The time-course of rhythmic and syntactic factors in silent reading in Turkish

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Background: Assignment of prosodic boundaries in an utterance depends on constituent lengths as well as syntactic structure (e.g., Ghini, 1993; Selkirk, 2000). In silent reading where prosodic cues are unavailable the Implicit Prosody Hypothesis (IPH, Fodor, 2002) suggests that "a default prosodic contour projected onto the stimulus may influence syntactic ambiguity resolution", even when there is no relevant punctuation. Fodor (1998) predicts that a construction's most natural prosodic contour, influenced by the same-size-sisters constraint, will favor length-balanced constituents. The IPH has been confirmed in many languages but with adjunct attachment ambiguities. Following upon a previous experiment, this study tests the IPH in a late/early closure ambiguity in Turkish that involves argument structure relations and pits the syntactic parsing strategy of Late Closure against a prosodically-motivated length constraint.

Materials: The Turkish ambiguity is illustrated in (1), where the homophonous morpheme *-u* on the noun *psikolog* (psychologist) can be interpreted either as possessive or as accusative.

(1) Late Closure (LC) **/** Early Closure **(**EC)

Ø	(Yaklaşık)	kırk	yedi	öğrenci-nin	psikoloğ-**u**	(bugün)
Pro	Nearly	forty	seven	student-GEN	psychologist-**3SG.POSS/ACC**	today

sev-**il-di**	**/**	sev-**diğ-in-i**	bayağı	san-ıyor-uz.
like-**PASS-PAST**	**/**	like-**FN-3SG.POSS-ACC**	much	think-PROG-1PL

We think that the psychologist of (nearly) forty-seven students was much liked (today). / We think that (nearly) forty-seven students liked the psychologist much (today).

A late-closed subject ends at *psychologist-POSS.* An early-closed subject ends at *student-GEN*, and the following noun *psychologist-ACC* is the object. The sentence is disambiguated at the embedded verb, *sevildi* (was liked) in LC and *sevdiğini* (liked) in EC structure. In speaking, a phrase boundary falls between the subject and the embedded verb phrase (Deniz & Fodor, 2013). Phonological phrase length has a range of 3-7 (average 4) PWds in Turkish (Nash, 1973). There were four conditions, manipulating length (lengthened subject/VP) and syntactic structure (LC, EC). A modifier either in the subject (*nearly*) or in the VP (*today*) modified phrase lengths, with a total 8 PWds in all cases. A preferred boundary location after the first 4 words would yield 4+4 balanced phrasing and favor EC for the lengthened subject condition and LC for the lengthened VP condition. (See Table 1 for details.) There were 24 experimental sentences (normed for LC/EC semantic unbias). An acceptability judgment pre-test ensured naturalness.

Procedure: 48 native speakers of Turkish silently read the sentences presented as a whole on the computer screen and answered the comprehension questions that followed.

Results: Six eye-tracking measures (first fixation, gaze, regression path, re-reading and total duration and the probability of regression out) were entered into a mixed-effects linear/logistic regression model for the disambiguating region (6^{th} word) and spillover region (7^{th} word). Analyses on four measures (excluding first fixation duration, probability of regression out) revealed a LC advantage in the disambiguating region (*t*'s > 5.25); there was a preference for balanced lengths in four measures (excluding first fixation, gaze duration, *t*'s > 2.01, *z* = 2.62) and a LC advantage in total duration (*t* = 1.94) in the spillover region. (See Table 2 for details.)

Conclusion: The results confirm Fodor (1998, 2002): readers project prosodic boundaries in silent reading and in doing so, they are influenced by the balanced-sisters preference. But, as in the previous experiment in Turkish, the length effects are slightly delayed (spillover region) compared to syntactic biases (disambiguating region). The previous experiment, with 6 PWd-sentences where the spillover region was the matrix verb, offered two interpretations: (i) rhythmic information lags behind syntactic information, as previously predicted by Fodor (2002) or (ii) the parser uses rhythmic information once the ultimate length distribution is known, at the matrix verb. The current experiment, with spillover region not being the matrix verb, favors (i).

References: Deniz, N. D., & Fodor, J. D. (2013). Effects of constituent length on syntactic ambiguity resolution in Turkish, *AMLaP,* Marseille [Poster presentation]. **Fodor, J. D. (1998).** Learning to parse? *Journal of Psycholinguistic Research*, *27*(2), 285–319. **Fodor, J. D. (2002)**. Prosodic disambiguation in silent reading. In M. Hirotani (Ed.), *NELS 32* (pp. 112–132). Amherst, MA: GLSA Publications. **Ghini, M. (1993).** *Ø*-formation in Italian: A new proposal. In C. Dyck (Ed.), *Toronto Working Papers in Linguistics* (Vol. 12 (2), pp. 41–78). Department of Linguistics, University of Toronto. **Nash, R. (1973).** *Turkish intonation*. Paris: Mouton, the Hague. **Selkirk, E. (2000).** The interaction of constraints on prosodic phrasing. In M. Horne (Ed.), *Prosody: theory and experiment* (pp. 231–262). Dordrecht: Kluwer Academic Publishing.

Table 1. Length distribution and syntactic structure manipulation in the experiment.

Lengthened Subject - EC Balanced	**Lengthened VP - LC Balanced**
LC (5+3 PWds)	LC (4+4 PWds)
EC (4+4 PWds)	EC (3+5 PWds)

Table 2. Mean and standard error (SE) values for first fixation duration, gaze duration, regression path duration, re-reading duration, total duration (in milliseconds) and probability of regression out for the disambiguating region (6th word) and the spillover region (7th word)

		Disambiguating Region (6th word)		**Spillover Region (7th word)**	
		Mean	*SE*	*Mean*	*SE*
First Fixation Duration (ms.)	*Balanced, EC*	250.9	5.08	230.7	6.54
	Unbalanced, EC	229.8	4.01	222.6	6.42
	Balanced, LC	233.1	4.42	217.3	7.02
	Unbalanced, LC	248.2	5.24	227.3	6.92
Gaze Duration (ms.)	*Balanced, EC*	382.5	13.27	249.9	7.82
	Unbalanced, EC	364.5	14.25	245.4	8.26
	Balanced, LC	289.5	7.38	239.9	8.93
	Unbalanced, LC	327.7	9.92	254.1	8.64
Regression Path Duration (ms.)	*Balanced, EC*	494.2	27.63	401.6	36.34
	Unbalanced, EC	487.3	27.27	498.5	47.47
	Balanced, LC	361.6	15.68	379	36.07
	Unbalanced, LC	395.4	17.55	440.2	38.12
Re-reading Duration (ms.)	*Balanced, EC*	361.5	29.14	96.6	11.43
	Unbalanced, EC	331.5	23.24	108.6	13.07
	Balanced, LC	185.7	15.63	86.11	10.89
	Unbalanced, LC	234.5	19.82	114.5	13.51
Total Duration (ms.)	*Balanced, EC*	738.9	31.37	271.7	13.09
	Unbalanced, EC	693.6	25.98	259.6	14.23
	Balanced, LC	465.2	17.16	223.3	12.6
	Unbalanced, LC	546.8	21.85	266.3	13.92
Probability of Regression Out	*Balanced, EC*	0.13	0.019	0.19	0.029
	Unbalanced, EC	0.13	0.02	0.27	0.035
	Balanced, LC	0.11	0.019	0.19	0.032
	Unbalanced, LC	0.11	0.019	0.22	0.033