Developing a Framework of Communicative Functions for the Study of Speech Prosody

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Plenary paper presented at TAL 2012 Nanjing
27 May, 2012
1 From Function to Sound and back to Function

• In the 1980s, IPDS Kiel investigated form-function relationships in the prosody of German and English
  – synchronization of pitch peaks with vocal-tract opening
  – starting from German utterance
    *Sie hat ja ge'logen.* "She's been lying."
  – single accent, on the stressed syllable /'lo:/
    ° early peak before stressed-vowel onset
    ° medial peak in stressed vowel
    ° late peak late in stressed vowel
early peak
medial peak
late peak
– functional link of peak synchronization shown by contextualization

° early

¶ "Wer einmal lügt, dem glaubt man nicht."

¶ "Once a liar, always a liar."

° medial

¶ "Jetzt verstehe ich das erst."

¶ "Now I understand."

° late

¶ "Oh!"

– Identification as +- matching in context
• pragmatic functions of peak contour synchronization
  – early - finality
    ° knowing
    ° summarizing
    ° coming to the end of an argument
    ° resignation
– **medial - openness**
  
  ° *observing*
  
  ° *realising*
  
  ° *starting a new argument*
late - unexpectedness

° observing, realising in contrast to one‘s expectation
° surprise
° disbelief
• perceptual test paradigm, 11th ICPhS Tallinn 1987
  – shift of complete f0 contours through otherwise constant utterances
  – f0 peak contour shift from early via medial to late synchronization with the articulation of an accented syllable
  – discrimination of pitch changes
  – identification of meaning changes
Sie hat ja ge'logen. "She's been lying."

Identification in context
"now I understand"

2-step Discrimination
• the characteristics of the 3 peak categories are
  – **early** – falling pitch into the accented vowel to *low* level, decreasing prominence
  – **medial** – rising pitch into the accented vowel to *high* level before fall, increasing-decreasing prominence
  – **late** – rising pitch from *low* level late in the accented vowel to *high* before fall, late increasing prominence
Before ICPhS in 1987, the data were presented in a talk to Osamu Fujimura’s research group at AT&T Bell Labs at Murray Hill in June 1986

- Mark Liberman, Janet Pierrehumbert, Richard Sproat
- A young Chinese PhD student, Chilin Shih
  - classified the series of 11 stimuli with reference to Mandarin tones
    - 1 – 4 = low tone 3
    - 5 = high falling tone 4
    - later in series tone 4 changed to tones 2 + 4
° change from tone 3 to tone 4 occurred abruptly from stimulus 4 to 5
° change from tone 4 to tones 2 + 4 was gradual and less easy to locate, had occurred at stim 9
° these judgements of the f0 peak shift series in terms of Mandarin tones parallel the categorization in terms of pragmatic functions
° tones 3 vs. 4, and early vs. medial peaks are differentiated by low vs. high f0 in relation to vowel onset
° these categorizations possible on general language-independent psychophonetic principle
• f0 peak synchronization strong cue for the three functional categories
• but there are other acoustic cues
  – shape of the f0 contour
  – durations of the pre-accent and accent syllables
  – energy levels in pre-accent and accent syllables
• these property values are usually coupled in the natural productions of the three categories
• decoupling must be analysed systematically to evaluate the contribution of each property
• shape investigated by Niebuhr
• The different categories of f0 peak synchronization with vocal-tract opening
  – are manifestations of different argumentation functions in German
  – but code different lexical tones in Mandarin.
• However, the argumentation functions that have been proposed in relation to German prosody can be assumed to be valid in all languages.
• The question then is how finality and openness are signalled in Mandarin, where part of the prosodic meaning is absorbed in the function of lexical tone.
• *hao-3, xing-2* “OK”, recorded by Yi XU, UCL London, and Aoju CHEN, MPI Nijmegen

• Aoju CHEN suggested the following contextualization
  – FINALITY in argumentation

  Your boss asks you to hand in a project proposal soon. You explain that this is not feasible for various reasons. But your boss insists that your company needs the proposal quickly.

  Your boss: Will you then hand in the proposal in two weeks?

  You: (OK. I’m forced to agree.)

*hao-3*  🎧  🎧  *xing-2*  🎧  🎧
– OPENNESS in argumentation

Your boss asks you to hand in a project proposal soon. Because it is a very short proposal and you have a clear idea of what it should be like, you think it can be done quite easily.

Your boss: Will you hand in the proposal in two weeks?
You: (OK. I’m happy to agree.)

hao-3 xing-2
hao3: final – open; xing2: final – open, male speaker
hao3: final – open; xing2: final – open, female speaker
• ‘finality/resignation’ vs. ‘openness/happiness’ in
  – hao
    ○ either no rise or a much lower one
    ○ intensity lower and descending more quickly
    ○ the syllable is shorter
  – xing in the two contexts is similarly differentiated
    ○ lower vs. higher pitch rise
    ○ lower vs. higher and faster vs. more slowly descending intensity
    ○ shorter vs. longer duration.
both speakers differentiate the two contexts across the different word tones in the same way by lowering vs. raising pitch and prominence, superimposed on the lexical tones

- this essentially parallels signalling of the functional categories in non-tonal languages

The conclusions to be drawn from these few data are
- the substance – form – function relationship of argumentation in Chinese needs detailed analysis
- collection of a contextualized database
- including all 4 tones of Mandarin Chinese
2 KIM – The Kiel Intonation Model

• The experimental analysis of the relationship between argumentation functions and f0 peak contours in German became the core of KIM.

