Prosody and Sentence Processing

한국언어정보학회
April 22, 2017
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1

What is Prosody?

- ***Suprasegmentals*** has often been used to refer to *Prosody* (Lehiste, 1976).
- Umbrella term used to group together a number of **phonetic parameters** that typically extend over an utterance.
  - Fundamental Frequency (F_0) – Pitch
  - Duration - Timing
  - Intensity - Loudness

2

What is Prosody?

- The acoustic-phonetic parameters give rise to a set of **phonological phenomena.**
  - Stress/ pitch/ tone
  - Rhythm and timing
  - Intonation contour

3

What does Prosody do?

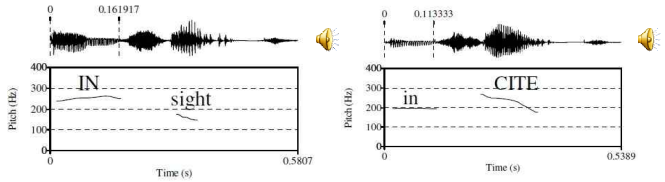
- Express emotion/affect
- Convey speaker-/dialectal-specific traits

What else?

4

Function of Prosody

- **Lexical stress: prominence of a syllable in a word.**



- Meaning distinction
- Lexical identification
- Lexical category distinction

- **Intonation: the use of pitch and duration in sentences.**
  - Distinction of **sentence type and meaning**.

John is coming .
John is coming !
John is coming ?

  - **Focus** in an utterance.

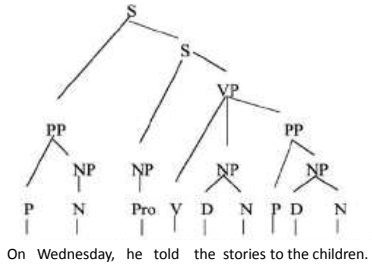
Please, hand me a red bulb.
vs.
*Please, hand me a **RED** bulb.*
vs.
*Please, hand me a red **BULB.***

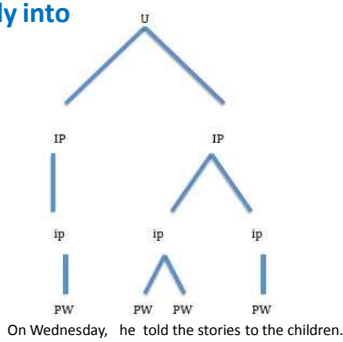
Phrasing

- When we produce running speech, we do not just put words one after another.
- Rather, we group them into hierarchical constituents: prosodic words, phrases, and utterances (simplifying a great deal).

Syntactic and Prosodic Hierarchies

Prosodic Phrasing refers to the way words are combined perceptually into groups .





On Wednesday, he told the stories to the children.

Prosodic Hierarchy in American English

Intonation Phrase

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Intermediate Phrase

|

Accentual Phrase

|

Prosodic Word

|

Syllable

9

Prosodic Structure in American English

H* L+H* L-H% | L* H- | L* L-L%

Utterance

Intonation phrases

Intermediate phrases

Pitch accents

final lengthening]]

pausing]|

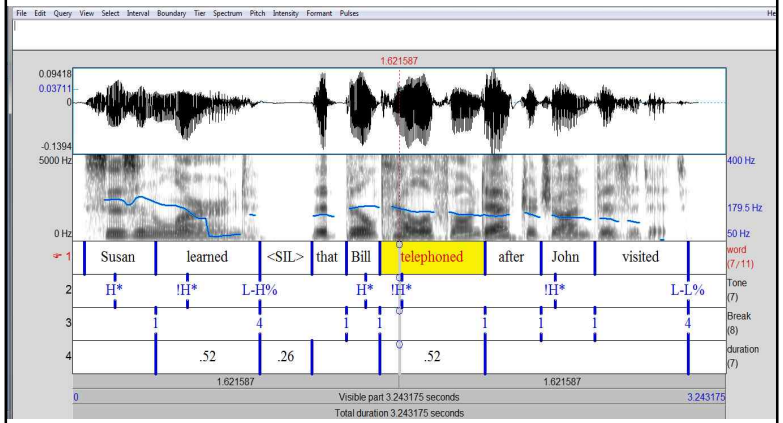
[[initial strengthening

[[resetting of pitch range

Diagram made by Schafer, Speer, Warren & White (2000)

