Prosodic evidence that parentheticals are placed by rightward movement[1]

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OVERVIEW

- **Syntax/prosody mismatches:**

(1) a. Everyone knows (||) that this is not true. (Taglicht 1998)
b. She gave her friend (||) an interesting book. (Taglicht 1998)
c. We know that this charge (||) is completely baseless. (Taglicht 1998)
e. George and Mary (||) give blood. (Shattuck-Hufnagel & Turk 1996)
d. Sesame Street is brought to you by: (||) The Children's Television workshop. (S&T 1996)
f. Tom washed and dried (||) the dishes. (McCawley 1998)

- **Overarching question:** How is the placement of prosodic boundaries determined?

- **Main claims:**

Prosodic boundaries are determined in direct correspondence with syntactic structure.

Rightward movement accounts for (at least certain) apparent syntax/prosody mismatches.[2]

- **Two sources of evidence:**

The prosody of parentheticals (part 1)

Prosodic disambiguation of PP-attachment ambiguities (part 2)

PART 1: PARENTHETICALS

- Certain adverbials can appear at different positions in the linear string.

Prosodic correlate: the adverbial is followed by a prosodic boundary.

(2) a. *Unfortunately* || the coffee spilled all over my notes. (initial)
b. The coffee *unfortunately* || spilled all over my notes. (parenthetical)
c. The coffee spilled *unfortunately* || all over my notes. (parenthetical)
d. The coffee spilled all over my notes, *unfortunately*. (final)

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[2] A similar proposal to account for mismatches was made by Mark Liberman in a presentation at UMass, reported on in Bing (1985).

Focus on parentheticals:

1. What is the syntactic analysis of parentheticals?
2. Why is parenthetical *unfortunately* followed by a prosodic boundary?

- Two analyses[3]:

  1. *Unfortunately* attaches at different positions and itself induces a prosodic boundary.

  2. *Unfortunately* always adjoins to TP, and an XP that appears to its right has undergone rightward movement to a position above it (cf. Ross 1973, Emonds 1979, Potts 2002 (for *as*-parentheticals), Stowell 2002). Prosodic boundaries follow from this syntax.

- We show that the two theories make **distinct prosodic predictions**, and **theory 2 is supported**.

Analysis 1: Multiple attachment sites

- *Unfortunately* can attach at different positions on the clausal spine (e.g. TP, *v*P, VP).

  (3) **Initial/final *unfortunately* = adjunction to TP**
  $[_{TP}$ (unfortunately) $[_{TP}$ the coffee spilled all over my notes] (unfortunately)]

  (4) **Parenthetical *unfortunately* = adjunction lower**
  a. the coffee $[_{vP}$ unfortunately $[_{vP}$ spilled all over my notes]] (adjunction to *v*P)
  b. the coffee spilled $[_{VP}$ unfortunately $[_{VP}$ all over my notes]] (adjunction to VP)

- Different syntax between (2a-c) — but a uniform prosody. An additional mechanism is required to account for the prosody.

  E.g. **comma morpheme**: Prosodic boundaries are the direct phonological reflex of a comma morpheme that forms part of the composition of parentheticals (following Potts 2005, Selkirk 2005).

Analysis 2: Unique attachment site + movement

- *Unfortunately* always attaches high in the structure, adjoined to TP.

  When an XP appears to the right of *unfortunately*, it does so via rightward movement.

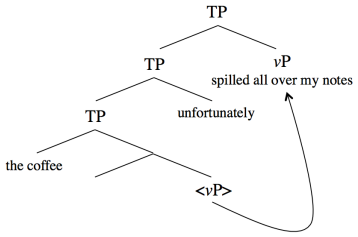
  (5) **Final[4] *unfortunately* = adjunction to TP**
  $[_{TP}$ $[_{TP}$ the coffee spilled all over my notes] unfortunately]

[3] We will not consider here two alternatives: the 'orphan' account in which parentheticals are not part of the structure (Fabb 1990, Espinal 1991, i.a.), and the extravagant-tree approach in McCawley (1982).

