Given material can be deaccented.
- Relatively little evidence.



# Focus - production studies

- Few production studies of focus realization that provide full analyses of the intonation contours.
- Cooper, Eady and colleagues have published several studies that report peak f0 and durations of key words under various focus conditions.
- Cooper, Eady and Mueller (1985) examined contrastive focus elicited by questions about explicit alternatives, e.g.

Chuck liked the present that Shirley sent to her sister.

- (A) **Did William or Chuck like the present that Shirley sent to her sister?**
- (B) **Did Chuck like the letter or the present that Shirley sent to her sister?**
- (C) **Did Chuck like the present that Melanie sent to her sister or the one that Shirley sent?**
- (D) **Did Chuck like the present that Shirley sent to her sister or the one she sent to her brother?**

Excerpted from Cooper, William E., Stephen J. Eady, and Pamela Mueller. "Acoustical Aspects of Contrastive Stress in Question-answer Contexts." *Journal of the Acoustic Society of America* 77, no. 6 (June 1985).

# Cooper, Eady and Mueller (1985)

- Subjects read sentences as answers to pre-recorded questions.
- Subjects were asked to repeat an item if experimenter judged that contrastive focus had not been placed appropriately ('rarely').
- Measured duration and peak f0 in each key word.

- No broad focus condition
- Pre-focal words appear to be accented although given.
- Post-focus f0 is similar across conditions, and looks unaccented.
- Can't determine accent type.

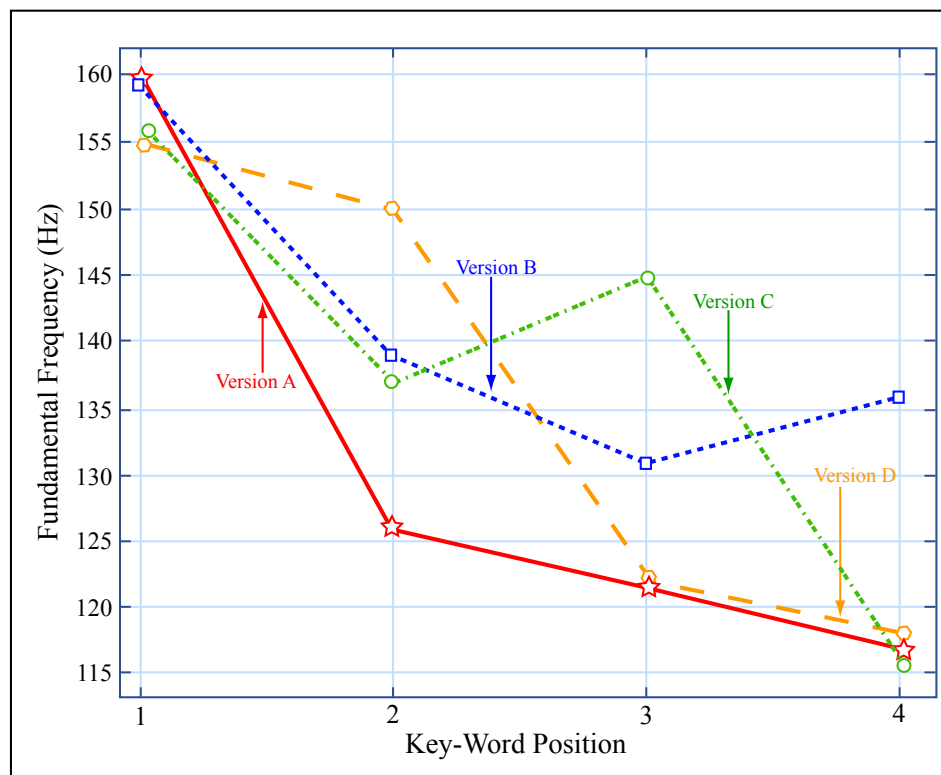


Figure by MIT OpenCourseWare. Adapted from Excerpted form Cooper, William E., Stephen J. Eady, and Pamela Mueller. "Acoustical Aspects of Contrastive Stress in Question-Answer Contexts." *Journal of the Acoustic Society of America* 77, no. 6 (June 1985).

# Cooper, Eady and Mueller (1985)

- Experiment 2 used a similar method, but with longer answers and a 'neutral' condition: sentences read without context.

My *sister* took the *trolley* from *school* to the *store* to buy *fish* and *chips* on *Tuesday*.

- (A) **Did your sister or your brother take the trolley from school to the store to buy fish and chips on Tuesday?**
- (B) **Did your sister take the trolley from school to the store or from school to the restaurant to buy fish and chips on Tuesday?**
- (C) **Did your sister take the trolley from school to the store to buy fish and chips on Tuesday or on Friday?**

Excerpted from Cooper, William E., Stephen J. Eady, and Pamela Mueller. "Acoustical Aspects of Contrastive Stress in Question-answer Contexts." *Journal of the Acoustic Society of America* 77, no. 6 (June 1985).

# Cooper, Eady and Mueller (1985)

- No significant differences between broad focus (N) and words up to and including focus in A,B,C.
- Final focus (C) is not distinct from broad focus (N) by peak f0 (as claimed by Jackendoff, Selkirk)
- Final word is longer under narrow focus (C) than broad focus (N).
- Post-focus f0 is similar in A,B and looks unaccented.

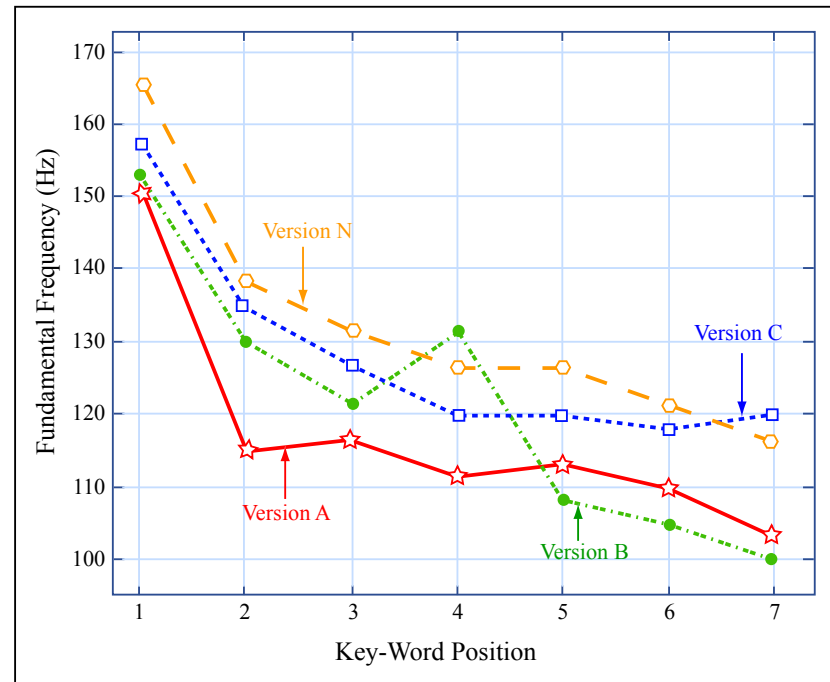


Figure by MIT OpenCourseWare. Adapted from Excerpted form Cooper, William E., Stephen J. Eady, and Pamela Mueller. "Acoustical Aspects of Contrastive Stress in Question-Answer Contexts." *Journal of the Acoustic Society of America* 77, no. 6 (June 1985).

# Welby (2003)

- Experiment 1 materials: Recorded question-answer pairs.
- Two questions:
  - Object-NP focus, e.g. ‘What newspaper do you read?’
  - VP focus, e.g. ‘How do you keep up with the news?’
- Four versions of each answer (below).
  - 48 Q/A pairs, 2 versions of each question \* 4 versions of each answer
- Subjects rated the appropriateness of answers on a 5 point scale.
  - 80 subjects. Each heard each Q/A pair in one condition.