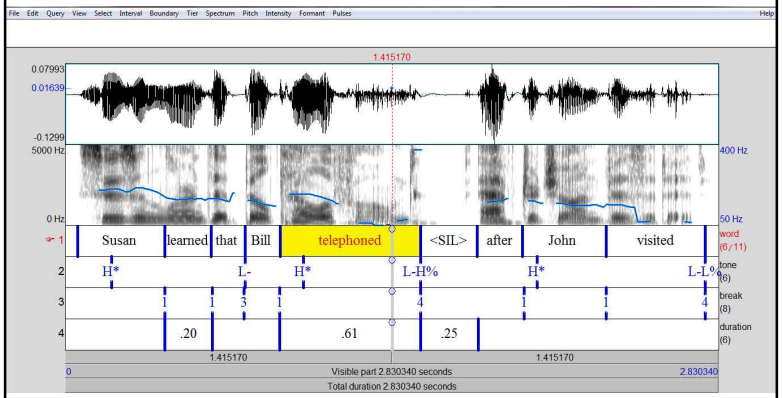
10

Susan learned that Bill telephoned *after John visited.*
(Low attachment)



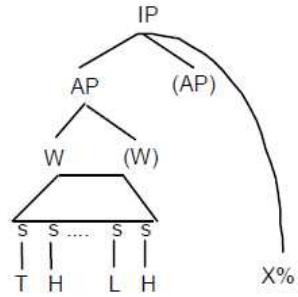
11

Susan learned that Bill telephoned *after John visited.*
(High attachment)



12

Prosodic Structure in Standard Korean



IP=Intonation Phrase
AP=Accentual Phrase
W=Prosodic Word
s=syllable
T=H when s begins with aspirated/ tense obstr.
Otherwise, T=L
X% = IP boundary tone

Figure 1: Intonation structure of Korean **(Jun, 1993;1996)**

13

Prosody and Sentence Processing

- **Modular Model of Syntactic Parsing**
  Parsing is performed initially by a syntactic module that is not influenced by other higher-order variables (Frazier 1987, 1995)
- **Constraint-based Competition Model**
  All available information is used in initial parsing of a sentence – syntactic, lexical, discourse, contextual, and non-linguistic information (MacDonald et al., 1994; Tanenhaus et al. 1995)

14

Prosody and Syntactic Ambiguity

15

Syntactic Ambiguity

- **Global Syntactic Ambiguity**: whole sentence has two or more possible syntactic structures and interpretations.

Julie revised the draft that she wrote on the balcony.

Pam ran into the killer of the journalist who received lots of attention.

16

Syntactic Ambiguity

- **Temporary (Local) Syntactic Ambiguity**: the representation of the underlying linguistic structure of the utterance remains temporarily ambiguous until it's later clarified in the sentence.

Pour the egg in the bowl over the flour.

Although the two friends pushed the car wouldn't budge.

17

Kjelgaard & Speer (1999)

Cross-modal naming task

1. Subjects **listened** to an auditory prime stimulus that is immediately followed by the presentation of a visual target.

2. Participants **name** the visual stimulus into the microphone **as quickly as possible** to complete the sentence.

18

Auditory stimuli:

Whenever the guard checks the door

Visual stimuli: *it's locked / is locked.*

19

- Naming response was faster when the prosody is congruent with the initial syntactic parsing.

[[*Whenever the guard checks* **]** *the door*] *is / it's locked.*

➢ **Early closure of the relative clause**:

Whenever the guard checks, the door is locked.

➢ **Late closure of the relative clause:**

When the guard checks the door, it's dark.

20

Clifton, Carlson, & Frazier (2002)

- **Informative Boundary Hypothesis** (Carlson et al, 2001) the interpretation of a prosodic boundary is determined not by its absolute size, but by its size relative to relevant certain other boundaries.

- Ambiguous sentences were manipulated with prosodic boundaries.