• It differs in various ways from the modelling of prosody in AM phonology
  – communicative function dominates prosodic form
  – communicative categories do not presuppose discrete boundaries
  – short-time segment and long-time prosody windows are synchronized with broad margins around segmental landmarks, e.g. accented vowel
– f0 peak and valley patterns have holistic relationship to communicative categories
  ° not decomposed into local L, H tones of pitch accents, phrase accents and boundary tones
– f0 prime prosodic marker of communicative categories but energy, long-term phonation, segmental timing also important contributors
– f0 contour synchronization has to include shape and height for category identification
  ° holistic bundles of properties in production and perception of communicative functions
3 Framework of Communicative Functions

- Karl Bühler, Sprachtheorie. 1934
  - *Organon Model*
  - at any one moment in speech communication, the linguistic sign has a threefold relationship
    - ° to the Sender: EXPRESSION
    - ° to the Receiver: APPEAL
    - ° to the Factual World of objects and relations: PROPOSITIONAL REPRESENTATION
  - in varying proportion and weight.
3.1 Information Selection and Weighting

- In verbal interaction, communicators select information points and weight them in relation to each other in the communicative situation.
  - various formal devices: deviation from default word order, cleft sentences, lexical intensifiers
  - sentence accentuation: segment duration, pitch, energy, to make specific syllables salient for highlighting words and syntactic elements
- analysis of propositional meaning
  - focus, presupposition, new/given
  - in information structure
Mary came with Manny
No, Anna came with Manny.
Focus on high tones in Mandarin, Liu 2009
3.2 Argumentation Function

- The Speaker develops selected information points into an ARGUMENTATION structure, with reference to
  - FINALITY
  - OPENNESS
  - UNEXPECTEDNESS
- cf. the German *gelogen* and the Mandarin *hao/xing*
3.3 Interrogative Function

- **INFORMATION QUESTIONS** ask for specific information about subject, object, place, time, modality
  - focusing on **FACT ORIENTATION**, matter-of-fact appeal for information
  - focusing on **LISTENER ORIENTATION**, request appeal for information, friendliness
Where?
• **Polarity Questions** ask for a decision as to the truth value of a proposition or argumentation along a positive – negative polarity scale
  – focusing on Listener Orientation: decision left open for the listener to make
  – introducing Speaker Orientation: prejudging the listener’s decision towards one pole
Is he in Rome? Rising pitch
Is he in Rome? Falling pitch
• **Repeat Questions** ask for repetition of what has been said
  – to confirm an information point in a question-word question
  – to confirm the truth value of a dialogue partner’s statement
Where?
He’s in Rome?
3.4 Intensification Function

- Intensification of information points
  - in ARGUMENTATION
  - in INFORMATION QUESTIONS
  - in REPEAT QUESTIONS
- 2 possibilities (cf. Niebuhr, Phonetica 67 (2010))
  - NEGATIVE INTENSIFICATION: strengthens asonority
  - POSITIVE INTENSIFICATION: strengthens sonority
ARGUMENTATION – *It stinks.*

medial peak

early peak – neg. intens.

medial peak – pos. intens.
Where?

INFORMATION QUESTION

REPEAT QUESTION

neg. intens.
4 Applying the Framework to Comparative Prosodic Research

• The data-derived communicative functions
  – of information selection and weighting
  – of argumentation
  – of interrogativity
  – of intensification
can be taken as basic in any language.

• Linguistic analysis needs to find their formal exponents in the languages of the world.

• Thus, the functional framework becomes a powerful tool in comparative prosodic research.
4.1 Mandarin Chinese

- information selection and weighting (focus) and finality/openness argumentation in Mandarin have already been mentioned
- interrogative function has been studied extensively, generally from linguistic form, even Liu & Xu, Liu
  - subjects read isolated sentences marked graphically as statements by period, as ma particle question or as question in declarative syntax with ?
  - leaves out situational embedding of different types of interrogative function in speech communication, not reliably separated in 380 sentences/speaker
  - but regularities on lexical tone patterns shown
Tone 4

statement

decl. synt. quest.

ma particle quest.
This formal approach to questions in Mandarin needs a complement

- an approach that starts from the different types of interrogative functions I have illustrated, and analyses their phonetic exponents
- by collecting data in situationally anchored dialogues that verbalise the functions
- and have a high probability of triggering functionally adequate natural interaction
Dialogues husband/wife how to occupy their son

**Husband:** POLARITY QUESTION open decision

- What shall we do with the boy today? What do you think?  
  A *Does he want to go to the zoo/beach?*

