Cross-linguistic differences in incremental planning under message uncertainty

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Speakers occasionally must begin speaking before they are certain of what message to communicate [1]. One strategy that could allow them to do this is incremental planning: speakers can begin producing the more certain parts of an utterance, and continue planning as the rest of the message becomes clearer. The degree to which speakers plan incrementally is under strategic control [2], depending on both the production context and the grammar of the language [3,4]. This might suggest that speakers' strategies for planning under uncertainty can vary with the language being spoken. Here we use an event-description paradigm to investigate how the word orders of Spanish and English affect speakers' strategies and time course of event description when part of the message is still unknown.

Procedure. 27 Spanish speakers and 29 English speakers viewed videos of unfolding motion events, where an actor moves from a source location to a goal location on the opposite end of the screen. Participants' task was to describe the unfolding event for their experiment partner (a confederate) in a Zoom session, and they were told their partner would have to identify the scene in real time. In each trial, there were two potential goal locations on the screen. The two goals were the same object type but in different colors; see Figure 1. Felicitous descriptions must therefore specify the color of the goal, e.g., *the butterfly is moving to the red slide*. The trial unfolded according to one of two conditions: In the Direct condition, the actor moved in a direct path towards the target, making the target goal known once the movement began. In the Uncertain condition, the actor initially moved in a path that was equally between the two goals, creating temporary ambiguity about the target goal. When it was near the two potential goals, the actor turned toward the target goal, disambiguating the message and completing the event.

Hypotheses. Although there is initial uncertainty about the goal identity in the Uncertain condition, the noun portion of the goal (*slide*) can be planned in advance because it is shared by both goal options. However, grammar rules of English require that the color – the *uncertain* component – be spoken before the noun. In contrast, nouns in Spanish typically appear before adjectives (e.g., *tobogán rojo, 'slide-red'*). When producing Spanish, speakers can produce the certain component (*slide*) first, allowing more time to plan the uncertain component (*red*). We expected participants to plan their utterances incrementally as the event unfolds, resulting in longer initiation latencies and word durations in the Uncertain condition than in the Direct condition. However, differences between the Uncertain and Direct conditions should be smaller in Spanish compared to English, or at least emerge later in the utterance.

Results. For analyses of durations, utterances were divided into six chunks, see Figure 2: 1) speech initiation latency, 2) Actor, 3) Verb, 4) Preposition + article, 5) Goal, 6) Color. Spaces between chunks (silence, word additions) were included with the later chunk. Figure 3 shows that for speech initiation latency, we found a marginal interaction between Condition and Language – latencies were longer in the Uncertain condition, but the effect was larger in English compared to Spanish. In contrast, durations of the color chunk and the goal chunk were longer in the Uncertain condition for Spanish but not for English. Interactions at other positions were not significant, but we observed main effects of Condition: durations of the Verb and the PP+article were longer in the Uncertain condition. Finally, Figure 4 shows that English speakers were more likely to pause (>100 ms silence) in the Uncertain compared to the Direct condition before the verb and the PP, while for Spanish speakers the effect emerged before the color.

Discussion. Crosslinguistic differences in word order affected speakers' incremental versus advance planning strategies. The Spanish *noun-adjective* word order allowed more incremental planning, but English speakers had to consider the ambiguous goal (color) at earlier positions, given the *adjective-noun* word order, yielding more advance planning. Our findings show that the balance between advance planning and incrementality in language production is influenced by both message properties and grammatical properties of the language: uncertain messages delay and lengthen production, but the locus of these effects depends on the word order.

References
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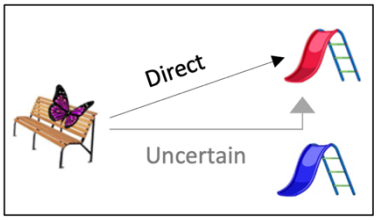

Fig. 1. Example of a trial display. Arrows and labels are for illustration only, demonstrating the trajectory for the Direct condition (black) versus the Uncertain condition (gray).