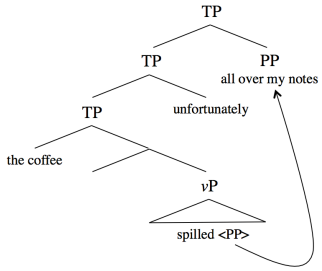
[4] Theory 2 allows two possible analyses of initial *unfortunately*. First: *unfortunately* could left-adjoin to TP, the same as in (3). Second: *unfortunately* could always right-adjoin to TP, but the entire TP could undergo rightward movement above *unfortunately* (cf. analysis of parenthetical *unfortunately* in (6)). The second analysis, and with certain assumptions, the first, are compatible with the proposal for the determination of prosodic boundaries given below.

(6) **Parenthetical *unfortunately* = adjunction to TP + rightward movement**

a. Rightward movement of *v*P



b. Rightward movement of PP (or VP)



- All cases of parenthetical *unfortunately* have a common syntactic signature, making it possible to derive the prosody directly from the syntax.

  – An XP adjoined to TP is preceded by a prosodic boundary.[5]

  The XP that undergoes rightward movement above *unfortunately* is preceded by a boundary, and that boundary immediately follows *unfortunately*.

  Since *unfortunately* itself is adjoined to TP, it should also be preceded by a boundary. However, this boundary is generally not realized as *unfortunately* is prosodically subordinated and "suffixed" to the preceding prosodic domain.

Dissociable prosodic predictions

- Emonds (1979) claims that a parenthetical can only be followed by a single constituent. But we'll see that this is incorrect, and the two theories make different prosodic predictions when there are **multiple constituents** to the right of the parenthetical:

  (7) … ADV XP_1 XP_2.

- **Theory 1:** If prosodic boundaries are determined by a comma morpheme part of the parenthetical, a given parenthetical should induce **one** prosodic boundary, immediately following it.

  (7') … ADV || XP_1 XP_2.

- **Theory 2:** ADV is adjoined to TP, and XP_1 and XP_2 have undergone rightward movement to adjoin to TP above ADV. If any XP adjoined to TP is preceded by a boundary**,** both XP_1 and XP_2 should be preceded by boundaries, giving **two** boundaries.

  (7'') … $\_\__1$ $\_\__2$ $]_{TP}$ ADV || XP_1 || XP_2.

[5] There are other ways of stating the generalization consistent with the data. For example, it could be that an XP which undergoes rightward movement is preceded by a boundary, with the boundary linked to movement, rather than high attachment resulting from the movement. One could also use cyclic spell-out. Suppose that constituents spelled-out in the same cycle (one of which is TP) are separated by boundaries of equal strength (Wagner 2005), and that adjuncts to TP are spelled out in the next higher cyclic domain. The boundary generalization can be derived if boundaries of inner cycles are of lower strength than boundaries of outer cycles (as is independently motivated for deriving recursive nesting, such as in coordinate structures). For the critical cases in this talk, these approaches converge in predictions with the one given above.

Experiment 1: testing the prosodic predictions for parentheticals

Question: Are there one or two boundaries when two XPs follow the parenthetical?

Two PPs and parenthetical 'please'

- Sentences contain two PPs with *please* inserted at different positions.

(8) a. Tap the frog **please** with the flower on the hat. (Condition 1: early please)
b. Tap the frog with the flower **please** on the hat. (Condition 2: late *please*)
c. Tap the frog with the flower on the hat **please**. (Condition 3: final *please*)

- Test sentences are ambiguous (see Exp. 2-3), but disambiguated by written context so that *with the flower* is interpreted as an instrument, *on the hat* as a goal.

(9) Context: *John is in the forest. He sees a frog who is wearing a hat. There is a flower nearby. You want John to take the flower and use it to tap the frog's hat. This is what you say to him: "Tap the frog with the flower on the hat."*

Intended interpretation: Tap the frog by using a flower on its hat.

Production

- Participants are presented with a sentence like (8a-c) preceded by a context like (9). They are instructed to read all material silently to themselves, and then **record themselves saying aloud the test sentence**.

- Design = Latin Square; 9 items, constructed in analogy to (8); 18 participants.