- *wǒmen jīntiān dài érzi qù nǎr wán ne? nǐ zěnme xiǎng?*  
  A *tā xǐhuan qù dòngwùyuán/hǎitān ma?*

**Wife:** (Contrastive) STATEMENT

- *I don’t think so.*  
  B *He wants to go to the beach/zoo.*

- *wǒ xiǎng tā bù yuàn yì qù.*  
  B *Tā xǐhuan qù hǎitān/dòngwùyuán.*
Husband:

REPEAT QUESTIONS requesting confirmation

• C1 _He wants to go to the beach/zoo?_
• C1 tā xǐhuan qù hǎitān/dòngwùyuán?
• C2 _He does not prefer the zoo/beach?_
• C2 tā bù shì gèng xǐhuan qù dòngwùyuán/hǎitān ma?

REPEAT QUESTIONS D with disbelieving SURPRISE

• D1 _He wants to go to the beach/zoo? I can hardly believe that._
• D1 tā xǐhuan qù hǎitān/dòngwùyuán? zhēn nányǐxiāngxìn!
ma polarity question
A

statement
B

prosody repeat quest.
C1
hǎitān “beach” intensified

reinforced *ma*
repeat question C2

contrastive statement  B1

surprise repeat quest.  D1
• These are data from a single female speaker
  – Xiaojun ZHAO. 赵筱筠, born 1973
  – together with her husband Alexis Michaud, she translated my English dialogues
  – it was not possible to recruit also a male speaker
  – so she read both parts
• I now propose an extensive study of interrogative vs. declarative functions in Mandarin Chinese within the communicative framework I have outlined
  – recording of dialogues with a large number of male/female speakers who also swap the texts in the two roles
  – to obtain complete data sets from all speakers
  – adjustment of the dialogue if necessary
  – addition of other frames to include a wider spectrum of intensification
4.2 Comparison Mandarin - English

• In both languages, raised pitch has important role in the signalling of REPEAT QUESTIONS
  – in Mandarin, pitch register is raised in declarative syntax, vis-à-vis statement
  – in English, the main pitch effect is in the final high rise starting on the last accent

• When SURPRISE is added to request for confirmation
  – English uses a late high-rising valley
  – Mandarin expands the f0 contours of the tones in the focused word
  – intensification by breathiness in both languages
• POLARITY QUESTIONS
  – in English, word-order questions with nuclear fall/rise depending on prejudged/open decision
  – in Mandarin, *ma* particle questions
    ° either pitch register of entire sentence raised
    ° or only pitch contour of the tones in focused word raised
    ° does this reflect the functional difference coded by pitch direction in English?
4.3 Frequency Code

- Since higher pitch serves to differentiate questions from statements in Mandarin and English
  - the issue of a universal feature arises
  - Ohala’s *Frequency Code*
    - in asking a question a speaker subordinates to a listener
    - subordination is coded by universal mechanism of raising pitch in speech
  - certainly ingredient in question coding/decoding
  - but cannot explain all types of questioning
• Function of **REPEAT QUESTIONS** is
  – to attract attention and stimulate a dialogue partner into action
  – rather than a passive subordination to the partner’s response
• And **POLARITY QUESTIONS** prejudging the answer have *falling* pitch in West Germanic languages.
• Many subtle differentiations of communicative question functions need a more sophisticated *Interrogative Code*
• encapsulates the multifarious relations in communicative interaction of SPEAKER and LISTENER
  – with the central listener-oriented APPEAL function
  – adjusted in various ways by the speaker’s attitudes and expressiveness
• evidence that APPEAL function is coupled with high pitch
  – but there are data from African register tone languages that do not support this high-pitch link
  – so a universal *Interrogative Code* needs cautious developing in a framework of communicative functions
5 Conclusion and Outlook

• The “function first, form second” approach makes it possible
  – to develop a language-independent framework of communicative functions
  – into which each language fits its own formal means for coding the inter-language functions
  – thus providing a powerful tool in comparative prosodic research.
• Its application necessitates a fundamental change in data acquisition methodology
  – reading off isolated sentences will no longer do
  – tightly contextualized utterances in plausible texts are needed
  – that can capture the functions to be investigated.
• The proposed function – form investigation needs to be extended to a great variety of languages.
• This cross-linguistic function – form approach will lead to a new, communicatively insightful prosodic typology of the world’s languages
  – and to a reassessment of traditionally postulated universal codes
  – and the theoretical framework of communicative functions itself will be further developed and refined.
• This research strategy picks up the goal Eduard Hermann formulated in his world-wide survey of question prosody 70 years ago: to capture

  “the distribution of different rhythmic-melodic properties over the different speech functions and their summation in one and the same function.”
Thank you!

to Aoju CHEN, MPI Nijmegen, and Yi XU, UC London for making recordings for me
to Fang LIU for stimulating exchanges on her PhD thesis and questions in Mandarin
and with deep indebtedness to Alexis Michaud and Xiaojun ZHAO for insightful discussion of my English dialogue scripts, for translating them into Mandarin Chinese and for recording them so competently
and last but not least to all of you for listening to me.