

## Effects of surprisal in (long-distance) licensing of Turkish NPIs

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Licensing of negative polarity items (NPIs; e.g., *any*) has mostly been examined in relation to cue-based memory retrievals (e.g., [1],[2]) as they involve linguistic dependencies, but in head-final languages, NPIs precede their licensors (e.g., negation-marked verb), so their processing can (also) involve prediction for their governors ([3],[4],[5]). Long-distance (matrix verb) licensing of an NPI in an embedded clause (EC) has been argued to be affected by EC structure in Turkish [6], a head-final language, and the matrix verb type [7]. If the EC is marked for tense, agreement, and factivity on its verb, it is predicted to form an opaque domain and prevent matrix verb licensing of an embedded NPI. If the matrix verb is a neg(ative)-raising verb (e.g., *think*), it can license an embedded NPI. An eye-tracking experiment and an acceptability judgment task tested (i) if EC structure is used for predicting long-distance licensing of the Turkish NPI, *hiç kimse* “anybody”, and (ii) if there is retroactive intrusion [8]. **Materials:** The experimental sentences, as in (1), involved the NPI as the direct object of an EC ( $N_{items} = 60$ ,  $N_{fillers} = 96$ ). There were 12 conditions. The matrix verb was either neg-raising (NR, 1a-f) or non-neg-raising (NNR, 1/a-f) and the EC had either a transparent (T, 1a-c) or an opaque (O) domain (1d-f). NPI was either locally licensed (LL) by the embedded verb (1a,d), long-distance licensed (LDL) by the matrix verb (1b,e), or unlicensed (UL) (1c,f). A pre-test ensured comparable bias for EC type and neg-raising properties of matrix verbs. **Procedure:** 72 native speakers of Turkish silently read the sentences on a computer screen, and answered the comprehension questions while their eye movements were recorded. The acceptability judgment task (with a 1-7 Likert Scale) was given to the same participants two weeks later. **Predictions:** For (i) surprisal [4,5] would predict a role for EC structure in that the transparent conditions would take longer to read than opaque conditions as comprehenders may not yet decide on the grammaticality of the sentences in anticipation of matrix verb licensing. For (ii), if there is retroactive intrusion [8], at least the offline data [9-10], would show similar results for licensing in syntactically and semantically (il)licit cases. **Results:** The eye-movement data were analyzed on first fixation duration (FFD), gaze duration (GD), regression path duration (RPD), re-reading duration (RRD), total duration (TD), and probability of regression out (PRO) through mixed-effects *linear/logistic* regression models for the embedded verb (7<sup>th</sup> word) and its spillover region (8<sup>th</sup> word) and the matrix verb (9<sup>th</sup> word) and its spillover region (10<sup>th</sup> word). Analyses showed a slowdown for transparent domains in RRD on the EC verb and GD, RPD, TD, and PRO on its spillover region ( $t$ 's  $\geq 2.03$ ). EC structure and licensing predicted RRD on the EC verb and RPD and PRO on its spillover region ( $\chi^2$ 's  $\geq 8.51$ ). Further analyses showed for the opaque conditions an advantage for LL, but no difference between LDL and UL ( $t$ 's  $\geq 2.55$ ,  $z = 2.36$ ). There was no effect of licensing in transparent domains ( $t$ 's/ $z$   $\leq .41$ ). Analyses on the matrix verb showed a disadvantage for neg-raising in GD, RPD, RRD and TD ( $t$ 's  $\geq 2.19$ ). This interacted with licensing only for TD ( $\chi^2 = 28.36$ ), showing a slowdown for UL conditions with neg-raising verbs ( $t = 3.11$ ) (Table 1 summarizes the data for EC regions.) Acceptability judgment data were analyzed through *ordinal* regression models. The results showed the highest ratings for LL conditions followed by LDL, then UL conditions (Table 2). The differences in ratings were more pronounced for non-neg-raising conditions ( $z$ 's  $\geq 2.98$ ). **Conclusion:** The eye-tracking data showed that Turkish readers used embedded verb morphology to predict LD licensing of NPIs: When the EC formed an opaque domain, grammaticality was judged at that region, but this was not the case when it was transparent. This supports an expectation-based parsing view for head-final languages [8]. Judgment data showed effects of neg-raising and licensing for ungrammatical conditions (NNR, O) like those in semantically (NR) or syntactically licit (T) ones, suggesting retroactive intrusion in Turkish [8]. Finding both surprisal and retroactive intrusion effects for the same structure in a head-final language, albeit in different experiments, is promising as such structures can allow for testing prediction and memory effects together [11].

**Expt. Sentences:** Matrix verb (MV): Neg-Raising (NR) / Non-neg-Raising (NNR). EC structure: Transparent (T), Opaque (O). Licensing: Locally licensed (LL), Long-distance Licensed (LLD), or Unlicensed (UL). Negation suffix is in bold face and underlined.

