Processing cataphors: Mismatch effects reflect syntactic prediction

Anna Giskes[1] and Dave Kush[2,1]
[1] *Norwegian University for Science and Technology (NTNU)* [2] *University of Toronto*

Background. Cataphors, as in (1), come before their antecedents. During incremental processing, cataphors cannot fully be interpreted until an antecedent has been identified. Previous research has argued that cataphors cause *active dependency completion*: the parser posits coreference with an upcoming syntactic position (often the subject), before number/gender features in that position have been processed bottom-up. Evidence comes from Number- and Gender-Mismatch Effects (N/G-MME): in manipulations like (1), readers reliably slow down at the subject *John* when it does not match the gender/number of the cataphor [e.g., 1-2].

(1) a. When he resigned, John praised the professor. (Subject-Match)
b. When they(PL) resigned, John praised the professors. (Number-Mismatch)
c. When she resigned, John praised the professor. (Gender-Mismatch)

Such MMEs are consistent with a parser that posits a subject antecedent before reaching that position and commits to predictive structure building to accommodate the posited antecedent (Syntactic Prediction). But MMEs are also consistent with a parser that opportunistically posits coreference only when it has reached an available NP, just before gender/number features are processed bottom-up [1] (Opportunistic Dependency Completion).

[3] manipulated Number-Match between a cataphor and a main subject in Dutch, a V2 language with subject-verb number agreement. Because of V2, the main verb precedes the subject in the Dutch equivalents of (1). Therefore, the researchers could potentially observe Syntactic Prediction as a NMME at the verb, before the subject. [3] observed no NMMEs at the main verb and argued against Syntactic Prediction. A shortcoming of [3]'s design is that they counter-balanced main subject+verb number between-items, not within-items. As a consequence, any differences in processing plural and singular verbs may have obscured an underlying NMME.

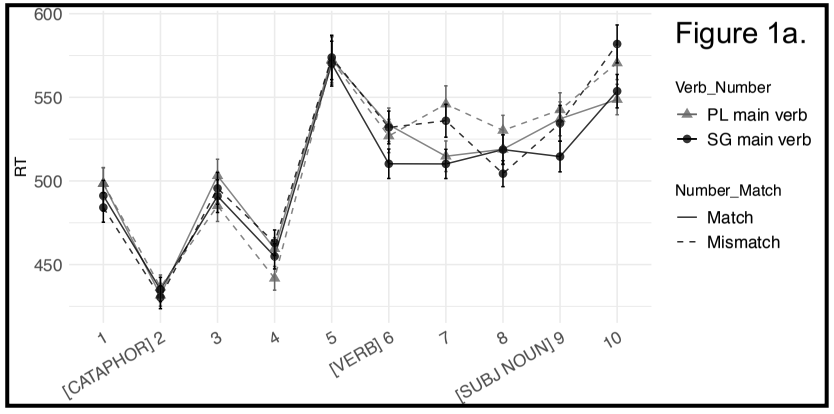
Experiment. We followed up on [3] with a 2x2 self-paced reading experiment (n=160): in sentences like Table 1, we manipulated NUMBER of the main verb+subject, and number-MATCH between this subject and a cataphor in a fronted adjunct clause. The critical region was the main verb. We reasoned that if the parser commits to an advance syntactic prediction of a subject antecedent, this should trigger syntactic prediction of a number-matching main verb.

In a separate item set with singular cataphors, we manipulated the gender-MATCH of a proper name in subject position. With these control items, we aimed to replicate the subject GMMEs reported in previous research.

Results. See Figs.1-3. We analyzed the verb region and two spillover regions without overt number marking. Bayesian analyses revealed a significant Verb-Number x Match interaction in the critical verb region, indicating a NMME only for singular main verbs. In the first spillover region, we observed a main NMME: a main effect of Match, with longer RTs for the Mismatch conditions. The gender manipulation yielded a GMME in the critical name region and the spillover region, replicating previous work.

Conclusion. NMMEs in the regions of interest suggest cataphors can trigger Syntactic Prediction. We take the NMMEs as evidence of prediction of a main subject antecedent, and consequent prediction of a number-matching verb. The interaction effect at the verb also supports the hypothesis that syntactic prediction might not be equally strong for plural and singular.