- Recordings were made in a sound attenuated booth in the Prosody Lab at McGill University using a Logitech headset.

Data analysis

- Sound files were perceptually coded by three annotators (authors and an RA) for where prosodic boundaries were placed in the participants' productions:

(10) a. *One boundary before 'with the flower'*
Tap the frog (please) || with the flower (please) on the hat (please).

b. *Two boundaries*
Tap the frog (please) || with the flower (please) || on the hat (please).

c. *One boundary before 'on the hat'*
Tap the frog (please) with the flower (please) || on the hat (please).

Clarifying predictions of the two theories

Critical condition

(11) **Early *please* (both PPs to the right of *please*)**
Tap the frog please with the flower on the hat.

- *Theory 1: multiple attachment sites + comma morpheme*

(12) **Theory 1: Predicts <u>one</u> boundary** (cf. 7')
Tap the frog please ‖ with the flower on the hat.

- *Theory 2: Unique attachment/movement + boundaries from TP adjunction*

Prediction more nuanced than above. If *with the flower* and *on the hat* move separately above *please*, two boundaries are predicted, as in (7''). If the structure for the *v*P is a Larsonian (1988) shell structure or downward cascade (Pesetsky 1995), there would be a constituent containing both *with the flower* and *on the hat*, and that constituent could move above *please*, predicting only one boundary.

(13) **Theory 2: Predicts <u>optionality</u> between two boundaries and one**
a. Tap the frog $\_\__1$ $\_\__2$ $]_{TP}$ please ‖ [with the flower]$_1$ ‖ [on the hat]$_2$. (move separately, cf. 7'')
b. Tap the frog $\_\__1$ $]_{TP}$ please ‖ [with the flower on the hat]$_1$. (move as constituent)

Baseline condition

(14) **Late *please* (only *on the hat* to the right of *please*)**
Tap the frog with the flower please on the hat.

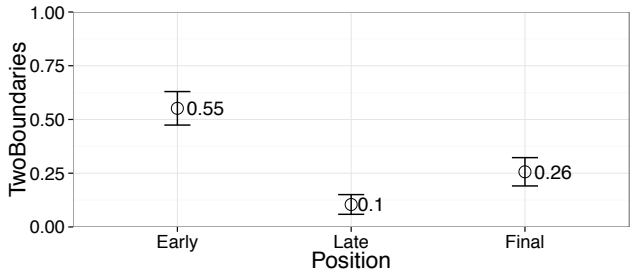
(15) **Both theories: Predict <u>one</u> boundary**
Tap the frog with the flower please ‖ on the hat.

- Theory 1 always predicts one boundary. Theory 2 predicts one boundary because only *on the hat* has moved to adjoin to TP above *please*; *with the flower* remains low, (16).

(16) Tap the frog with the flower $\_\__1$ $]_{TP}$ please ‖ [on the hat]$_1$.

Results

- The proportion of sound files in which participants produced two boundaries by condition:



- In the baseline condition (late *please*), where both theories predict one boundary, the proportion of productions with two boundaries is nearly at floor.

- In the critical condition (early *please*), results are consistent with the prediction of the unique attachment theory with boundaries determined from TP adjunction: there is optionality in whether participants produce two boundaries or one.

Conclusion from experiment

- Results support a unique attachment analysis of parentheticals and an analysis of the prosodic boundary following parentheticals as mapping directly from syntax.

> Prosodic boundaries are determined in direct correspondence with syntactic structure.
>
> An XP adjoined to TP is preceded by a prosodic boundary.

Appendix: Syntactic constraints on rightward movement

- Rightward movement in parenthetical constructions obeys constraints on rightward movement.

Case 1: Right Roof Constraint

(17) **Right Roof Constraint** (originally, Ross 1967)
Rightward movement out of a CP is banned.

- Contrast can be understood as an effect of the RRC:

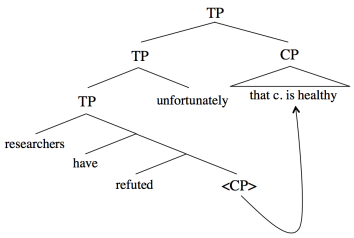
(18) a. Researchers have refuted, *unfortunately*, that chocolate is healthy.
b. ?#Researchers have refuted that chocolate *unfortunately* is healthy.