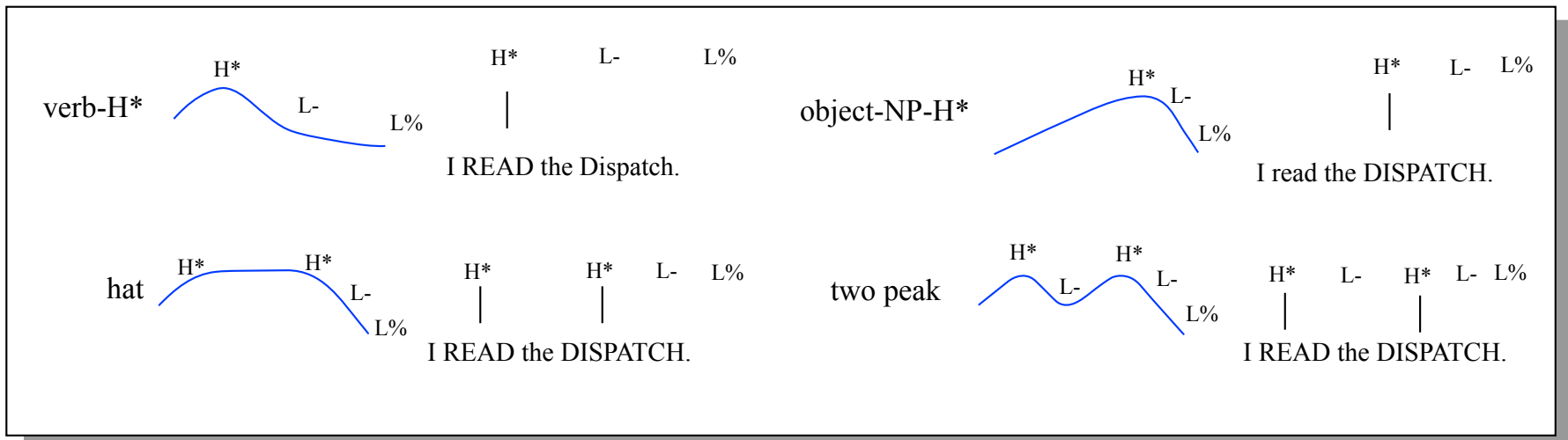


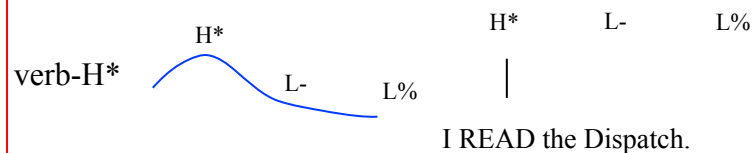
Figure by MIT OpenCourseWare. Adapted from Welby, Pauline. "Effects of Pitch Accent Type and Status on Focus Projection." *Language and Speech* 46, no. 1 (2003): 53-81.

## Welby (2003) - predictions

- Object-NP focus, e.g. ‘What newspaper do you read?’
- VP focus, e.g. ‘How do you keep up with the news?’

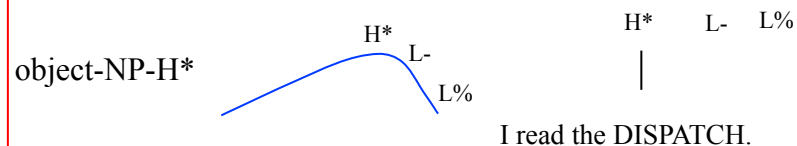
Obj: Bad - no accent on Obj

VP: Bad - projection impossible

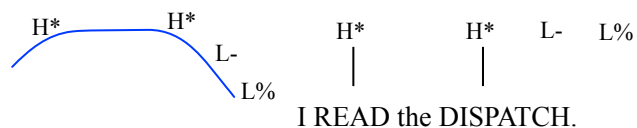


Obj: Should be good

VP: Good if projection is OK



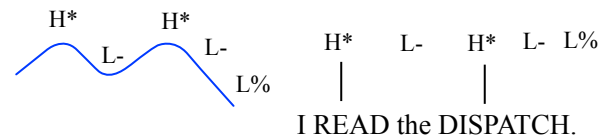
hat



Obj: OK if only nuclear accents mark focus.

VP: OK

two peak



Obj: Bad if nuclear accents mark focus.

VP: OK

# Welby (2003)

- Sample f0 tracks of answers.
- Recorded by one speaker.

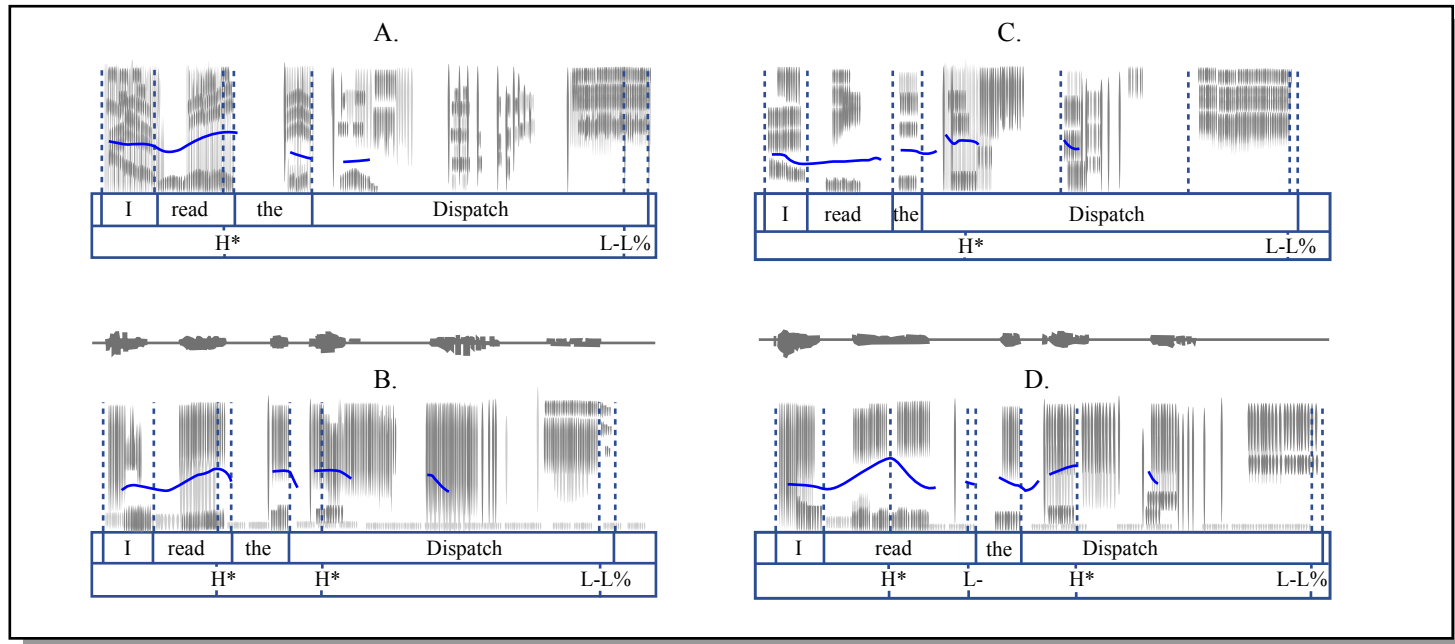
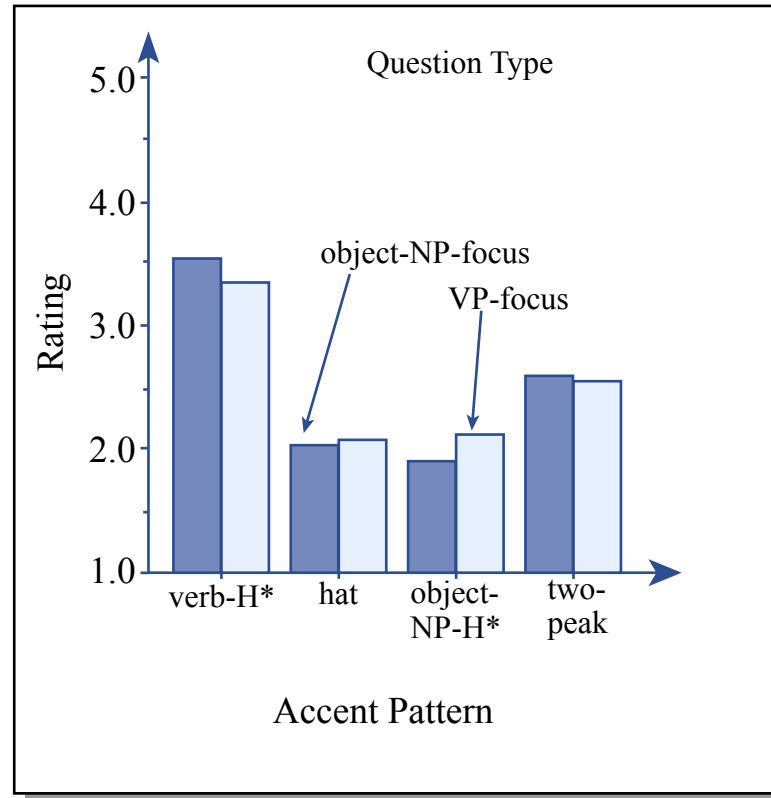


Figure by MIT OpenCourseWare. Adapted from Welby, Pauline. "Effects of Pitch Accent Type and Status on Focus Projection." *Language and Speech* 46, no. 1 (2003): 53-81.

