Delayed structural prediction for relative clauses in Santiago Laxopa Zapotec, a language with robust resumptive pronouns

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Comprehenders of a transitive relative clause (RC) often exhibit preference or ease in interpreting the relativized noun (= head) as the RC subject [1]. This "subject RC" (SRC) bias depends on features of the head, especially animacy [2-5]. [4-5] argue the SRC bias stems from early predictions mapping animates to subject positions, perhaps due to universal alignments between animacy and subjecthood [6-7]. Yet this pattern has not been investigated across diverse languages [cf. 8], although we know the basic SRC bias itself varies widely [9-11]. To that end, we present a picture-matching experiment with eyetracking on incremental RC parsing in Santiago Laxopa Zapotec (SLZ). SLZ has typologically-unfamiliar features relevant for RC processing, including an abundance of resumptive pronouns (RPs) [12] and a strict word order without argument structure alternations [13]. Indeed, we observe a unique pattern of behavior. Not only do SLZ comprehenders lack any offline SRC bias for globally ambiguous RCs, but they also seem to wait until all arguments have been observed before using animacy information to consider a parse. We take this pattern to reflect **universal animacy alignment preferences** filtered through **language-specific biases and strategic delayed interpretation**.

SLZ is an Oto-Manguean language of southern Mexico with strict VSO word order. Transitive RCs feature one pre-verbal argument (the head) and one post-verbal co-argument. RCs are SRC/ORC ambiguous (1) unless a grammatical RP marks the subject or object dependency explicitly (2-3). RPs are used frequently even in simple RCs; in a related language, subject RPs are even preferred to gaps [14]. Pronouns mark animacy classes, e.g. HU(man), IN(animate).

Methods 102 native SLZ speakers (age 18–85, median: 40) participated in an auditory picture-matching task [8, 11] in Santiago Laxopa, MX, using recorded stimuli. 24 critical trials presented instructions (e.g. 1) with an RC to describe one of two images to select (Fig. 1). Items (Table 1) crossed *Dependency Type* (Gap vs. Object RP), *Head Animacy* (HU vs. IN), and *Co-Arg. Animacy* (Mis- vs. Matching head). Participants' gaze was tracked at 60Hz with a Tobii Pro Nano as they listened and gave touch responses on a Surface Pro running OpenSesame [15].

Results We analyzed responses and gaze data binarized by region [16] in logistic m.-e. models in `brms`. Responses (Fig. 2) showed accurate interpretation of ObjRPs, $\beta = {}_{.95}(-2.05, -1.20)$, but no SRC bias in ambiguous Gap conditions, and IN heads were no less likely to receive an SRC response, $\beta = {}_{.95}(-0.15, 1.11)$. Similar patterns held online: in Gap conditions (Fig. 3), looks to SRC and ORC images were both equiprobable across conditions for much of the stimulus; IN heads cued no less SRC looks, $\beta = {}_{.95}(-0.85, 0.17)$ and no more ORC looks, $\beta = {}_{.95}(-0.92, 0.18)$. Comparing trials with ORC responses in Gap and ObjRP conditions (Fig. 4), we observe object RPs were interpreted rapidly, cuing a reduction in SRC looks in the following region, $\beta = {}_{.95}(-1.02, -0.34)$. Notably, this RP-cued reduction was largest in trials with a HU co-argument, $\beta = {}_{.95}(0.00, 1.32)$, an effect consistent with a late-arriving preference for HU subjects.

Discussion SLZ comprehenders do not engage in strong predictive dependency formation in RCs, contrasting with e.g. [8, 11], and contradicting simple universalist accounts of an animacy-dependent SRC bias. Why might they prefer to delay? English comprehenders acquire prediction of a gap site *g* in development [17], possibly because waiting for the decisive evidence after *g* will always require retroactive processing. The problem for SLZ comprehenders differs in three ways: (A) they often have positive cues at *g* (RPs); (B) if not, they may pick any *g*; moreover, (C) the lack of passive-like alternations may bleed the predictability that English comprehenders exploit [13, 18]. We posit that given this confluence of differences, prediction of *g* never has much net value in SLZ. But note, the fact that co-argument animacy still influenced late online considerations—despite (C)—supports the strong claim that animacy alignment is a universal influence on comprehension, even when perhaps not a truly valid cue.

				Head	**RC[**	**V**	**(_?)**	**Co-Arg**	**(_?)**			**]**
(1)	Udanh	fotografia'nh	tse	bi'i xyage'nh		txube		coche'nh		kwit	yegu'nh.	
	touch	the.picture	of	the.boy		pull		the.car		near	the.river	

"Touch the picture of {**SRC** the boy who is pulling the car / **ORC** the boy who the car is pulling} near the river."

(2)	…	bi'i xyage'nh	txube	**=ba'**	coche'nh	(3)	…	bi'i xyage'nh	txube	coche'nh	**leba'**
		the.boy	pull	**=he**	the.car			the.boy	pull	the.car	**him**

"…the boy who (he) is pulling the car" (**SRC**) "…the boy who the car is pulling (him)" (**ORC**)

Table 1: The eight conditions of one 2 x 2 x 2 item frame.