Figures and Tables



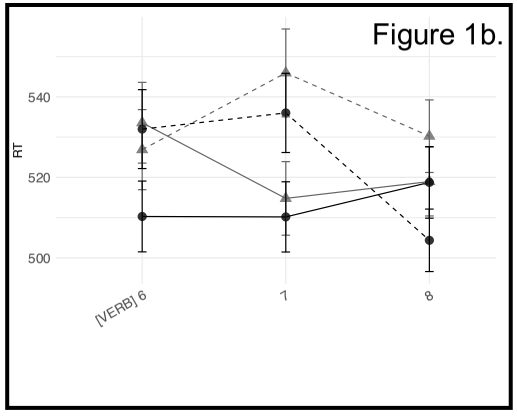


Figure 1a: Mean RTs (se) for the Number items.

Figure 1b: Closeup of the Critical Regions on the Number items.

Figure 2: Mean RTs (se) for the Number items.

Table 1: Example item sets.

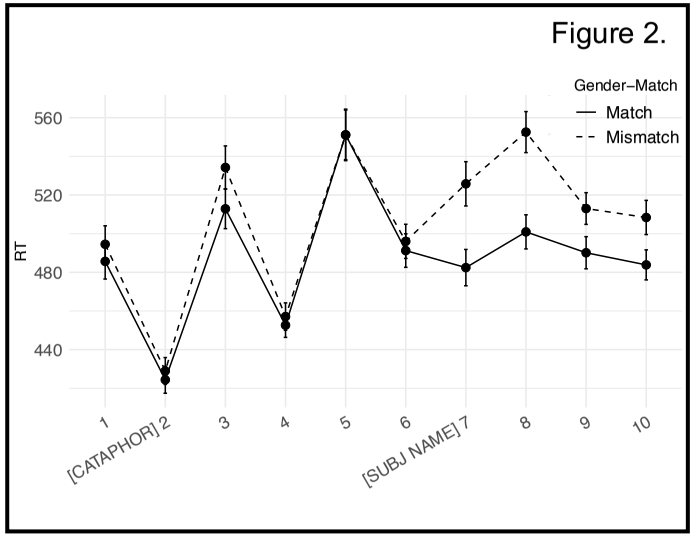


Table 1.

Number items:						
Singular Verb, Match/Mismatch	Nadat$_1$ After	**[hij/zij]**$_2$ [he/they]	ontslag$_3$ resignation	[had/hadden]$_4$ [had.SG/PL]	genomen,$_5$ taken,	kopieerde$_6$ copied.SG
	de bijzonder$_7$ the exceptionally		jonge$_8$ young	onderzoeker$_9$ … researcher		
Plural Verb, Match/Mismatch	Nadat$_1$ After	**[zij/hij]**$_2$ [they/he]	ontslag$_3$ resignation	[hadden/had]$_4$ [had.PL/SG]	genomen,$_5$ taken,	kopieerden$_6$ copied.PL
	de bijzonder$_7$ the exceptionally		jonge$_8$ young	onderzoekers$_9$ … researchers		
	After he/they(PL) resigned, the exceptionally young researcher/s copied (the professor's personal files on a USB stick.					
Gender items: Match/Mismatch	Nadat$_1$ After	**[zij/hij]**$_2$ [she/he]	de treinkaartjes$_3$ the train_tickets	[hadden/had]$_4$ [had.PL/SG]	gekocht,$_5$ bought,	schreef$_6$ wrote.SG
	Sandra$_7$ Sandra	onmiddellijk$_8$ immediately	de datum$_9$ the date	van [haar/Jans]$_{10}$ of [her/Jan's]	aankomst op$_{11}$ … arrival	up
	After she/he had bought the train tickets, Sandra immediately wrote down her/Jan's date of arrival...					

References [1] Van Gompel, R. P., & Liversedge, S. P. (2003). *JEP: Learning, Memory, and Cognition*, *29*(1), 128. **[2]** Kazanina, N. et al. (2007). *JML*, *56*(3), 384-409. **[3]** Giskes, A. & Kush, D.W. (2021). CUNY 2021 [poster presentation].