

Prosody drives eye movements from early on in semantic comprehension

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Background: Numerous studies have shown that sentence-level semantic comprehension may sometimes proceed in a non-incremental fashion. Such processing delays may not only relate to structural complexity and the avoidance of semantic revisions [1-3] but also to the visual presentation of sentence materials. In particular, word-by-word reading lacks relevant auditory cues that the parser can use for predicting upcoming sentence continuations [4]. However, in a former ERP study with spoken sentences, we did not find an effect of prosody on predictive processing. Though the manipulation of prosodic contours in that study was directly informative with respect to the semantic phenomenon under investigation (i.e. the processing of quantifier restriction), the amplitude of the N400 was exclusively modulated by the truth evaluation process.

Paradigm: The present study tested the effects of prosodic contours on semantic comprehension in sentences involving quantifier restriction. We applied the experimental design of [5] to a visual world paradigm, a method that has a long-established tradition in research on sentence-level prosody [6]. In each trial, participants viewed an array of four pictures (A-D; Fig.1 and 2), in which objects like triangles of different colors (e.g. blue or red) were presented inside and outside of a container form (e.g. a circle). After a short preview, participants heard naturally-produced sentences with the quantifier *alle* ('all') in one of two prosodic variants: Variant (1) involved a falling contour, signaling the end of the sentence on the adjective *blau* ('blue'), and variant (2) involved a continuation rise, signaling that a further restriction would follow [5]. Five seconds after the start of the audio signal, three of the pictures disappeared. Participants responded as fast as possible whether the remaining picture fitted with the sentence just heard by pressing buttons.

Conditions: Depending on the context pictures, sentences (1) and (2) involve different truth values at the **adjective** (*blau*, 'blue'): they are false for A,C and D but true for B. For (2), truth values may change for sentences related to pictures A and D at the preposition *innerhalb* ('inside-of') or *außerhalb* ('outside-of') in the relative clause. In these cases, the truth evaluation was shown to be postponed from the adjective to the preposition. We examined whether sentence-end prosody yields an immediate commitment on the adjective by signaling that no meaning shift would follow.

Eye Tracking and Hypotheses: We measured fixations during sentence listening on the four pictures for five seconds after the onset of the auditory signal and calculated empirical log transformations [7] of fixation proportions at the position of the adjective (*blau*, 'blue'). At this word, we expected more looks towards simple pictures that involved a local evaluation of the sentence as "true" (B), relative to all other pictures. If the prosodic manipulation is considered immediately, we expect that for sentence-end prosody (1), participants should equally reject false (C) and complex conditions (A,D), as prosody indicates that no meaning shifts would be possible. Thus, each of these three pictures should be equally rarely fixated. For sentence-continuation prosody (2), a similar pattern as in previous studies should arise: the looks towards the complex pictures (A,D) should be in-between the looks to simple pictures involving true (B) and false (C) truth evaluations.

Preliminary Results and Discussion: So far, we could not finish data acquisition due to COVID-19. Here, we report the results of 9 participants (see Fig.3). The overall task performance was high (94.9% correct responses). Similar to previous ERP studies, we found a processing bias towards true utterances: Participants fixated pictures associated with true judgments (B) more often than false ones (A,C,D) for sentence-end prosody (1) at the **adjective**. For sentence-continuation prosody (2), the fixation pattern was more variable at the adjective. We thus found an immediate interaction between prosodic information and the semantic truth evaluation, contrary to our previous ERP results. In our presentation, we will discuss this apparent discrepancy between the two methods. However, the current results generally need to be interpreted with caution, as they are only initial findings, and the total number of participants ($n=32$) still has to be measured. The current data are also the background for further studies on quantifier acquisition.