# Welby (2003)

Results (1 is best, 5 is worst):

- all accent patterns are equally acceptable whether focus is on VP or NP
- $H^*L-H^*$ , object  $H^* < \text{two-peak} < \text{verb-}H^*$





# Welby (2003) - results

- Object-NP focus, e.g. ‘What newspaper do you read?’
- VP focus, e.g. ‘How do you keep up with the news?’

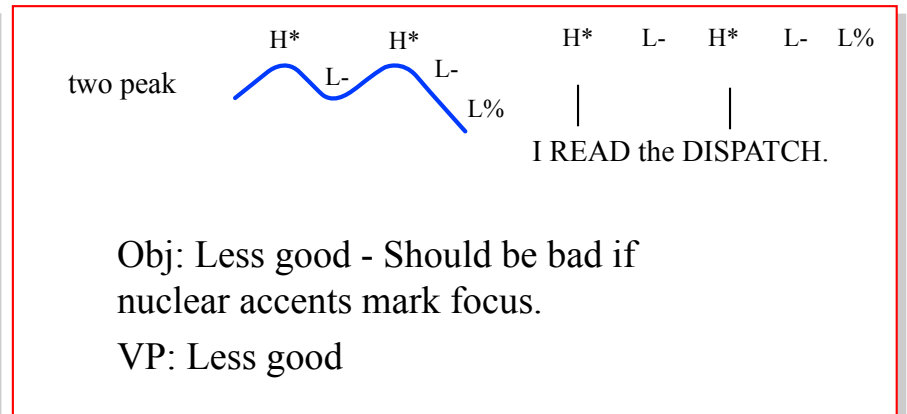
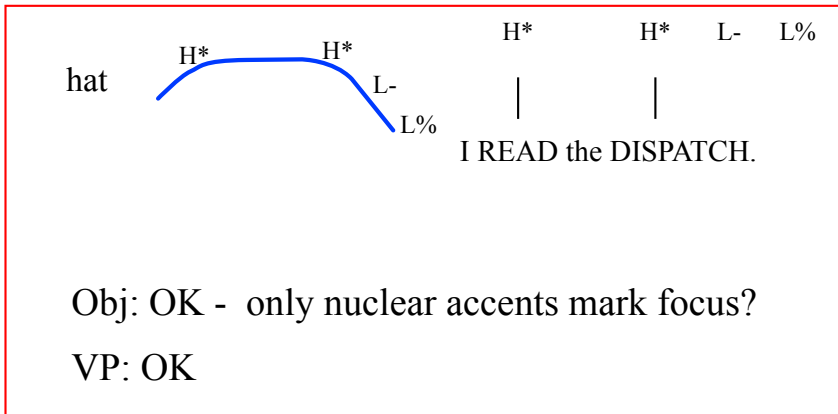
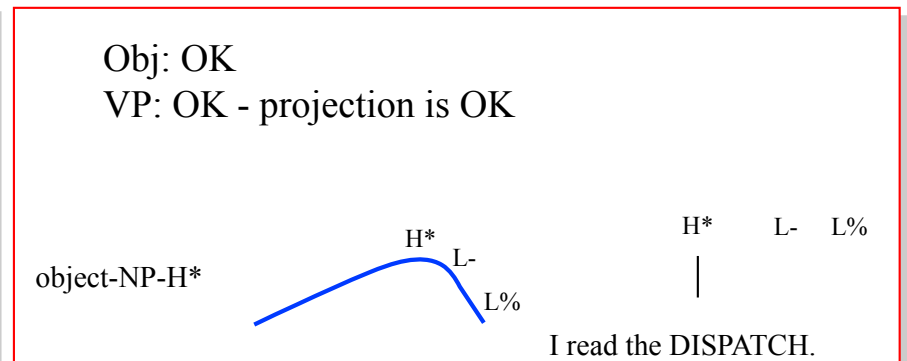
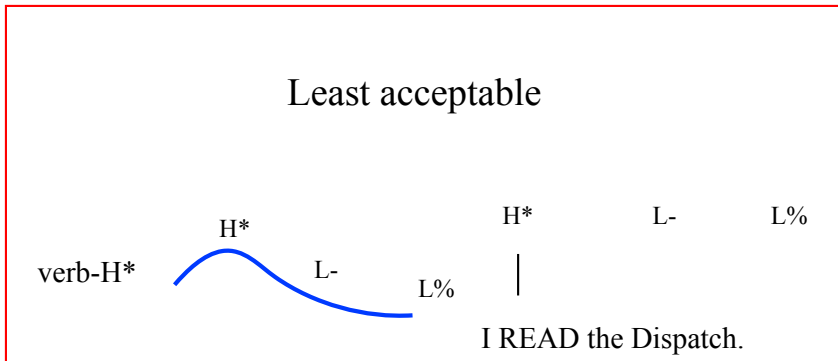


Figure by MIT OpenCourseWare. Adapted from Welby, Pauline. "Effects of Pitch Accent Type and Status on Focus Projection." *Language and Speech* 46, no. 1 (2003): 53-81.

## Welby (2003) - results

- Hypothesis: Two peak answer is not appropriate for VP focus, it is a double focus.
  - ‘I write for the Times but I READ the DISPATCH’.
- So it may be the case that only nuclear accents mark focus - it is the details of focus marking of constituents that need clarification.
- Production studies needed!

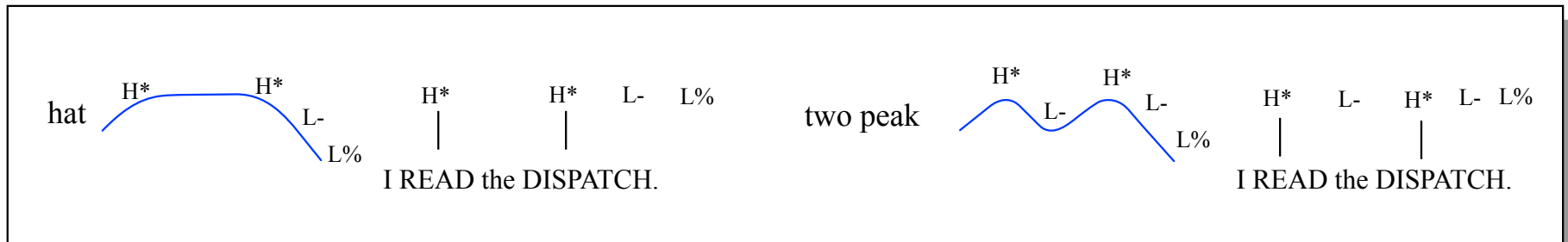


Figure by MIT OpenCourseWare. Adapted from Welby, Pauline. "Effects of Pitch Accent Type and Status on Focus Projection." *Language and Speech* 46, no. 1 (2003): 53-81.

# Summary

- Pierrehumbert and Hirschberg (1990): intonation marks the way that the propositional content of an utterance relates to an evolving ‘discourse model’ or set of ‘mutual beliefs’
- This includes marking ‘information status’ of parts of an utterance
  - focus/background
  - contrast
- Many of the specifics remain unclear. Need:
  - Production studies - what intonation do people use in different contexts?
  - Perception studies - what meaning do people extract from different intonation contours?

# Cross-linguistic variation in prosody

Prosodic resources used in English:

- Pitch accents
  - Placement
  - Type
- Phrasing
- Boundary tones
- Pitch range (accents, phrases).

Not all languages make use of all of these resources, and there appear differences in the roles of these resources in signaling meaning.

# Cross-linguistic variation in prosody

Survey selected languages that illustrate some of these differences, concentrating on:

- Mandarin Chinese - no pitch accents, no boundary tones?
- Korean - no pitch accents.
- Revisit the role of pitch range in English in light of its importance in languages without pitch accents.

