

Interplay of syntactic parsing strategies and prosodic phrase lengths in processing Turkish sentences

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Purpose of the study: Parsing of spoken sentences may be open to influences from syntactic parsing strategies, the locations of prosodic boundaries, and phrase lengths. Kjelgaard and Speer (K&S, 1999) found that inappropriate prosodic contours caused more processing difficulty in early closure (EC) structures than late closure (LC) structures in English. One explanation they considered was that when prosodic phrasing is uninformative/misleading about syntax, the parser resorts to a syntactic LC strategy. An alternative explanation emphasizes the parser's interpretation of prosodic phrase lengths. The Rational Speaker Hypothesis (RSH; Clifton et al., 2006) claims that prosodic breaks flanking short constituents are treated as more informative about syntax than breaks flanking longer constituents, since the former would not be motivated by optimal length considerations. K&S did not manipulate phrase lengths so these explanations could not be distinguished. To disentangle them, we tested a Turkish construction with LC and EC in two listening experiments.

Materials: Sentences in Experiment 1 had phrase length distribution similar to the K&S English materials. Experiment 2 manipulated lengths in reverse. The stimuli had cooperating, conflicting or neutral prosody. The following illustrates the research design. (PWd = Prosodic Word)

	Cooperating Prosody	Conflicting Prosody	Neutral Prosody
Experiment 1 (Length conditions similar to K&S)	LC (4+2 PWds) EC (3+3 PWds)	LC (3+3 PWds) EC (4+2 PWds)	LC (4+2 PWds, syntactic) EC (3+3 PWds, syntactic)
Experiment 2 (Length conditions reversed)	LC (3+3 PWds) EC (2+4 PWds)	LC (2+4 PWds) EC (3+3 PWds)	LC (3+3 PWds, syntactic) EC (2+4 PWds, syntactic)

Phonological phrases with 2 PWds would be considered short in Turkish, whereas 3-4 PWds fall within normal range (Nash, 1973; average length = 4.2 PWds, range = 2.9 to 7.8).

Procedure: In an end-of-sentence comprehension ('got it') task, participants listened to spoken sentences and after each one they indicated whether they 'understood' or 'did not understand' it. Comprehension questions at random intervals checked for accuracy. Response times were taken to reflect ease or difficulty of processing, and were analyzed via mixed effects modeling.

Predictions: For **Experiment 1**, a default syntactic LC strategy and the RSH make similar predictions. If the syntactic strategy applies when prosodic cues are uninformative or misleading, there should be an advantage for LC syntax in neutral and conflicting prosody conditions. In the cooperating prosody condition, LC syntax might also be favored, but the informative prosodic cues could result in equally easy processing for LC and EC, as K&S observed for English. RSH predicts an LC advantage in cooperating and conflicting prosody in Experiment 1 because the 4+2 cooperating prosody would be more informative for LC structure, and the 3+3 conflicting prosody would be interpreted as less informative about syntax, making it easier to disregard. In **Experiment 2**, the syntactic strategy still predicts an LC advantage in neutral and conflicting prosody conditions, but the RSH now predicts an EC advantage for cooperating and conflicting conditions since EC has the more noteworthy cooperating prosody (2+4 PWds) and the easier to ignore (3+3) conflicting prosody. RSH does not apply in the neutral prosody condition in either experiment.

Results: The data are summarized in Table 1. The results support an interplay of both RSH and syntactic Late Closure. Experiment 1 showed an LC-advantage for both LC-cooperating (4+2) prosody and LC-conflicting (3+3) prosody. This could be due to either the syntactic LC strategy or the RSH interface strategy. In Experiment 2, the LC advantage in those conditions disappeared, indicating that in Experiment 1 it was not due solely to a syntactic LC strategy; this suggests that RSH also plays a role. However, Experiment 2 did not show an EC advantage either, as would be predicted by RSH alone. Thus, the best fit for the combined data set is a trade-off between syntactic LC bias (= anti-EC bias) and RSH, which can reinforce each other (Experiment 1) or cancel each other out (Experiment 2).

In the neutral (no-breaks) prosody conditions, to which RSH does not apply, the sole significant advantage was for LC in Experiment 2, where LC *syntactic* phrasing was 3+3. A likely explanation is that LC acted in concert there with a mentally projected prosodic boundary (Pauker et al., 2011), with a bias toward optimal/balanced (3+3) phrase lengths.

Conclusion: Results overall suggest that constituent lengths do modulate the parser's interpretation of overt prosodic boundaries as well as listener-projected boundaries. Yet, the syntactic Late Closure strategy cannot be eliminated in favor of prosodic interface constraints.

Turkish sentence materials:

In (1), the morpheme ‘-ı’ on ‘danışman’ (advisor) is homophonous for possessive and accusative. A late-closed subject ends at the POSS morpheme. An early-closed subject ends at the GEN morpheme, followed by an ACC-marked object.

- (1) Ø (Yaklaşık) yirmi öğrenci-nin danışman-ı (oldukça)
Pro (Nearly) twenty student-GEN advisor-3SG.POSS/ACC (much)

{	LC: eleştir- il-di criticize-PASS-PAST	}	san-dı-m. think-PAST-1SG
	EC: eleştir- diğ-in-i criticize-FN-3SG.POSS-ACC		

LC: ‘I thought that the advisor (POSS) of (nearly) twenty students was (much) criticized.’

EC: ‘I thought that (nearly) twenty students criticized the advisor (ACC) (much).’

The parenthesized words (‘nearly’/‘much’) in (1) were included to lengthen either the subject or the VP respectively. Cooperating prosody had a prosodic boundary following the subject (Kamali, 2008) as is standard since the subject is the default topic in Turkish (Erguvanlı, 1984). The morphology of the subordinate clause verb (intransitive for LC; transitive for EC) subsequently disambiguates the temporary ambiguity.

Table 1. Summary of data for Experiments 1 and 2

	Cooperating Prosody	Conflicting Prosody	Neutral Prosody
Experiment 1	LC < EC ($\beta = -.125, SE = .059,$ $z = -2.10, p < .05$)	LC < EC ($\beta = -.251, SE = 0.062,$ $z = -4.03, p < 0.001$)	LC = EC ($\beta = .00007, SE = .062,$ $z = .001, p = .99$)
Experiment 2	LC = EC ($\beta = 6.97, SE = 44.77,$ $z = -.161, p = .87$)	LC = EC ($\beta = -2.19, SE = 45.08,$ $z = -.05, p = .96$)	LC < EC ($\beta = -86.12, SE = 39.63,$ $z = -2.1, p < .05$)

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