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Word order affects the time-course of sentence formulation in Tzeltal

Elisabeth Norcliffe¹, Agnieszka E. Konopka¹, Penelope Brown¹ & Stephen C. Levinson^{1,2} (¹Max Planck Institute for Psycholinguistics, ²Radboud University Nijmegen)
elisabeth.norcliffe@mpi.nl

To produce a sentence, speakers must first generate a preverbal message and then map it onto a linguistic structure. How are these processes affected by word order? Eye tracking studies have shown that in English, sentence formulation may be lexically incremental [1]: speakers may begin their utterance having conceptually and linguistically encoded only one character (the subject), and may delay encoding of additional characters and the relationship between them until after they complete encoding of the subject character. Lexical incrementality is supported by English syntax because verbs are positioned sentence-medially: the event structure and the verb need not be planned in advance. In verb-initial languages by contrast, speakers *must* plan the verb prior to speech onset, and we hypothesize that this grammatical constraint may influence the extent to which speakers encode the event structure at the outset of formulation. We used eye tracking to study the time-course of sentence formulation in Tzeltal, a verb-initial Mayan language: specifically, we take advantage of word order variability in Tzeltal to test whether early verb production implies that speakers encode the relationship between the two characters earlier than when verbs are produced sentence-medially.

In Tzeltal, basic word order is VOS (1), although scrambled SVO ordering (2) is also possible:

(1) ya s-nuts me'mut te antse	(2) te antse ya s-nuts me'mut
ASP 3SG-chase chicken the woman	the woman ASP 3SG-chase chicken
The woman is chasing a chicken	The woman is chasing a chicken

Thirty four native Tzeltal speakers participated in a picture-description eye-tracking study [1,2]. Target pictures, embedded in a list of unrelated fillers, showed two-character events that could be described with active or passive sentences. The distribution of responses on these trials (1145 sentences, 78% verb-initial and 22% verb-medial) was consistent with the overall preference for VOS word order [3]. Passives were produced slightly less frequently than actives (47% of the total dataset); the majority of passives had V-Oblique-S word order (89%).

We examined the distribution of fixations to the two characters over time for the different sentence types. The time-course of formulation for (active) VOS and SVO sentences showed that speakers were more likely to distribute their attention between the two characters in verb-initial sentences in a very wide time window (the first 2000 ms of a trial) than in verb-medial sentences. Specifically, formulation of SVO sentences proceeded as in English active sentences: speakers directed their gaze to the agent rapidly after picture onset and shifted attention to the patient approximately around speech onset [1], suggesting that encoding of the two characters was sequential. In contrast, formulation of active VOS sentences began with early fixations to the agent after picture onset, but this was rapidly followed by a sustained phase (400-2300 ms) in which fixations were distributed evenly between the agent and patient. This indicates earlier encoding of the patient and the action/verb than in SVO sentences. Finally, speakers redirected their gaze to the agent (the sentence-final subject) at around 2300 ms. A similar pattern was observed with passive verb-initial sentences: only after a phase of distributed attention between agent and patient did speakers direct their gaze to the patient (the sentence-final subject), at around 2300 ms.

The difference between the formulation of verb-initial and verb-medial sentences shows that speakers of Tzeltal adopt different strategies to encode these sentence types and, crucially, that the time course of encoding event participants may be mediated by the structural constraints of the language.

References

- [1] Gleitman, January, Nappa, & Trueswell (2007). *JML*, 57, 544-569.
- [2] Griffin, & Bock (2000). *Psych Sci*, 11, 274-279