# Mandarin Chinese Intonation

- How does intonation work in languages with lexical tone?

## Mandarin Chinese

- 4 contrasting tones distinguish words

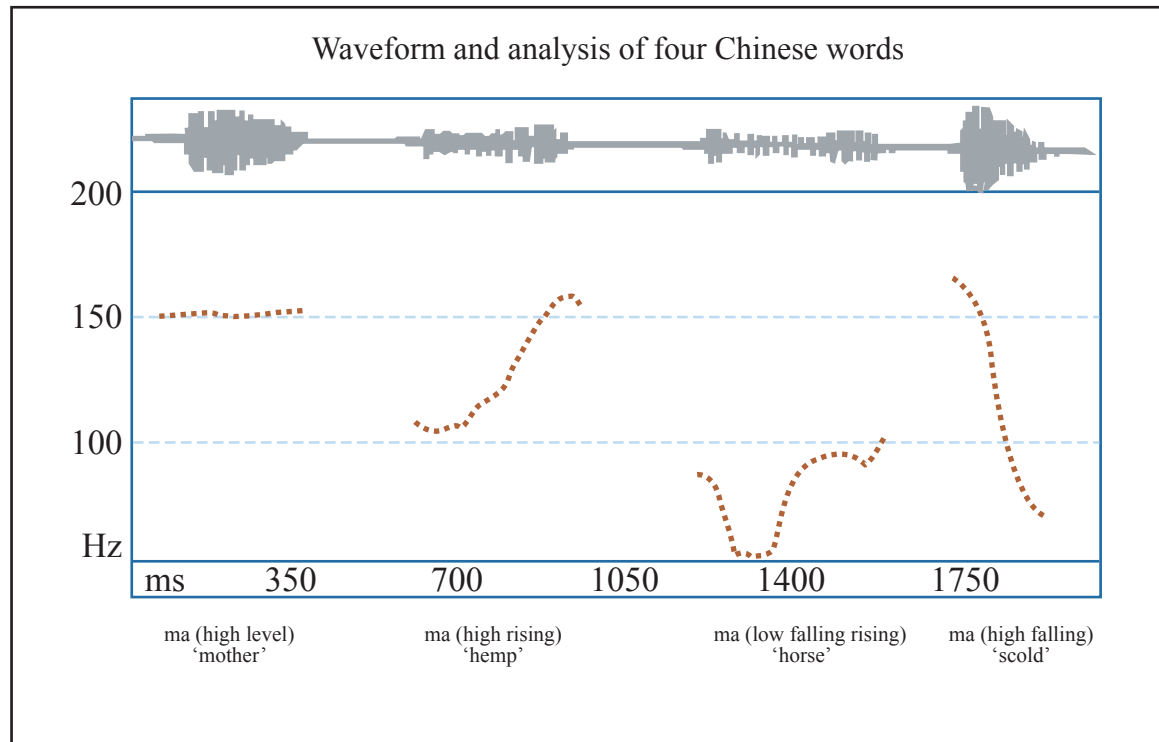


Figure by MIT OpenCourseWare.

# Mandarin Chinese Intonation

- Every syllable has a lexical tone (with the possible exception of ‘neutral tone’ syllables).
- Unsurprisingly, there are no pitch accents.
- It is not clear that there are boundary tones.

# Focus intonation in Mandarin Chinese

- Xu (1999) elicited sentences with focus on different words by providing questions as context and underlining narrow focus item. E.g.

## Questions preceding the target sentences

Māomǐ gàn má ne?	(What is kitty doing?)	VP focus
Shéi mō māomǐ?	(Who is touching kitty?)	Subj focus
Maōmǐ zěnmō nòng māomǐ?	(What is kitty doing to kitty?)	V focus
Maōmǐ mō shénmō?	(What is kitty touching?)	Obj focus

Figure by MIT OpenCourseWare.

Word 1	Word 2	Word 3
<b>HH</b> māomǐ 'kitty'	<b>H</b> mō 'touches'	<b>HH</b> māomǐ 'kitty'
<b>HR</b> māomǐ 'cat-fan'	<b>R</b> ná 'takes'	<b>LH</b> mǎdāo 'sabre'
<b>HL</b> māomǐ 'cat-rice'	<b>F</b> mài 'sells'	
<b>HF</b> māomǐ 'cat-honey'		

Figure by MIT OpenCourseWare.



# Focus intonation in Mandarin Chinese

- Focus is implemented as variations in the local pitch range in which lexical tones are realized.
  - Non-final focused words: expanded pitch range
  - Post-focus words: lowered, compressed pitch range
  - Pre-focus, final focus: ‘neutral’ pitch range

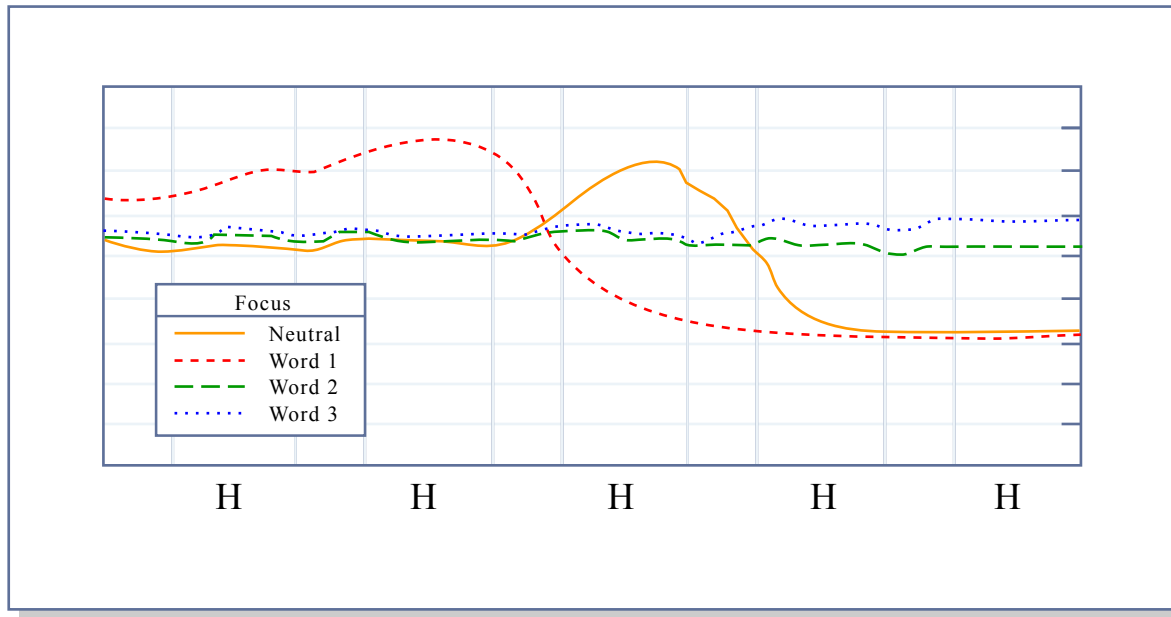
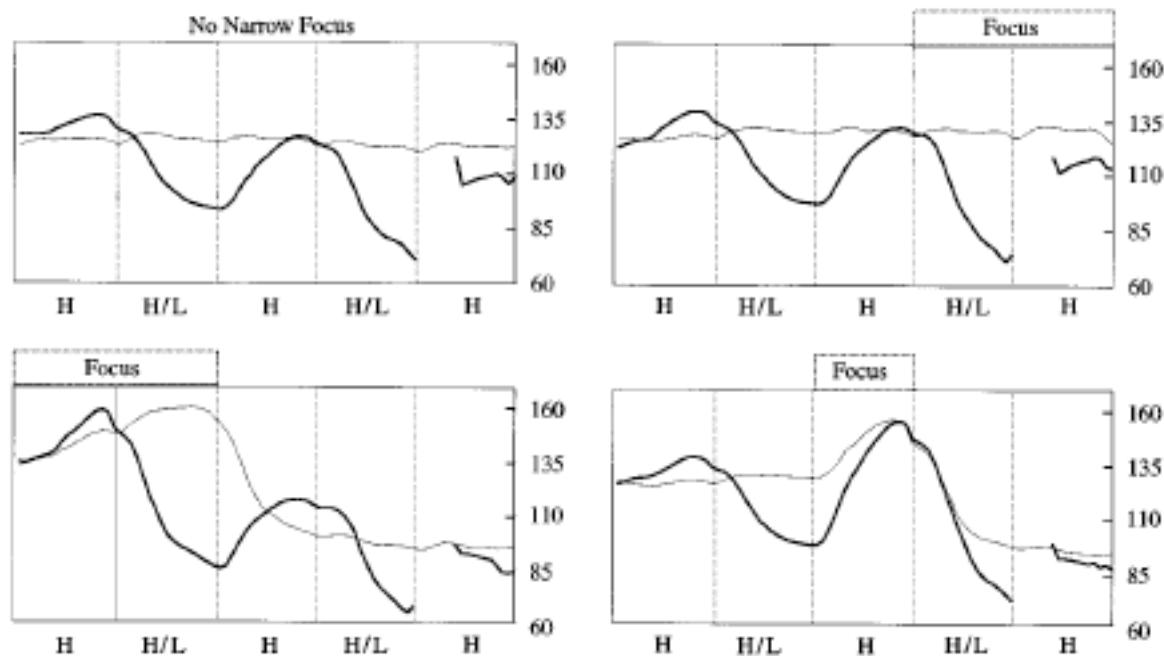


Figure by MIT OpenCourseWare.