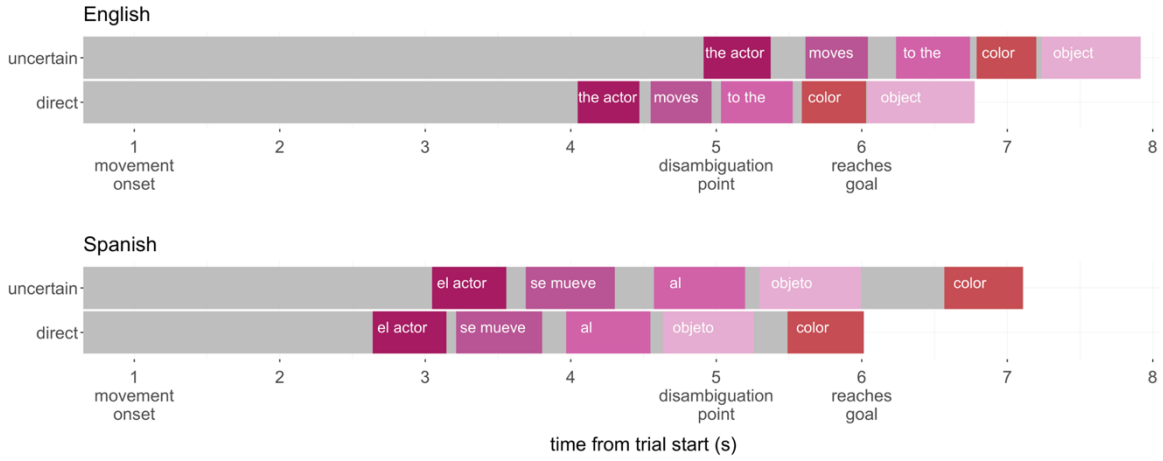

Fig. 2. Average chunk durations illustrated on the trial timeline, as a function of Language and Condition. Trials began at 0 seconds and ended at 10 seconds but these time points are not displayed. The disambiguation point (turn) only applies to the Uncertain condition.

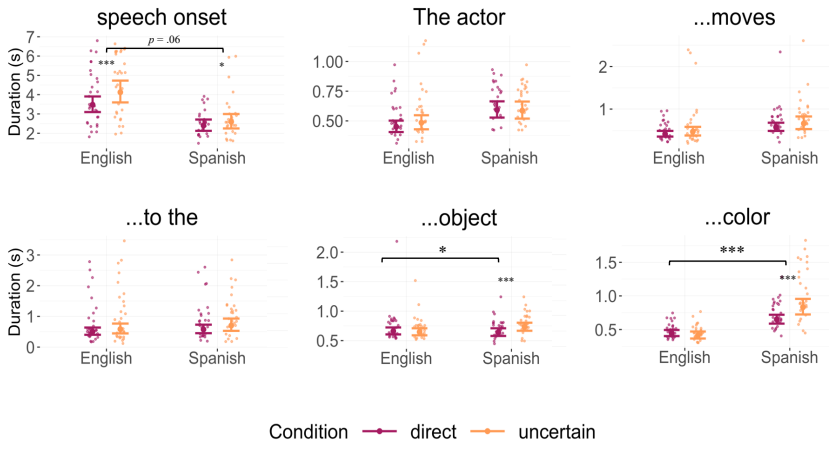

Fig. 3. Model predictions for the duration of each chunk as a function of Language and Condition. Recall that in English the color chunk was produced before the object chunk. Asterisks representing statistical significance are only shown for significant interactions and their simple effects. Error bars represent 95% CI.

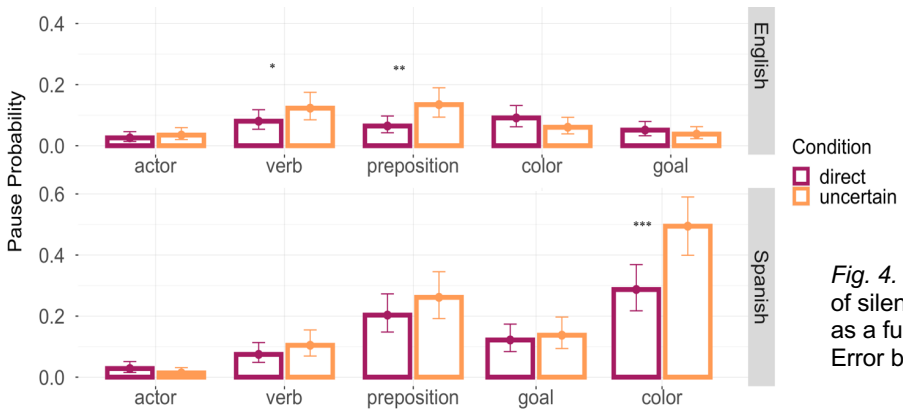

Fig. 4. Model predictions for the probability of silent pauses (>100 ms) at each chunk, as a function of Language and Condition. Error bars represent 95% CI.