High Attachment Interpretation

(4) Who came out ahead?

a. Old men and women$_{IPh}$ with very large houses [0 IPh]

b. Old men$_{IPh}$ and women$_{IPh}$ with very large houses [IPh IPh]

c. Old men and women$_{ip}$ with very large houses [0 ip]

d. Old men$_{ip}$ and women$_{ip}$ with very large houses [0 ip]

21

Prosodic Boundary Matters in Parsing

- Prosodic cues are not only used when the syntactic parser faces an ambiguity.
- Rather, listeners employ those cues immediately to optimize syntactic parsing of upcoming sequences.
- Listeners exploit phonetic cues to infer prosodic boundary level in predicting the morphosyntactic identity of upcoming phrases.

  - Affect the listener's initial interpretation of utterance.

  - Predict material which has yet to be spoken.

22

Prosody in L2 Sentence Processing

23

Studies on L2 Prosodic Phrasing

- Few studies on the role of prosody in L2 sentence processing.

- Given the strong contribution of prosodic cues to the comprehensibility of language, we might expect that prosodic information will serve an important role in the comprehension of second language (L2) if the target language employs prosody as an important cue for processing the language.

24

Research Questions

1. Do Korean L2 learners of English integrate English prosodic information in the same way that native speakers do when processing ambiguous linguistic contents in the target language?
2. How robust is the prosodic effect on the resolution of different types of syntactic ambiguities?
3. Do developmental factors (L2 fluency) influence L2 listeners' use of prosody?

25

Reading Norming Experiment

Purposes

- To establish baseline parsing preferences

Experimental Materials

- 11 types of English syntactic ambiguity (resolvable by prosody).
  - ➢ 6 ambiguous in both English and Korean language.
  - ➢ 5 ambiguous only in English.

26

1. Ambiguous both in English and Korean

Type1. Subject NP + VP + Adj + NP's NP

I've never seen the beautiful opera singer's sister.

Type 2. Subject NP+ VP + Adj + NP and NP

The pictures are portraits of honorary kings and queens.

Type 3. Subject NP + VP + NP and NP'S + NP

I know Paul and Joan's nephew.

Type 4. Subject NP + VP + NP + that clause + PP

She married the man she had met in her parents' church.

Type 5. Subject NP + VP + that clause + PP

Susan learned that Bill telephoned after John visited.

Type 6. Subject NP + VP + NP of NP + RC

Pam ran into the killer of the journalist who received lots of attention.

27

2. Ambiguous only in English

Type 7. Subject NP + VP + NP of NP'S + NP

I know the nephew of John's neighbor.

Type 8. Subject NP + VP + NP + PP (with)

The lawyer examined the map with the magnifying glass.

Type 9. Subject NP + VP + NP + Reduced RC

John is looking at a girl standing on the balcony.

Type 10. Relative clause + ADV + main clause

When you learn gradually you worry more.

Type 11. Subject NP + VP + NP with NP + RC

The dean liked the secretary with the professor who was reading a letter.

28

Method

- 20 English speakers & 20 Korean speakers
- Subjects were asked to read a sentence and answer the following question by pressing a button on a response box.
- Responses corresponded to the syntactic interpretations associated with early vs. late prosodic boundaries.
- The mean response ratings were counted.

29

Sample Trial, E-Prime text presentation

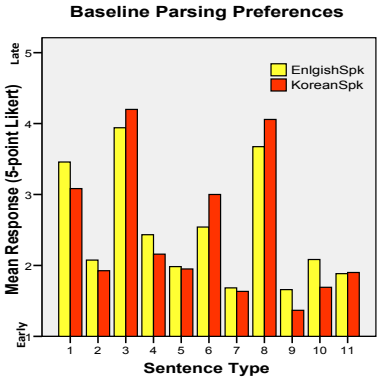
Pam ran into the killer of the journalist who received lots of attention.

Question: Who received lots of attention?

1. Definitely the journalist.
2. Probably the journalist, but maybe the killer.
3. Equally likely to be either the journalist or the killer.
4. Probably the killer, but maybe the journalist.
5. Definitely the killer.