# Focus intonation in Mandarin Chinese

- Focus is implemented as variations in the local pitch range in which lexical tones are realized.
  - Non-final focused words: expanded pitch range
  - Post-focus words: lowered, compressed pitch range
  - Pre-focus, final focus: ‘neutral’ pitch range



Courtesy Elsevier, Inc., <http://www.sciencedirect.com>. Used with permission.

Source: Xu, Yi. "Effects of Tone and Focus on the Formation and Alignment of  $f_{sub_0}$  Contours." *Journal of Phonetics* 27 (1999): 55-105.

# Focus intonation in Mandarin Chinese

Examples from Peng et al (2001):

Images and audio files removed due to copyright restrictions.

Please see: Peng, Shu-hui, Marjorie K. M. Chan, Chiu-yu Tseng, Tsan Huang, Ok Joo Lee, and Mary E. Beckman. "Towards a Pan-Mandarin System for Prosodic Transcription." In *Prosodic Typology: The Phonology of Intonation and Phrasing*. Edited by Sun-Ah Jun. New York, NY: Oxford University Press, 2005, pp. 230-270.

Figure 11.3. (a) Putonghua utterance of sentence *Wèi Lì mài là ròu*. 'Wei Li sells (Chinese) bacon.' as a statement with narrow focus on *Wèi Lì*  
(b) The same sentence uttered as an "out of the blue" statement with broad focus.

# Examples from Peng et al (2001):

Images removed due to copyright restrictions.

Please see: Peng, Shu-hui, Marjorie K. M. Chan, Chiu-yu Tseng, Tsan Huang, Ok Joo Lee, and Mary E. Beckman. "Towards a Pan-Mandarin System for Prosodic Transcription." In *Prosodic Typology: The Phonology of Intonation and Phrasing*. Edited by Sun-Ah Jun. New York, NY: Oxford University Press, 2005, pp. 230-270.

## Focus intonation in Mandarin Chinese

- Focus is also marked by duration: Word is longer when narrowly focused, compared to neutral/non-focused realizations.
- Compression of pitch range following focus is comparable to post-nuclear deaccenting in English.
- It also seems to be common cross-linguistically.
- Could English ‘deaccenting’ actually be pitch range compression?

# Declarative/Interrogative intonation in Mandarin

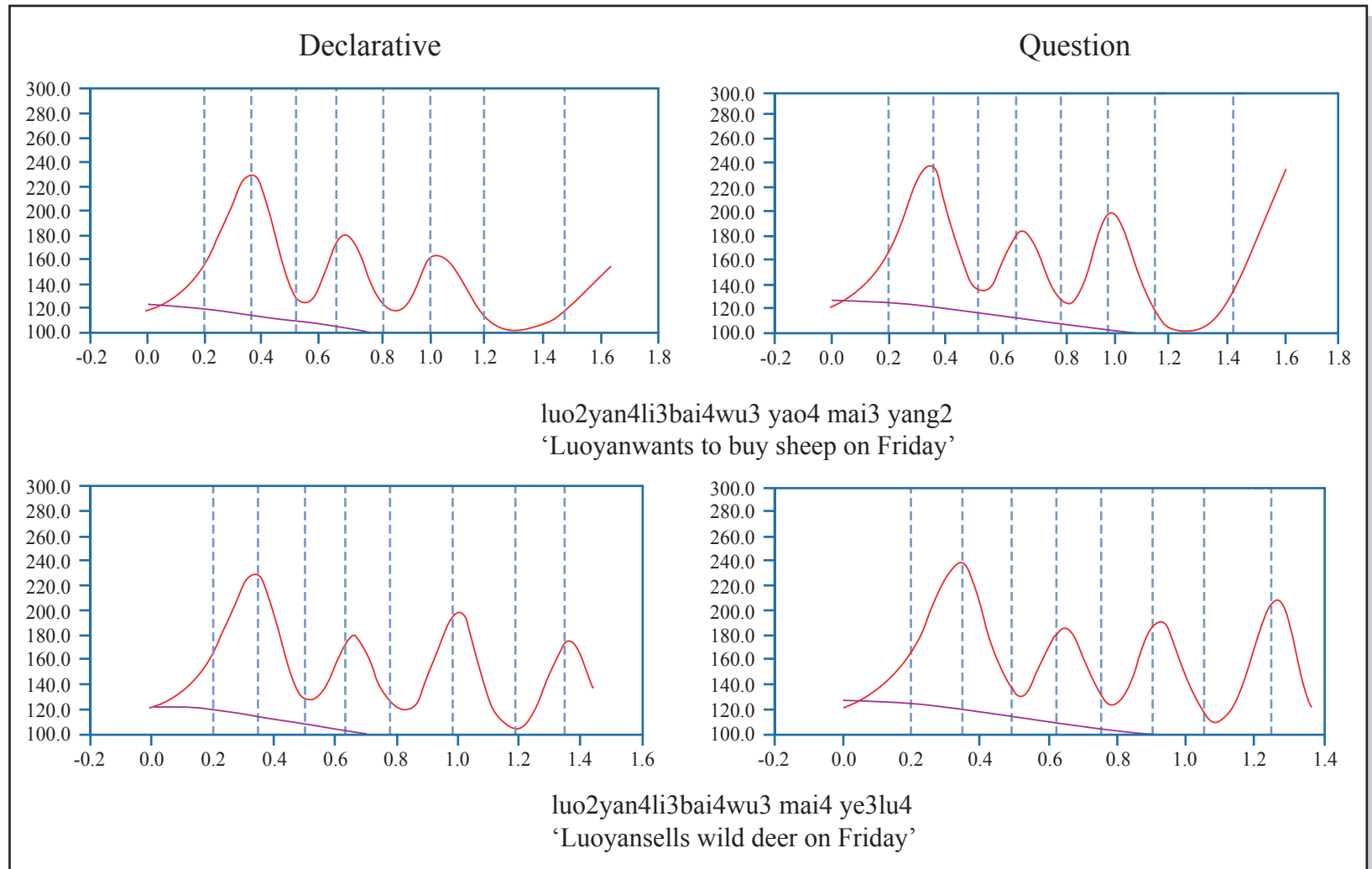
- Interrogatives can be distinguished from declaratives by global pitch range effects (Garding 1985, 1987, Yuan et al 2002, etc). (Examples from Peng et al 2001).

Images removed due to copyright restrictions.

Please see: Peng, Shu-hui, Marjorie K.M. Chan, Chiu-yu Tseng, Tsan Huang, Ok Joo Lee, and Mary E. Beckman. "Towards a Pan-Mandarin System for Prosodic Transcription." In *Prosodic Typology: The Phonology of Intonation and Phrasing*. Edited by Sun-Ah Jun. New York, NY: Oxford University Press, 2005, pp. 230-270.

# Declarative/Interrogative intonation in Mandarin

- Yuan et al 2002 analyzed matched declarative and interrogative sentences (indicated by punctuation).



# Declarative/Interrogative intonation

Higher pitch range and/or less downdrift differentiate questions from statements in a number of languages:

- in Hausa H is downstepped following L in statements, but not in questions (Inkelas and Leben 1990).
- Chichewa: questions have higher pitch range and less downdrift of H than statements (Myers 1996).