- (1) Hasan Bey [sekreter-in hiç kimse-yi önceden ...  
Hasan Mr. [secretary-GEN any body-ACC previously  
a. ara-ma-ma-sın-ı/dan] muhtemelen um-uyor-du/ yakın-ıyor-du NR / NNR, T, LL  
call-NEG-VN-POSS-ACC/ABL probably expect-/complain-PROG-PAST  
b. aramasını/dan] muhtemelen ummuyordu /yakinmiyordu ... NR / NNR, T, LDL  
c. aramasını/dan] muhtemelen umuyordu /yakınıyordu ... NR / NNR, T, UL  
d. ara-ma-yacağ-ın-ı/dan] muhtemelen um-uyor-du /yakınıyor-du ... NR / NNR, O, LL  
call-NEG-FN-POSS-ACC/ABL probably expect-/complain-PROG-PAST  
e. arayacağ-ın/dan] muhtemelen ummuyordu / yakınmiyordu ... NR / NNR, O, LDL  
f. arayacağ-ın/dan] muhtemelen umuyordu / yakınıyordu bence. NR / NNR, O, UL

'Hasan probably (didn't) expect(ed)/complain(ed) that the secretary (didn't) call(ed) anybody previously.'

**Table 1.** Mean and standard error (SE) values in parentheses for GD, RPD, RRD, TD (in ms) and PRO for the EC verb (7<sup>th</sup> word) and its spillover region (8<sup>th</sup> word).

EC	MV	Lic.	EC verb (7 <sup>th</sup> word)					EC verb's spillover (8 <sup>th</sup> word)				
			GD	RPD	RRD	TD	PRO	GD	RPD	RRD	TD	PRO
T	NR	LL	411.7 (12.7)	503.7 (17.2)	545.5 (26.3)	756.2 (23.7)	0.14 (.02)	276.7 (7.2)	388.1 (21.7)	376.7 (23.4)	429.3 (13.4)	0.13 (.02)
			419.2 (15.2)	507.8 (20.4)	651.8 (33.1)	834.6 (31.8)	0.1 (.02)	279.5 (7.6)	392.4 (20.1)	381.6 (22.4)	455.7 (16.1)	0.18 (.02)
			412.7 (13.4)	509.1 (19.9)	602.1 (32.7)	819.7 (30.1)	0.12 (.02)	278.1 (7.8)	403.7 (20.1)	370.9 (24.1)	443.8 (14.9)	0.19 (.02)
		NNR	426.5 (13.5)	549.9 (26.3)	662.8 (37.6)	858.5 (31.7)	0.12 (.02)	271.1 (6.8)	443.2 (25.4)	355.5 (17.9)	446.3 (14.6)	0.22 (.03)
			448.8 (14.0)	561.8 (22.7)	607.4 (28.2)	846.8 (25.8)	0.12 (.02)	278.5 (9.4)	403.2 (22.2)	378.5 (22.1)	456.5 (18.3)	0.2 (.03)
			447.1 (16.1)	564.6 (23.4)	682.1 (34.7)	878.1 (29.6)	0.13 (.02)	267.9 (7.1)	448.8 (26.7)	405.4 (20.4)	459.5 (15.4)	0.21 (.02)
	O	NR	431.2 (14.5)	541.3 (27.7)	561.6 (32.1)	783.4 (27)	0.1 (.02)	270.6 (7.1)	360.1 (20.1)	407.9 (26.7)	457.1 (16.9)	0.13 (.02)
			396.1 (11.4)	498.6 (22.9)	618.5 (30.1)	780.5 (25.5)	0.11 (.02)	264.8 (7.8)	410.7 (30.6)	376.7 (23.1)	438.1 (18.1)	0.17 (.02)
			445.0 (13.5)	524.2 (19.9)	565.5 (30.9)	782.1 (25.9)	0.11 (.02)	269.7 (6.6)	389.3 (26.1)	386.8 (21.2)	414.3 (13.5)	0.13 (.02)
		NNR	424.8 (11.4)	502.7 (21.2)	543.9 (25.4)	766.3 (22.7)	0.07 (.02)	266.5 (6.4)	352.8 (24.4)	387.2 (24.9)	452.4 (16.9)	0.1 (.02)
			421.7 (11.4)	521.6 (20.9)	639.0 (28.4)	818.2 (24.9)	0.12 (.02)	261.6 (6.4)	386.4 (26.6)	355.8 (19.1)	423.3 (13.7)	0.16 (.02)
			435.5 (13.6)	538.2 (23.1)	588.6 (33.1)	830.7 (29.2)	0.12 (.02)	269.1 (8.3)	392.2 (25.2)	377.8 (23.3)	441.9 (16.6)	0.15 (.02)

**Table 2.** Mean acceptability judgment scores (and their SEs) for the 12 conditions.

	Transparent			Opaque		
	LL	LDL	UL	LL	LDL	UL
NR	5.13 (.11)	2.84 (.12)	2.14 (.09)	5.33 (.11)	3.16 (.12)	2.15 (.09)
NNR	5.76 (.10)	2.73 (.11)	2.29 (.10)	5.72 (.10)	2.53 (.11)	2.02 (.08)

**References** [1] Vasishth, et al., 2008 [2] Yanılmaz & Drury, 2018 [3] Crain & Fodor, 1985 [4] Hale, 2006 [5] Levy, 2008 [6] Kornfilt, 2007 [7] Horn, 1995 [8] Campanelli & van Dyke, 2016 [9] Su & Aparicio, 2022 [10] Lee & Yun, 2022 [11] Parker et al., 2017