

## **“Please continue this –uh– ...”: How speech disfluencies facilitate unpredictable completions**

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Speech disfluencies are often produced in cognitively demanding situations (e.g., Bortfeld et al., 2001). The presence of a disfluency can therefore be a cue for listeners to adjust their expectations about the upcoming referent in favor of more cognitively demanding candidates. A substantial body of research has indeed shown that speaker disfluencies facilitate listener’s processing of unexpected words, for instance, infrequent (e.g., Bosker et al., 2014) or unpredictable (e.g., Corley et al., 2007) words. Many influential studies in the field have used experimental designs that investigate the effect of a disfluency on the processing of pre-selected referents that are typically manipulated along a single lexical variable (e.g., frequency) between conditions.

In the current study we investigated whether the facilitative effect of disfluencies on unexpected words would extend to a setting that does not restrict the set of possible referents. More specifically, we conducted an ‘open-choice completion’ study in which participants were asked to complete highly-constraining sentence prompts (mean cloze score of the predictable ‘target’ word = 0.80, SD=0.15) with a single spoken noun. The prompts were pre-recorded and presented auditorily in two conditions (fluent, disfluent), with the disfluency being realized as a filled pause in prompt-final position (see Figure 1). A total of 180 German sentence prompts were created and a minimum of 20 completions were collected for each item in each condition. The lexical frequency of given completion nouns was determined via Frequency Classes based on the German reference corpus, DeReKo (Lüngen, 2017).

A logistic mixed-effects regression model with maximal random effects structure revealed that fluent prompts had a higher probability of being completed with the predictable target noun than disfluent prompts ( $\beta=0.86$ ,  $SE=0.31$ ,  $z=2.79$ ,  $p<0.01$ ). This suggests that the presence of a disfluency made participants favor less predictable completions. In addition, in the disfluent condition, the chance that participants completed the prompt with the target noun increased as the lexical frequency of that predictable noun decreased (see Figure 2). This indicates that the disfluency does not necessarily introduce a bias towards alternative completions, but rather licenses low frequency completions even if they are highly predictable.

A linear mixed-effects model revealed faster speech onset times for completions in the disfluent condition compared to the fluent condition, which is most likely an effect of the temporal delay that the disfluency introduces, giving participants a head-start in the planning of their completion. However, while completion onset times were faster overall for disfluent prompts than fluent prompts, this advantage was greater for alternative completions compared to target completions (Estimate=-116.9,  $SE = 18.1$ ,  $t(6543.4)=-6.47$ ,  $p<0.001$ ) (see Figure 3). This is a strong indication that the disfluency facilitates alternative completions, making them available to participants more readily.

These results are consistent with previous work showing that speech disfluencies modulate listeners’ expectations about the upcoming speech signal, in favor of less predictable and less frequent candidates. Moreover, the current work extends previous evidence by demonstrating that the facilitation effects of disfluencies are detectable in the lexical characteristics of completion nouns in a setting that (a) does not introduce a fixed set of possible referents, and (b) uses constraining sentence prompts. Finally, our study provides a compelling indication that disfluencies facilitate low frequency candidates even if they are highly predictable.

*Eva ging zum Entenfüttern immer in den städtischen [äh] ...*

'To feed the ducks Eva always went to the communal [uh] ...'

Figure 1: Example stimulus in German and its English translation. The highly predictable 'target' noun for this item is *Park* ('park'), with a mean cloze score of 0.81. A rating study ensured that each sentence prompt had at least one semantically valid alternative completion. In the example stimulus this alternative completion is *Garten* ('garden') (mean rating=1.9, SD =1.1, on a scale of 1 (semantically valid) to 5 (semantically invalid)).

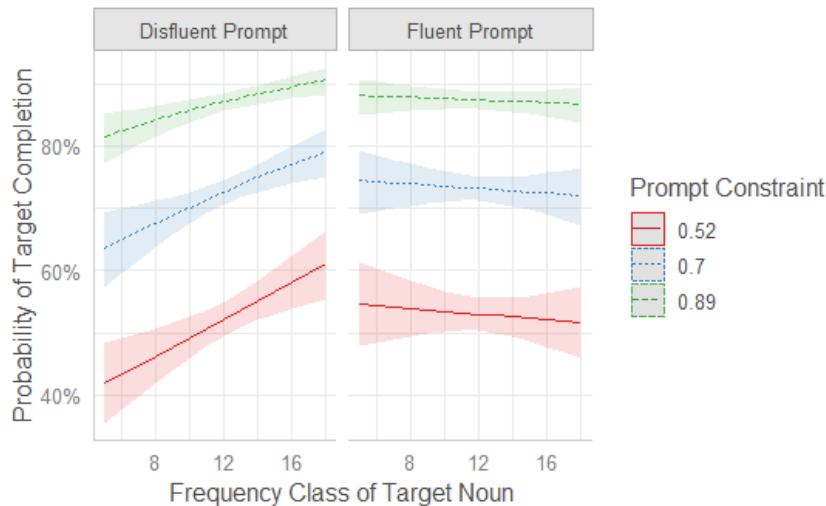


Figure 2: Probability that a given completion is equal to the highly predictable target noun for disfluent prompts (left panel) and fluent prompts (right panel). Both panels show that prompt constraint has a strong influence on the probability of a target completion. The frequency of the target noun hardly influences target completion probability in the fluent condition. However, in the disfluent condition, the probability of a target completion increases as the lexical frequency of the

completion decreases, i.e., has a higher frequency class. This suggests that the disfluency "reassured" participants in their choice of highly-predictable, low-frequency words.

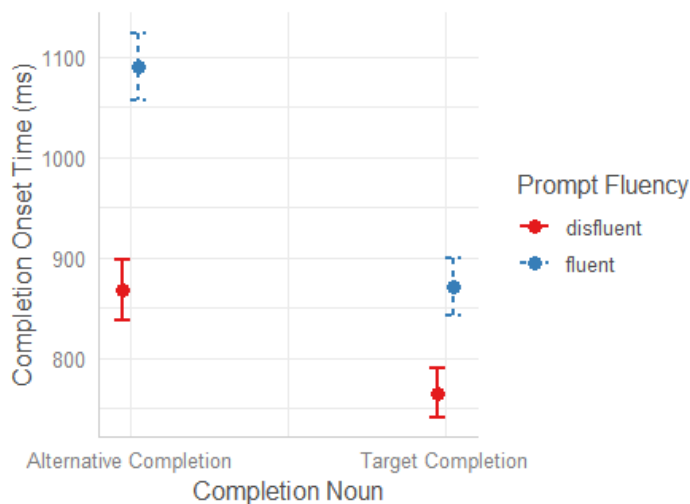


Figure 3: Speech onset time of completions in milliseconds by prompt fluency (fluent, disfluent) and completion noun type (target, alternative). While completion onset times were faster overall for disfluent prompts than fluent prompts, this advantage was greater for alternative completions compared to target completions. This suggests a facilitation of alternative completions in the disfluent condition.

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