

Prediction failure and executive control: Evidence from a modified Hayling Task

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The idea that language comprehension involves predictive mechanisms is now widely assumed (Kutas, DeLong, & Smith, 2011; Van Petten & Luka 2012; cf. Nieuwland et al., 2018). However, in everyday situations, predictions are likely to fail (Luke & Christianson, 2016), raising the question how the comprehension system recovers from prediction failures. The research here addresses this question from an executive control perspective, hypothesizing that in addition to reanalysis, *inhibition* also plays a role in recovery from failed prediction.

To examine the role of inhibition, we modified the Hayling task – a verbal sentence completion task used in the neuropsychological assessment of patients with executive dysfunction (Burgess & Shallice, 1997). The task consists of a series of high-cloze sentence fragments designed to elicit an expected completion. It requires participants to either **INITIATE** this expected response (Part A) or **INHIBIT** it (Part B) as quickly as possible. For example, given the fragment “In order to eat the soup, the guest asked the waiter for a clean...”, a participant in Part A should respond with a semantically coherent word (e.g. “spoon”), while a participant in Part B should respond with an unrelated, but grammatically correct word (e.g. “dog”).

We hypothesized that cues to prediction failure, while disruptive to response initiation, could facilitate inhibition of expected words. To control prediction success and failure, we manipulated gender agreement between articles and expected nouns in German. Articles that **MISMATCH** in gender with an expected noun cue the system to a prediction failure (Van Berkum et al., 2005). Compared to gender **MATCH** conditions, we expected the inhibition triggered by **MISMATCH** conditions to disrupt response initiation in the **INITIATE** part of the task as participants must search for another noun for sentence completion. We further hypothesized that gender **MISMATCH** would facilitate response inhibition in the **INHIBIT** part as inhibition from prediction failure might aid the participant in suppressing the expected response.

We constructed 32 German sentences with high cloze (avg. cloze: .80) noun completions. These were preceded by a gender marked article that appeared 5 syllables before the end of the sentence fragment. We manipulated the gender of this article to match or mismatch the expected completion, as in (1) where the expected completion is *Straße* ‘road-FEM’. Whole sentences were recorded and the final noun removed in Praat. Gender agreement and task instructions were counterbalanced across four lists. The experiment was conducted in two separate parts. Participants listened to the sentence fragments and were asked to **INITIATE** with the expected completion, or **INHIBIT** the expected completion by responding with an unrelated word. Responses were recorded and voice onset times measured.

- (1) Günther half der alten Dame über **eine/einen** vielbefahrene/vielbefahrenen...
Günther helped the old lady across **a-FEM/a-MASC** busy-FEM/busy-MASC...

In an LME model (fixed effects: task (**INITIATE** vs. **INHIBIT**) x gender agreement (**MATCH** vs. **MISMATCH**); random effects: participants & items), the interaction between task and gender agreement was significant ($\chi^2(1) = 28.1, p < .001$). Gender **MISMATCH** slowed **INITIATE** response onset times by 1296 ms ($t = -5.3$) and although not significant, we saw a numerical facilitatory trend for gender **MISMATCH** in **INHIBIT** response times by 253 ms, $t < 2.0$, (Fig. 1). This suggests that speakers had predicted the expected noun under both parts, but that gender **MISMATCH** facilitated suppression of the expected word. This hindered participants when producing a semantically coherent response, but aided participants when responding with an unrelated word. This evidence is consistent with inhibitory mechanisms being available during recovery from prediction failure.

To follow up on these initial results and the trend seen in the **INHIBIT** conditions, we would like to focus on properties of the expected word such as its morphological complexity next. This will allow us to gain a better understanding of the processes in place during prediction and recovery from prediction failure.

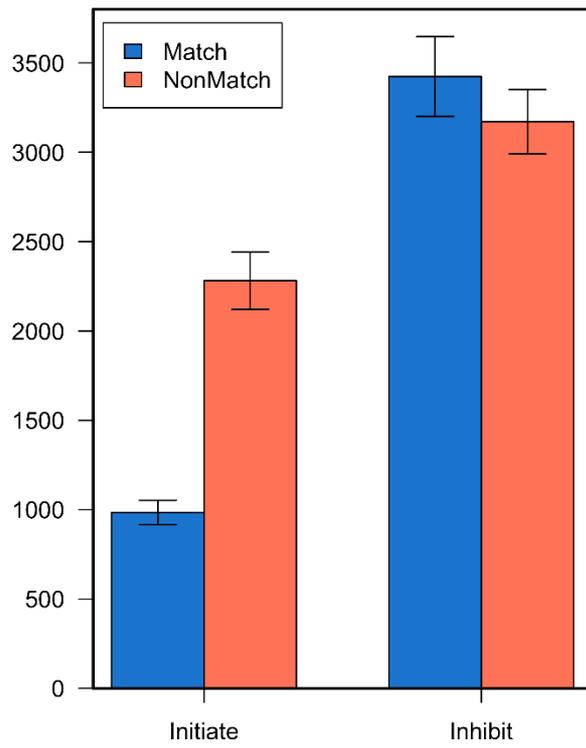


Figure 1. *Response onset times for sentence fragment completions (in ms)*