(18a): speaker finds it unfortunate that researchers have refuted the claim that chocolate is healthy.

(18b) ≠ (18a). In so far as (18b) makes sense at all, it must be that someone finds unfortunate the claim that chocolate is healthy.

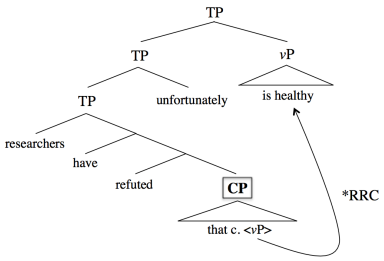
- The reading (18a) has derives when *unfortunately* attaches in the matrix clause:

(19)



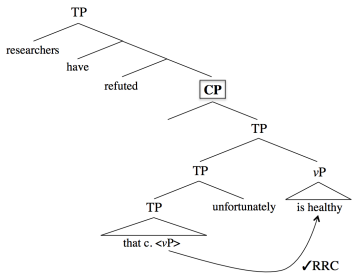
- A parse of (18b) with *unfortunately* attached in the matrix clause would involve rightward movement of *healthy* from its in situ position in the embedded clause to the matrix clause above *unfortunately*. This movement is ruled out by the RRC.

(20)



The only available parse of (18b) has *unfortunately* attached in the embedded clause. *Healthy* then undergoes rightward movement within the embedded clause, and the RRC is respected.

(21)



Case 2: Preposition stranding

(22) **Rightward movement cannot strand a preposition; neither can parentheticals**
a. *John climbed over yesterday the banister built by Martians. (heavy NP shift)
b. *The coffee climbed over unfortunately the banister built by Martians. (*unfortunately*)

PART 2: DISAMBIGUATION

- As a second extended argument for the role of rightward movement in resolving syntax/prosody mismatches, we show how it can help us understand a quite different puzzle from the psycholinguistics literature.

- Experimental results vary as to whether speakers reliably produce prosodic cues to disambiguate PP-attachment ambiguities.

  Snedeker & Trueswell (2003): speakers use prosody to disambiguate only when they are consciously aware that the sentence is ambiguous, and perhaps even then, only when there are no other contextual cues that disambiguate.

  Kraljic & Brennan (2005): speakers use prosody to disambiguate independent of awareness/context.

- We develop the puzzle with two production experiments.

Three-way ambiguity

- The sentences of interest are the same as in Experiment 1, though *please* is now not present.

(23) Tap the frog with the flower on the hat.

- They can be interpreted in at least three ways:

(24) a. *Interpretation 1: left reading*
Tap the frog that is holding a flower and tap it on its hat.
Tap [the frog with the flower] [on the hat].

b. *Interpretation 2: instrument/goal reading*
Tap the frog by using a flower and tap it on its hat.
Tap the frog [with the flower] [on the hat].

c. *Interpretation 3: right reading*
Tap the frog by using the flower that is sitting on the hat.
Tap the frog [with the flower on the hat].

Prosodic predictions from base syntax

- If syntax maps directly from prosody, from the base syntax associated with each reading, we would expect all three readings to be disambiguated.

<u>Left condition: left-like prosody</u>

- *With the flower* attaches as a modifier of *frog*, and *on the hat* attaches at the *v*P level:

(25) **Syntactic bracketing**
Tap [the frog with the flower] [on the hat].

- The difference in height between the two PPs should lead to a relatively stronger boundary before *on the hat* than before *with the flower*:

(26) **Corresponding prosody: stronger boundary before 'on the hat'**
Tap the frog with the flower || on the hat. ("left-like")

<u>Instrument/goal condition: list-like prosody</u>

- *With the flower* and *on the hat* both attach at the *v*P level:

(27) **Syntactic bracketing**
Tap the frog [with the flower] [on the hat].