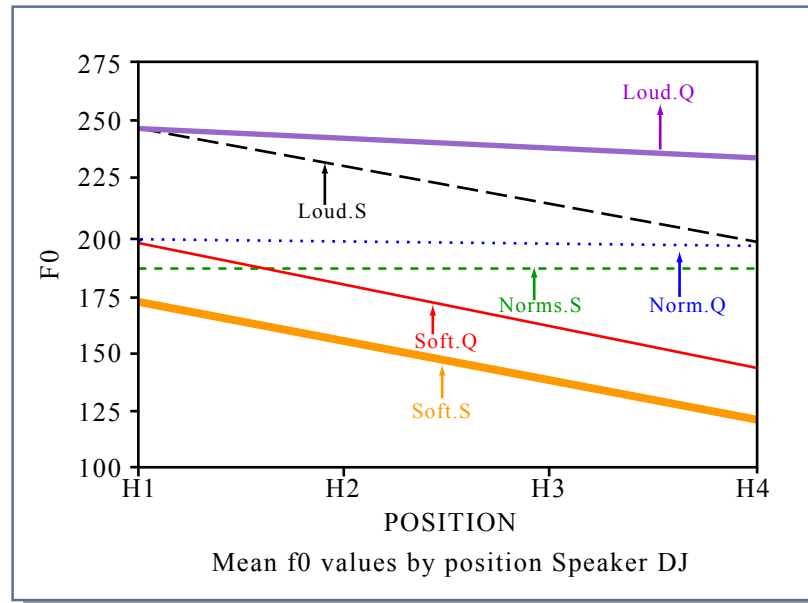


Figure by MIT OpenCourseWare.



# Pitch range in intonation

- These phenomena suggest that pitch range is central to intonation in many languages.
- Pitch range is treated as a continuous variable, independent of the tone sequence in Pierrehumbert 1980 and is not transcribed in AmE\_ToBI.
- The preliminary M\_ToBI (pan-Mandarin) transcription system proposed by Peng et al (2001) includes labels for pitch range effects:
  - %q-raise - ‘flat raised pitch range regularly seen in echo questions’
  - %e-prom - ‘local expansion of pitch range due to emphatic prominence’
  - %compressed - ‘reduction of pitch range’ (e.g. following focus).

# Korean Intonation

- The intonation of Seoul Korean has been studied in detail (e.g. S. Jun 1996, 1998), and there is also work on a number of other dialects.
- Seoul Korean lacks lexical tone, but also does not have intonational pitch accents - intonation is phrase-based.
- Description based on K\_ToBI (S. Jun 2000).

# Korean Intonation

Two prosodic constituents:

- Accentual Phrase
  - generally a lexical item plus a case marker or postpositions
  - marked by a melody: THLH (T=H if the AP initial segment is aspirated or tense, T=L otherwise)
- Intonation Phrase
  - consists of one or more APs
  - marked by final lengthening and a boundary tone.

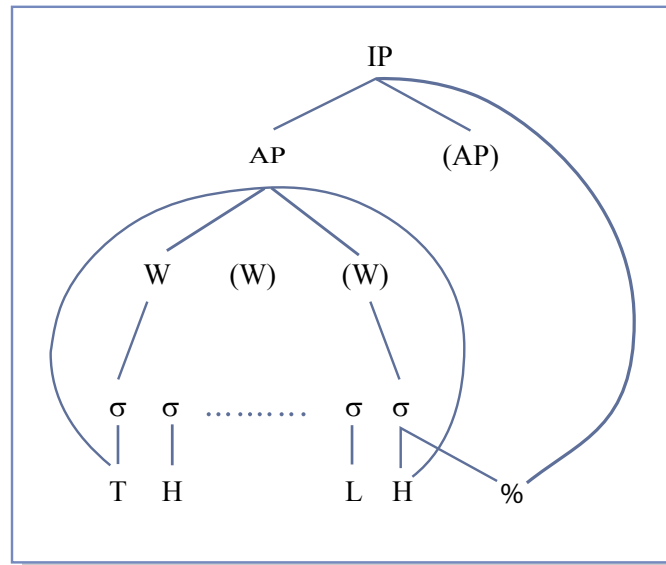
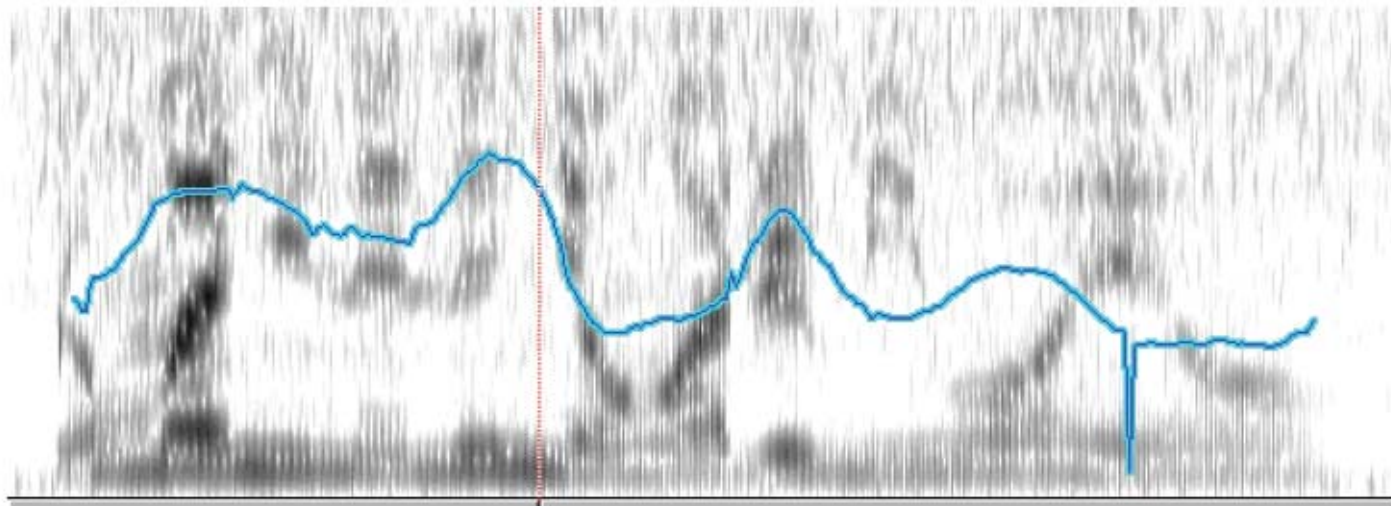


Figure by MIT OpenCourseWare.

# Korean Intonation

## Accentual Phrase

- If the AP contains 4 or more syllables, TH associate to 1st and 2nd syllables (or sometimes 1st and 3rd in longer AP), LH associate to penultimate and last syllables.
- If the AP contains fewer than 4 syllables various subsets of the full tonal pattern are realized (so far unpredictable, but not apparently contrastive).



[ L H L H][ L L H][ L H L%]



To listen,  
please see  
Ex.9 [here](#)

# Korean Intonation

## Accentual Phrase

- AP is also the domain of a number of phonological processes. E.g. Lenis stops are voiceless in AP-initial position, but voiced between voiced sounds AP-medially (S. Jun 1996).

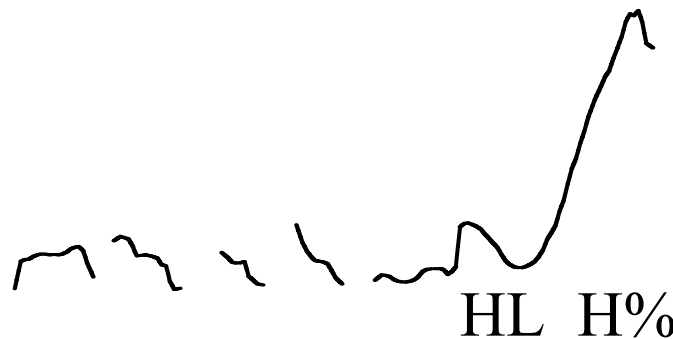
[tʃa:ŋ] ‘soy sauce’

[kotʃ<sup>h</sup>u dʒa:ŋ] ‘red pepper paste’

red pepper-soy sauce

## Intonational Phrase

- There is an astonishing variety of boundary tones, realized on the final syllable: L%, H%, LH%, HL%, LHL%, HLH%, HLHL%, LHLH%, LHLHL%



Listen to Ex.21 [here](#), but only the last quarter (“ANSONi pakiNsINiMnida”)

## Focus in Korean

Given the absence of pitch accents, how is material marked as prominent? Jun (2002):

- AP boundary preceding focus.
- Focus word lengthened, realized with expanded pitch range.
- Dephrasing: all words up to the end of the IP included in the AP with focus, or
- Pitch range compression - if post-focus string is long, AP boundary may be retained, but post-focal AP has reduced pitch range.