30

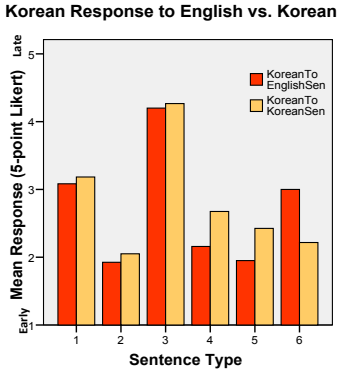
Written Test: No differences between Native English speakers and Korean-speaking Learners of English



- ANOVA compared English L1 and L2 speakers for each syntactic type.
- Effect of L1 approached significance only for 3 sentence types.
  - *PP ambiguity* (F(1, 38)=3.00, *p*=.09)
  - *Reduced RC ambiguity* (F(1, 38)=3.61, *p*=.06).
  - *RC+ ADV + main clause* (F(1, 38)=3.69, *p*=.06).

31

Written Test: Korean participants' parsing preferences for English and Korean sentences



- ANOVAs compared processing for sentences that were ambiguous in both languages.
- Effect of language was significant for complex NP only (6).
  - (F(1, 38)=5.25, *p* = .02).

32

Main Auditory Experiment

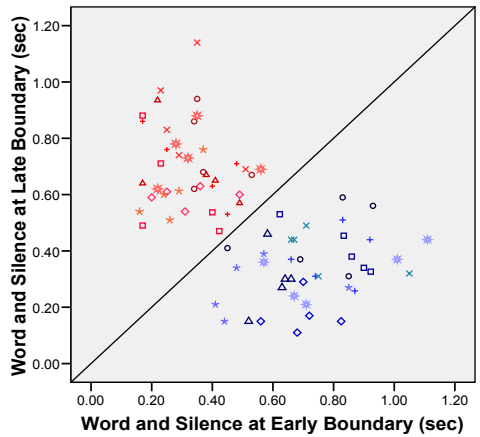
- Experimental Materials from Expt.1
- 5 items chosen for each of the 8 sentence types that showed most consistent participant judgments.
- 40 Target stimuli and 40 unambiguous control fillers.
- Two productions were recorded for each target stimulus, (1) with "Early boundary" prosody vs. (2) with "Late boundary" prosody.

[Linda **testified**]+pause [that the boss hid the **evidence** in June].

[Linda **testified** that the boss hid the **evidence**]+pause in June.

33

Duration measurements for Early boundary prosody vs. Late boundary prosody



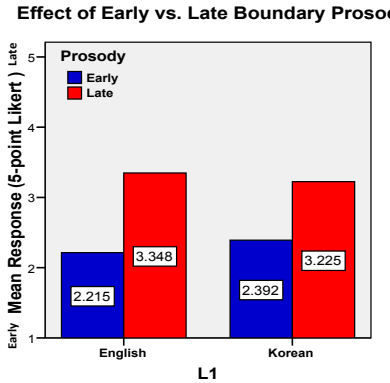
34

Method

- 24 Native English speakers.
- 24 Korean L2 learners of English.
  - TOEFL listening test to evaluate L2 fluency.
  - 12 were "advanced" L2 learners (score ≥ 8 out of 11).
  - 12 were "intermediate" L2 learners (score ≤ 7 out of 11).
- Auditory judgment task was otherwise identical to task used for the written materials in Expt. 1.

35

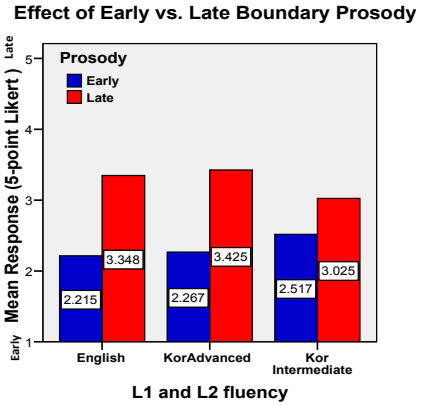
Do Korean L2 learners use prosodic information as native speakers do ?



- Significant effect of prosody in English and Korean listeners ($F_1(1,46) = 175.16$, $p < .001$, $F_2(1,32) = 149.97$, $p < .001$).
- For both native and nonnative speakers of English, prosodic information are useful to resolve syntactic ambiguities.