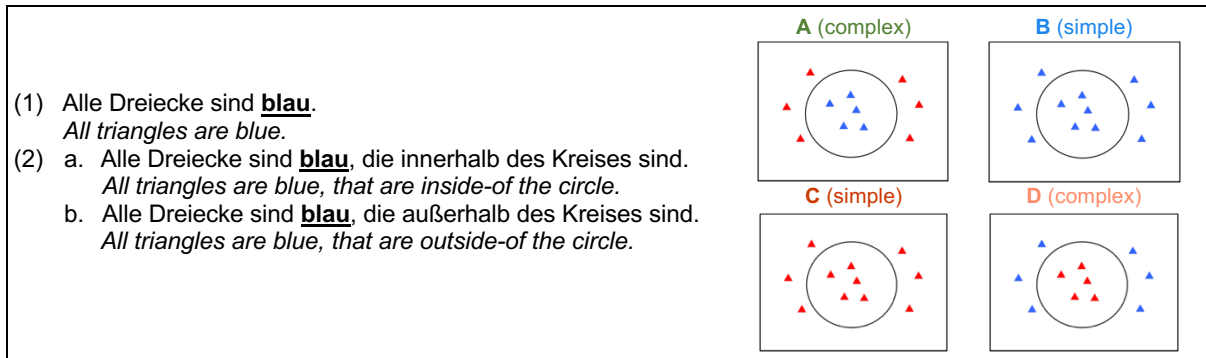


Fig. 1: Experimental sentences and the four pictures (A, B, C, D) that were used as targets for fixations in the experimental array. Figures were presented simultaneously, and their ordering on the screen was counterbalanced across items and participants.

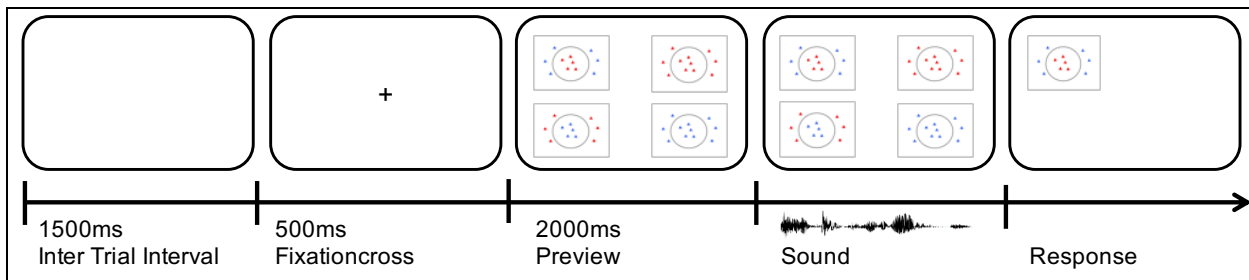


Fig. 2: Schematic overview of an experimental trial.

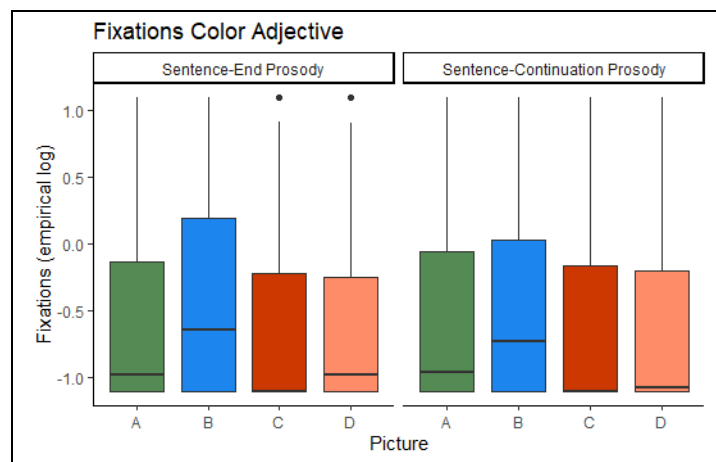


Fig. 3: Boxplot for empirical log transformed fixations to four pictures by prosodic variation in the time bin for the adjective. (Horizontal line = median; box = interquartile range; whisker = minimum/maximum; individual points = outliers)

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