(28) **Corresponding prosody: boundaries of equivalent strength before each PP**
Tap the frog || with the flower || on the hat. ("list-like")

Right condition: right-like prosody

- *On the hat* modifies *flower*, and *with the flower on the hat* attaches at the *v*P level:

(29) **Syntactic bracketing**
Tap the frog [with the flower on the hat].

(30) **Corresponding prosody: stronger boundary before 'with the flower'**
Tap the frog || with the flower on the hat. ("right-like")

Question: which of the three readings do speakers in fact prosodically disambiguate when they are aware/unaware of the ambiguity?

Production

- Participants are presented with a sentence like (23) preceded by a written context biasing one of the three readings, and are recorded saying aloud the sentence.

(31) a. Context for **left** condition: John is in the forest. He sees a frog who is holding a flower. The frog is wearing a hat. You want John to reach over and use his finger to tap the frog's hat. This is what you say to him: (23).

b. Context for **instrument/goal** condition: John is in the forest. He sees a frog who is wearing a hat. There is a flower nearby. You want John to take the flower and use it to tap the frog's hat. This is what you say to him: (23).

c. Context for **right** condition: John is in the forest. He sees a frog. The frog's hat is on the ground. There is a flower on top of it. You want John to take the flower and use it to tap the frog. This is what you say to him: (23).

Awareness manipulated across two experiments

- Exp. 2 and 3 differ in two ways intended to affect how aware participants are of the ambiguity.

(i) Instruction: explicit instruction about the ambiguity prior to the experiment vs. not.

(ii) Design: within vs. between subject.

- **Experiment 2: high awareness** (28 participants)

Before the experiment begins, participants are explicitly instructed that the test sentences will be ambiguous, and told to use intonation to convey the intended reading.

Design = within-subject, Latin Square; 9 items; a given participant sees 3 trials from the left condition, 3 from instrument/goal, and 3 from right.

- **Experiment 3: low awareness** (58 participants; more participants due to design)

  Participants are not instructed about the ambiguity prior to the experiment.

  Design = between-subject; 9 items; all trials a given participant sees are from one condition, and whether that condition is left, instrument/goal, or right varies between participants.

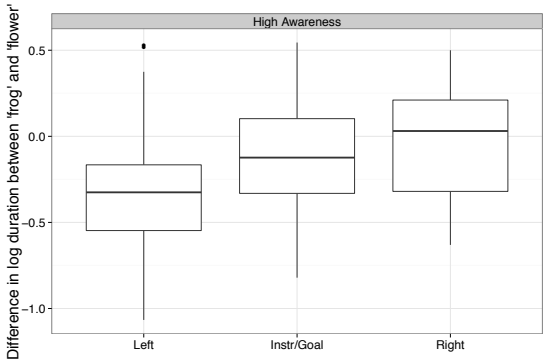
Data analysis

- Participants' productions are forced aligned with a transcription (Prosody Lab Aligner), and acoustic measures extracted.

- The most reliable acoustic proxy for prosodic boundary strength is **duration** of the word immediately preceding the boundary. We are interested in the duration of the words immediately preceding the two PPs (*frog*, *flower*).

Results: high awareness

- The difference in the mean log duration of *frog* and *flower* (log duration of *frog* – log duration of *flower*) across conditions for the high awareness experiment.

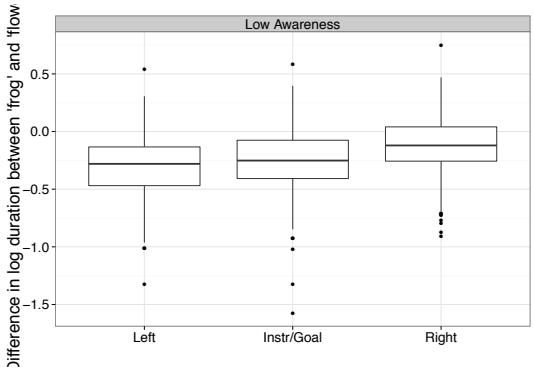


- When participants are aware of the ambiguity, they prosodically differentiate all three readings.

  The prosody associated with each reading is the one expected from (25)-(30).