36

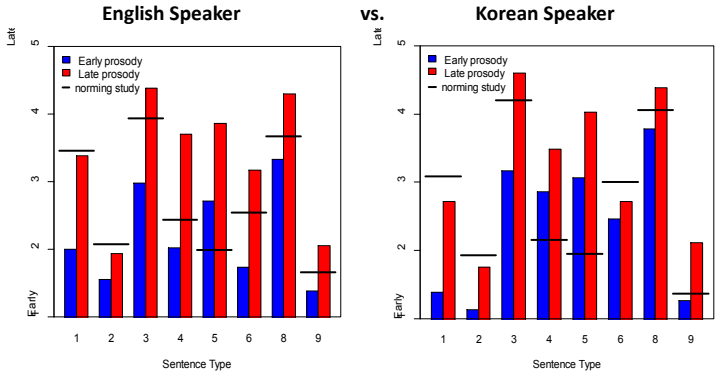
Are Advanced L2 learners better at using prosodic information than Intermediate L2 learners?



- Significant effect of prosody in English and Advanced and Intermediate L2 listeners (F_1 (2,45)= 165.26, $p < .001$, F_2 (1,64)= 131.00, $p < .001$).
- Post-hoc test shows that advanced L2 learners were more like native speakers than intermediate L2 learners were in their use of the contrastive prosodic cues.

37

Are there processing differences depending on syntactic ambiguity types?



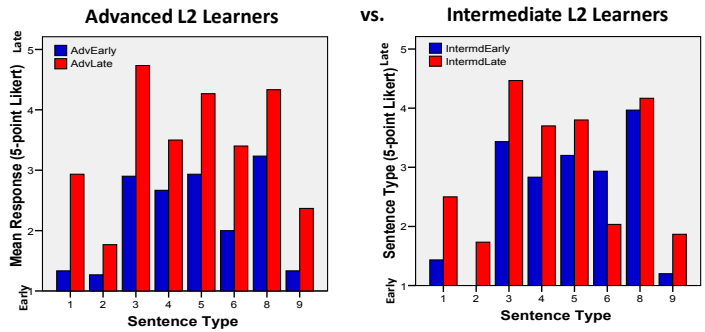
38

Are there processing differences depending on syntactic ambiguity type?

- The effect of Early vs. Late prosodic contrast was significant across all sentence types.
- There was a significant effect of sentence type in both L1 and L2 groups ($F_1(1,46) = 72.06$, $p < .001$, $F_2(1,32) = 17.62$, $p < .001$).
- Different syntactic ambiguities results in different degree of using of prosodic information.
  - Sentence type 2 (*Adj + NP and NP ambiguity*)
  - Sentence type 9 (*Reduced RC ambiguity*)
  - Sentence type 8 (*PP ambiguity*)
  - *Sentence type 6 (*NP of NP + RC ambiguity*)

39

Are there processing differences depending on syntactic ambiguity types?



- Advanced L2 speakers showed prosodic disambiguation very much like native speakers across all sentence types.
- Intermediate L2 learners failed to use prosodic cues as much as native speakers and advanced L2 learners did, especially for sentence type 6 (*NP of NP + RC) and 8* (*PP attachment*).

40

Conclusions

- Prosodic phrasing is universal for L1 and L2 sentence processing.
- Different types of syntactic ambiguities differ in the degree to which they are disambiguated by prosodic cues.
  - Some syntactic ambiguities (type 2, 8, & 9) remain strongly biased toward one interpretation over another even with prosodic cues.
  - Prosodic structure influences the strength of the bias, but does not reliably change the interpretation of the ambiguity toward the dispreferred syntactic parsing.

41

Conclusions

- Korean L2 learners make prosodic organization of an L2 spoken utterance to guide their interpretation of syntactically ambiguous phrases, even for sentences that don't have corresponding ambiguities in L1.
- L2 fluency reflects the developmental aspect of prosodic processing in L2 acquisition.
- Advanced L2 learners showed parsing preferences similar to the native English speakers', being sensitive to prosodic boundary cues such as syllable-final lengthening and following pauses, and thus were better able to disambiguate the speaker's intended interpretation than less fluent L2 listeners.

42