What's, uhh, coming next? ERP adaptation to distributional characteristics of disfluency

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Speech disfluency tends to precede unpredictable words [1], making disfluency a potentially useful pragmatic cue [2]. Some evidence indicates that listeners can use disfluency to modulate expectations about upcoming words: For example, the N400 expectancy effect can be attenuated following a filled pause (e.g. "um"), suggesting that such disfluencies decrease listeners' certainty about the semantic features of upcoming words [3]. However, other findings suggest disfluencies do not always specifically modulate the content of listeners' predictions, and instead under some conditions may rather serve to generally orient attention toward upcoming words [4]. Further, effects of disfluency on the content of listeners' expectations, when they are obtained, are neither automatic nor obligatory. Indeed, disfluency affects listeners' expectations less when a speaker is explicitly marked as likely to have difficulty producing fluent speech (and, thus, as more likely to be disfluent before predictable as well as unpredictable words) [5,6].

This ERP study investigates whether and how listeners can adjust their use of disfluency during processing given only *implicit* information about the utility of speech disfluencies over the course of an experiment. Specifically, we explore how listeners' use of disfluency dynamically adapts to the reliability with which a speaker produces them before unpredictable words. In addition to crossing **word expectancy** with **disfluency** in critical items [7], we manipulated the proportion of filler trials in which disfluency preceded unpredictable versus predictable words between two participant groups. For one group of participants (**reliable condition**), disfluency preceded unpredictable words (and predictable words were produced fluently) on a total of 75% of trials. For the other group (**unreliable condition**), disfluency was equally likely to precede unpredictable and predictable words. Crucially, critical items were identical across both groups, and the overall frequency of disfluency also did not differ between groups.

Overall we found that the N400 semantic expectancy effect was larger for words in disfluent contexts than in fluent contexts ($p<.001$; **Fig. 1**). This finding is more consistent with disfluency serving as a general attention-orienting cue [4] than as a cue to modulate the specific semantic content of predictions [3] within this experiment. Importantly, however, effects of disfluency were modulated by the distributional characteristics of disfluency in our materials, as evidenced by a significant interaction between word expectancy, disfluency, and reliability condition ($p<.005$; **Fig. 2**). Whereas disfluency enhanced N400 effects for participants in the reliable condition ($p<.001$), disfluency did not significantly influence N400 effects in the unreliable condition. These findings indicate that disfluency was less likely to orient listeners' attention when distributional associations between disfluency and unpredictable words deviated from listeners' prior expectations about these associations. Further, effects of filled pauses on listeners' memory for critical words in an incidental post-test diverged between groups, depending on when the word was encountered during the experiment ($p=.06$). In the unreliable condition, listeners were less likely to remember predictable words in disfluent than in fluent contexts late in the experiment ($p<.05$). This suggests that the combination of a disfluency and a predictable word became less surprising, and thus less memorable, over the course of the experiment. In contrast, there was no significant effect of disfluency on memory in the reliable condition.

These results, taken together, provide novel evidence that listeners can adjust how they use disfluencies as a pragmatic cue "on the fly" based on mere exposure to the distributional characteristics of a speaker's disfluencies.

References

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Example stimulus

[7] When the two met, one of them held out {his / his uhhh} {hand / badge}.

Fig. 1. Effects of disfluency and word expectancy across midline sensors (Fz, Cz, Pz, Oz).

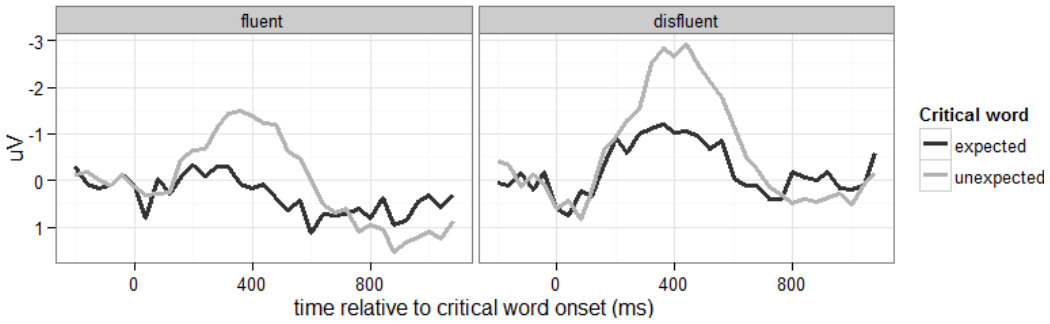

Fig. 2. Effects of disfluency, word expectancy, and group condition across midline sensors.