Results: low awareness

- The difference in the mean log duration of *frog* and *flower* (log duration of *frog* – log duration of *flower*) across conditions for the low awareness experiment.



- When participants are less aware of the ambiguity, they prosodically differentiate the right reading from the left and instrument/goal readings — but they do not differentiate left and instrument/goal.

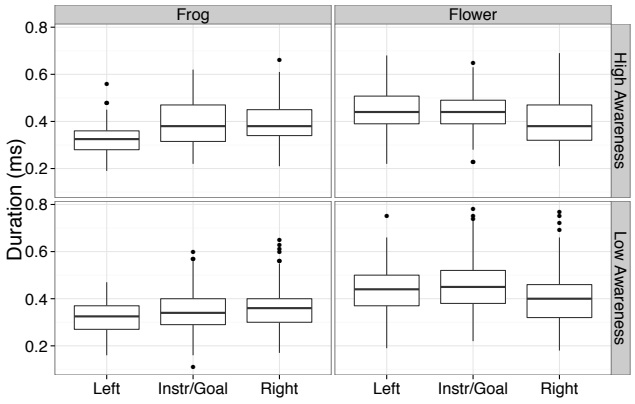
- Two consequences:

    1. Looks like a syntax/prosody mismatch: a direct syntax/prosody mapping appeared to predict that all three readings should be disambiguated, and they are not.

    2. The conflicting results in the experimental literature can be reconciled: some ambiguities are disambiguated independent of awareness; others are not.

What prosody do speakers use when they do not disambiguate left and instrument/goal?

- Absolute duration of *frog* and *flower* by condition in the high and low awareness experiments.



- In both experiments, right is different from left and instr/goal in that *flower* is shortened
- In the within design, *frog* is shortened in the left condition (compared to instr/goal and right).
  In the between design, *frog* is shortened in the left and instr/goal conditions (compared to right).
- The neutralization in Exp. 3 happens because instr/goal tends to be realized with left-like prosody.

Question: why is right always disambiguated from left and instrument/goal, but left and instrument/goal are not disambiguated from each other and both rendered with a left-like prosody when speakers are less aware of the ambiguity?

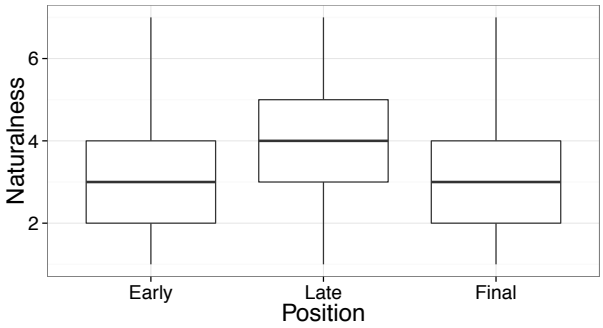
Analysis: neutralization through rightward movement

- **Proposal**: Prosody is determined from syntax. Rightward movement is responsible for neutralizing the prosodic contrast between the left and instrument/goal readings when participants are not highly aware of the ambiguity.

Rightward movement in the instrument/goal condition

- Evidence from parentheticals suggests that *on the hat* preferably undergoes rightward movement when the test sentences receive an instrument/goal interpretation.

- As part of Exp. 1, we collected naturaleness rating data (7 point Likert scale): how natural is parenthetical *please* when it occurs early, late, and finally?



- The preferred position for *please* is with *on the hat* moved to its right!

  (32) Tap the frog with the flower please || on the hat.

  The sentence might be easier to process with late *please* since it (and its prosodic rendering) supports an incremental step at which the first two constituents are interpreted.

- If *on the hat* rightward moves in the instrument/goal condition in the ambiguity experiments:

  (33) **Instrument/goal derivation with rightward movement of *on the hat***
  a. Tap the frog [with the flower] [on the hat]. (base syntax)
  b. Tap the frog [with the flower] __ $]_{TP}$ [on the hat]. (rightward movement)

  (34) **Corresponding prosody: stronger boundary before *on the hat***
  Tap the frog with the flower || on the hat.