Dependency Type	Co-Argument Animacy			
N1 = HU	*Mismatch*		*Match*	
Argument Gap (Ambig.)	boy pull car	(HU V IN)	boy pull girl	(HU V HU)
Object RP	boy pull car him	(HU V IN ObjRP)	boy pull girl him	(HU V HU ObjRP)
N1 = IN	*Mismatch*		*Match*	
Argument Gap (Ambig.)	car pull boy	(IN V HU)	car pull truck	(IN V IN)
Object RP	car pull boy it	(IN V HU ObjRP)	car pull truck it	(IN V IN ObjRP)

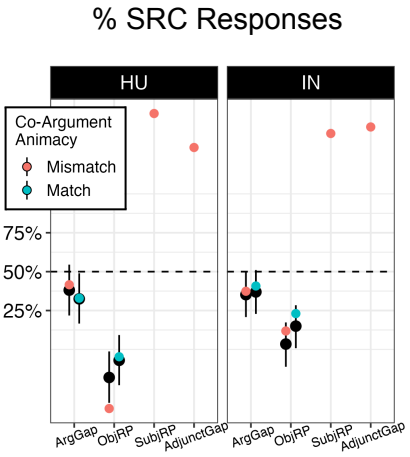

Figure 2: % SRC responses by Dependency Type, incl. data from unambiguous SRC filler conditions. Model estimates and 95% HDPIs in black. Note log Y axis.

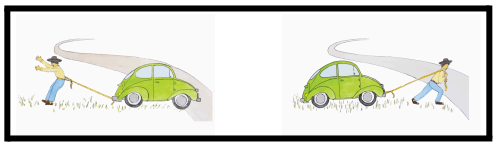

Figure 1: Example image choices for a Mismatch trial. For (1) the left image would be an ORC parse, and the right image an SRC parse.

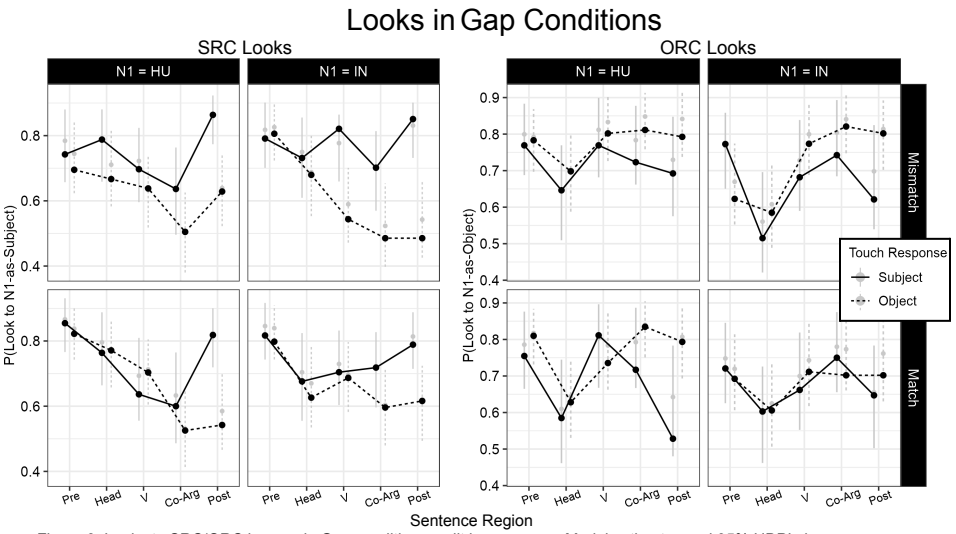

Figure 3: Looks to SRC/ORC images in Gap conditions, split by response. Model estimates and 95% HDPIs in grey.

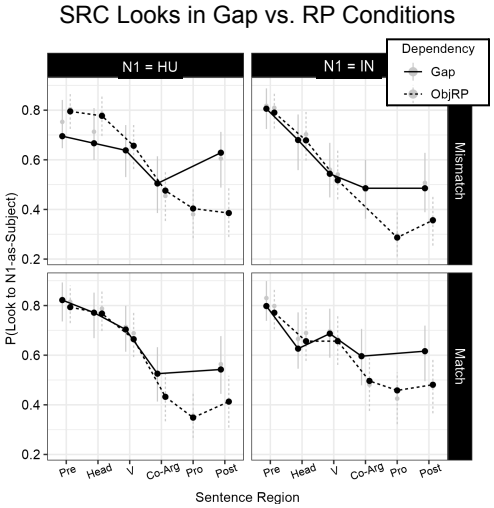

Figure 4: Looks to SRC images in Gap and RP trials with Object responses. Model estimates and 95% HDPIs in grey.

References [1] King & Just (1991) *JML* [2] Mak et al. (2002) *JML* [3] Traxler et al. (2002) *JML* [4] Gennari & MacDonald (2008) *JML* [5] Wagers & Pendleton (2015) *Proc WCCFL* [6] Bornkessel-Schlesewksy & Schlesewksy (2009) *Lang Ling Comp* [7] Hopper & Thompson (1980) *Language* [8] Hammerly et al. (2022) *Cognition* [9] Carreiras et al. (2010) *Cognition* [10] Polinsky et al. (2012) *Lingua* [11] Wagers et al. (2018) *Cognition* [12] Fadlon et al. (2019) *JML* [13] Gennari et al. (2012) *Cogn Psychol* [14] Foreman & Munro (2007) *Proc High Desert Linguist Soc* [15] Mathôt et al. (2012) *Behav Res Meth* [16] Huang & Snedeker (2020) *Cognition* [17] Atkinson et al. (2018) *Cognition* [18] Reali & Christiansen (2007) *JML*

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