# Focus and Phrasing

Focus has effects on phrasing in a number of languages:

- Korean - AP boundary preceding focus, dephrasing following focus.
- Japanese - Intermediate phrase (a.k.a. Major Phrase) boundary before focus, dephrasing following focus (suppression of MajorPhrase/Intermediate Phrase boundaries) (Beckman and Pierrehumbert 1986, Nagahara 1994)
  - Suppresses phrasal intonation, but not final lengthening (Sugahara 2003).
  - Restricted to given material (Sugahara 2003).
- Hausa - emphasized words begin new phrase (Inkelas and Leben 1990)
- Bengali - focused constituent is a phonological phrase (Hayes and Lahiri 1991).
- Chichewa - phonological phrase boundary after focus (Kanerva 1990).
- Focus is not marked by phrase boundaries in English.

# Focus and Pitch Range

The most consistent correlates of focus appear to be expansion of pitch range on the focus and reduction of pitch range following the focus.

- Applies in languages with and without pitch accents.
- Could the appearance of post-focus dephrasing actually result from pitch range compression?
  - Japanese is supposed to have dephrasing after focus, but Sugahara (2003) found major syntactic boundaries are marked by final lengthening even in post-focal position. Small  $f_0$  differences correlated with phrasal difference.
  - Compression of post-focal tones, not dephrasing?
- Could the appearance of post-nuclear deaccenting actually result from pitch range compression?
  - Post-focal pitch range compression without complete elimination of accents/tones is observed in Mandarin, NK Korean, Swedish (Bruce 1982), Neapolitan Italian (D'Imperio 2000), Catalan (Estebas Vilaplana 2003), European Portuguese (Frota 1998).



# Post-nuclear pitch range compression?

Pierrehumbert (1980) observes small 'echo' accents in post-nuclear stretches:

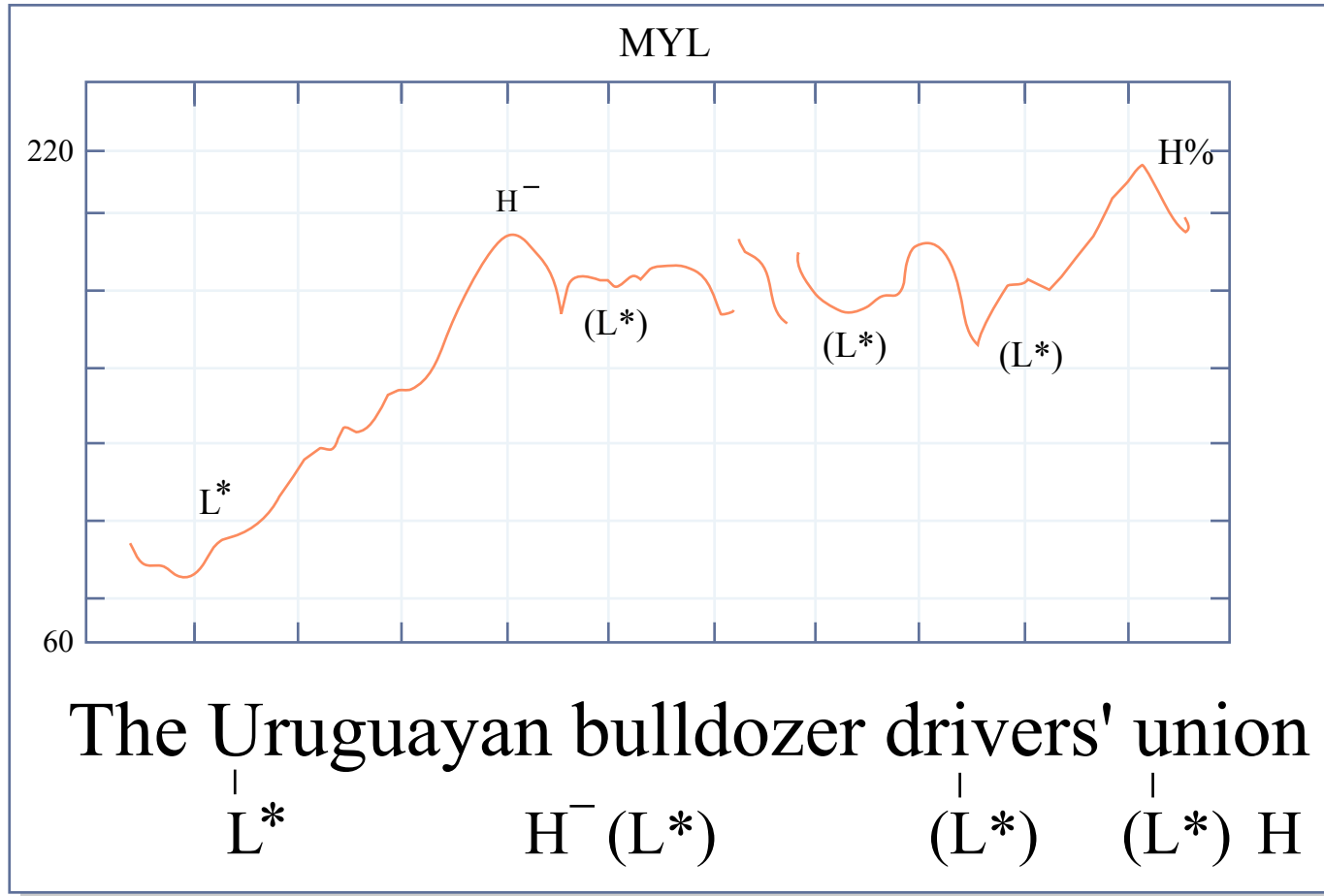


Figure by MIT OpenCourseWare.

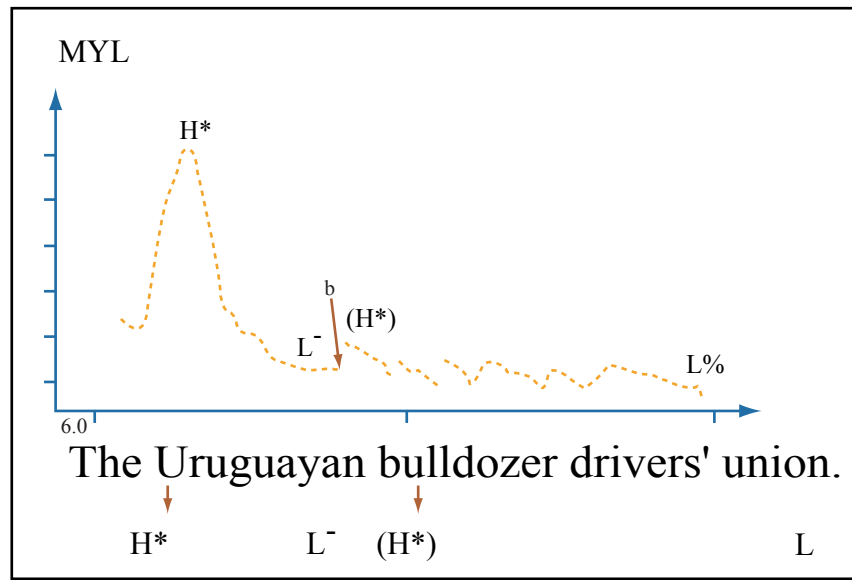


Figure by MIT OpenCourseWare.