- So, revising the syntax to take into account rightward movement, a direct syntax/prosody mapping has the revised predictions in (35) for the prosodic rendering of each reading:

(35) Left: Tap the frog with the flower || on the hat.

Instr/goal: Tap the frog || with the flower || on the hat. (base)
Tap the frog with the flower || on the hat. (w/ movement; preferred)

Right: Tap the frog || with the flower on the hat.

- Note: parenthetical intuitions suggest that rightward movement is not easily available in the left and right conditions in a way that could affect prosody.

(36) **Hypothetical left derivation with rightward movement of *with the flower***
a. Tap [the frog with the flower] [on the hat]. (base syntax)
b. Tap [the frog __] __]$_{TP}$ [with the flower] [on the hat]. (rightward movement)

(37) Tap the frog please with the flower on the hat.
a. Please tap the frog by using a flower and tap it on its hat. (list, cf. Exp. 1)
b. ??Please tap the frog that has a flower and tap it on its hat. (left)

(38) **Hypothetical right derivation with rightward movement of *on the hat***
a. Tap the frog [with the flower on the hat]. (base syntax)
b. Tap the frog [with the flower __]]$_{TP}$ [on the hat]. (rightward movement)

(39) Tap the frog with the flower please on the hat.
a. Please tap the frog by using a flower and tap it on its hat. (list, cf. Exp. 1)
b. ??Please tap the frog by using the flower that is on the hat. (right)

Experimental results follow straightforwardly

- The right reading is only compatible with a right-like prosody, and the left and instrument/goal readings are not compatible with this pattern.

  ⇒ Right is disambiguated from left and instrument/goal independent of awareness.

- Due to optional rightward movement of *on the hat*, the instrument/goal reading may be conveyed with a left-like prosody — making it prosodically indistinguishable from the left reading.

  ⇒ Left and instrument/goal are not always disambiguated.

- Rightward movement of *on the hat* is preferred with the instrument/goal reading, so when participants are unaware of the ambiguity, they render that reading with a left-like prosody.

  When speakers are aware of the ambiguity, they do not do the rightward movement of *on the hat* with the instrument/goal reading, so the sentence is rendered with a list-like prosody. The instrument/goal reading is then prosodically distinct from the left reading.

  ⇒ Left and instr/goal are disambiguated in the high aware experiment, but not in the low aware.

  The preference for rightward movement in the instrument/goal condition overrides the utility of the base syntax for disambiguation in the low aware experiment.

CONCLUSION

View of the syntax/prosody interface:

- Prosodic boundaries are determined in direct correspondence with syntactic structure.

- Rightward movement accounts for (at least certain) apparent syntax/prosody mismatches.

Adverbials like *unfortunately* and *please* attach high in the structure, and achieve parenthetical placement by rightward movement of constituents above them.

- Support for our view of the interface: if more than one constituent occurs to their right, each one is preceded by a prosodic boundary, unless they move as a constituent — consistent with theory where adjunction to TP resulting from rightward movement leads to prosodic boundaries.

Speakers reliably disambiguate some PP-attachment ambiguities and not others.

- Support for our view of the interface: those that are not disambiguated are the ones where an independently supported preference for rightward movement neutralizes the prosodic contrast.

Outlook: it may be possible to extend the hypothesis so that other cases of optional boundary placement reflect optional rightward movement.

- Some evidence that optional boundaries are impossible when not derivable by rightward movement:

(40) a. *But [$_{DP}$ almost || all of them] knew that. (Taglicht 1998)
b. *[$_{DP}$ Danish || beer] is better. (Taglicht 1998)
c. *Three mathematicians || in ten] derive a lemma. (Pierrehumbert 1980)
d. George and || Mary give blood. (Shattuck-Hufnagel & Turk 1996)
e. *Both the bumper and [$_{DP}$ the bashed-in || fender] will have to be replaced. (Pierre 1980)
f. * Tom washed || and dried the dishes. (McCawley 1998)

In (40a-f), a non-constituent – e.g. *all of them knew that* in (40a) – would have to undergo rightward movement to derive the boundary.

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