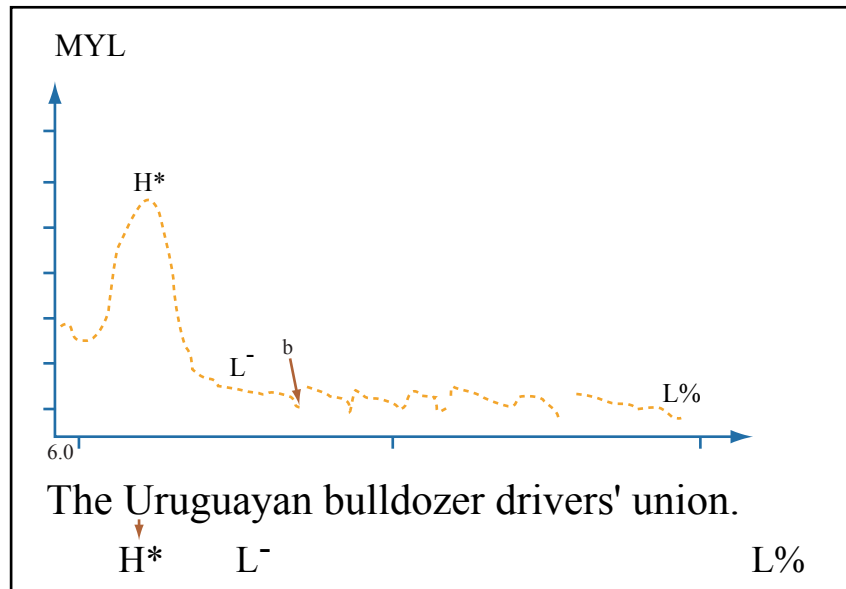


Figure by MIT OpenCourseWare.

# Post-nuclear pitch range compression?

Beaver et al (2004) provide evidence that phrasal prominence distinctions are possible in post-nuclear position, although marked more consistently by duration and intensity rather than  $f_0$ .

- Studied ‘Second Occurrence Focus’ sentences:
  - a. Both Sid and his accomplices should have been named in this morning’s court session.
  - b. But the defendant only named Sid in court today.
  - c. Even the state prosecutor only named Sid in court today.
  - a. Defense and Prosecution had agreed to implicate Sid both in court and on television.
  - b. Still, the defense attorney only named Sid in court today.
  - c. Even the state prosecutor only named Sid in court today.
- SOF word is longer and more intense than matched non-focused word.
- Minimal  $f_0$  effects (minimum  $f_0$  is slightly lower in SOF in d.obj position)

# Post-nuclear pitch range compression?

- Typical 'SOF' utterance:

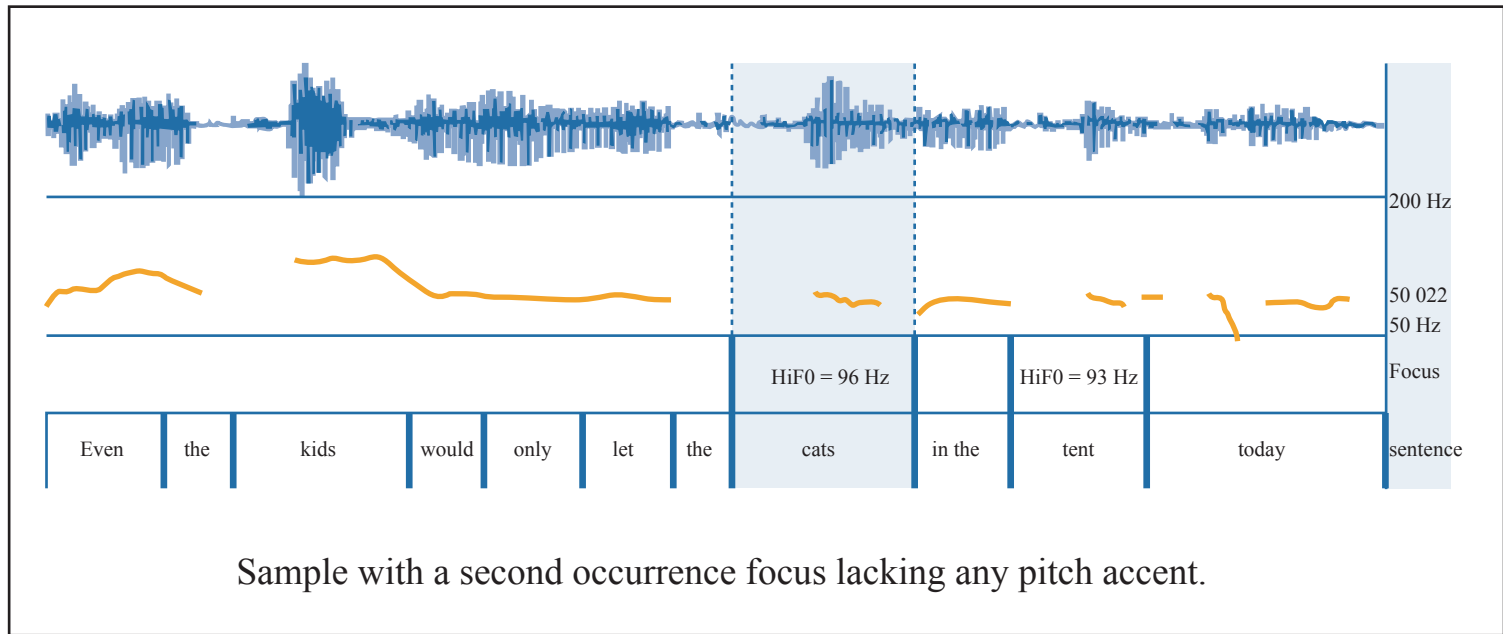


Figure by MIT OpenCourseWare.

# Post-nuclear pitch range compression?

- Occasionally a pitch accent is observable (and audible) on SOF:

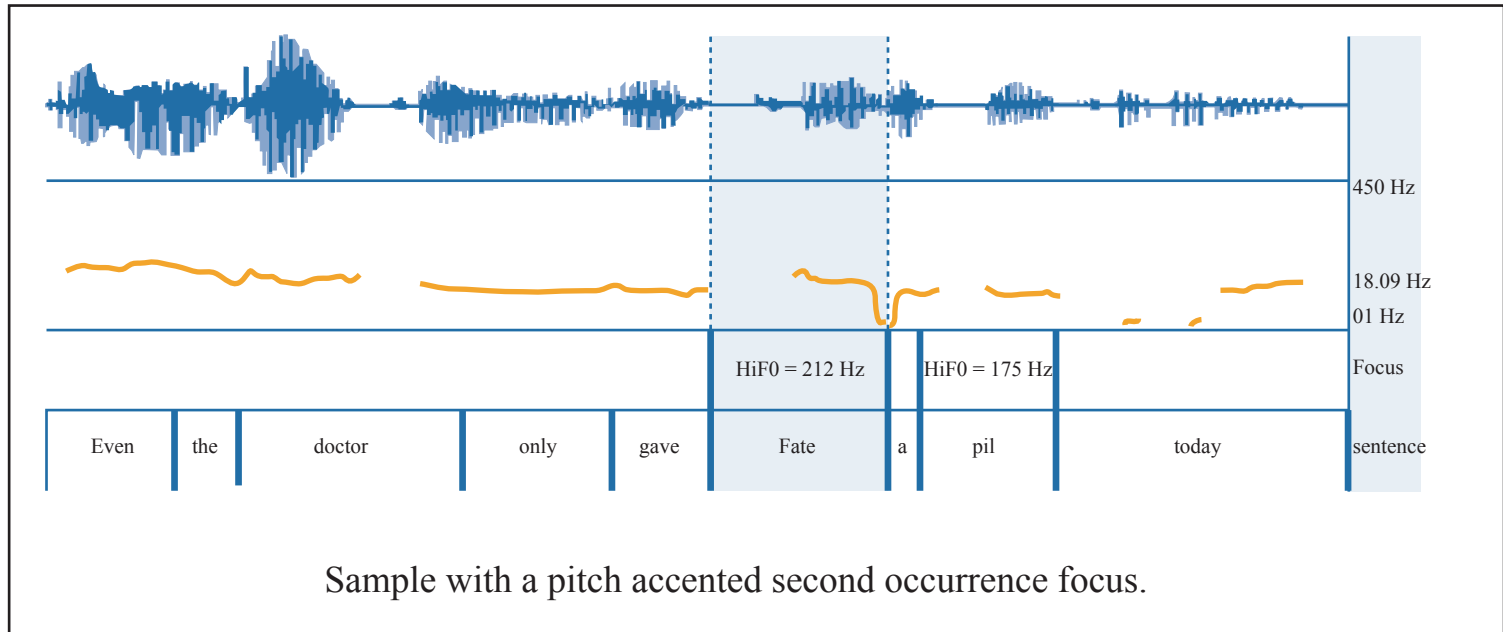


Figure by MIT OpenCourseWare.

# Summary

- Not all languages have pitch accents or boundary tones.
- All languages seem to use pitch range and phrasing.
- In English, pitch range may play a bigger role in signaling basic functions like focus than is implied by ToBI.