PREDICTION GONE WRONG: A MOUSE-TRACKING STUDY IN SENTENCE COMPREHENSION

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Prediction is thought to enhance sentence comprehension (Pickering & Garrod, 2007), because it is supported by a smart system that is mostly right and therefore likely to speed up processing. An alternative view is that prediction does not always benefit comprehension because, on average, predictions are wrong more often than they are right. On this view, prediction may be better viewed as part of processes that support error-based learning (Chang, Dell, & Bock, 2006).

To compare these accounts, a mouse-tracking study was carried out where 42 participants selected one of four objects on a computer screen based on written instructions like “Click on the car that is orange” (Fig.1). Target displays included a goal object (e.g., *orange car*), a distractor object in a different color (*pink car*), and two other objects, one of which matched the color of the goal object (*orange* drawer, *blue* walnut). Target trials were preceded by 3 types of primes where participants selected the same goal object as in the target trials based on instructions presented with and without modifiers (15 trials per condition). *Neutral* primes had goal objects of a different color than those on target trials (“Click on the car [that is red]”). *Match* primes had the same color goal object in both prime and target displays (“Click on the car [that is orange]”). *Mismatch* primes had goal objects that matched the color of a distractor in the target trial (“Click on the car [that is pink]”).

Reaction times (RTs) for clicking on the correct goal object were compared across conditions over time. If predictions are generated by a smart comprehension system, then Neutral RTs should be intermediate between Match RTs and Mismatch RTs. If Neutral RTs pattern like Mismatch RTs, this would suggest that predictions in this condition can routinely slow down processing in a manner akin to when the system is explicitly misled.

RTs dropped over the course of the experiment (*t*=-8.8), likely reflecting the learning of expectations that supported fast responding to instructions (Fig.2). Importantly, Match RTs were faster than both Neutral and Mismatch RTs (t=-3.8), but Neutral and Mismatch RTs did not differ from each other. There was no difference due to presence of the modifier.

Figure 1: Target screen

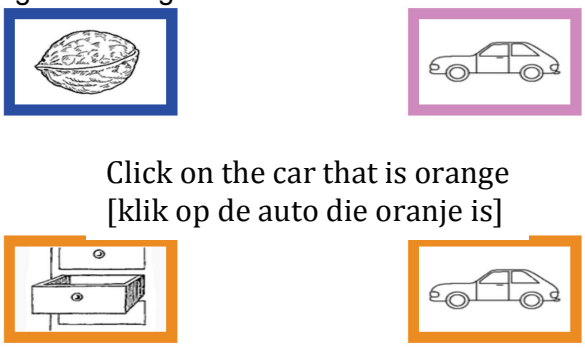
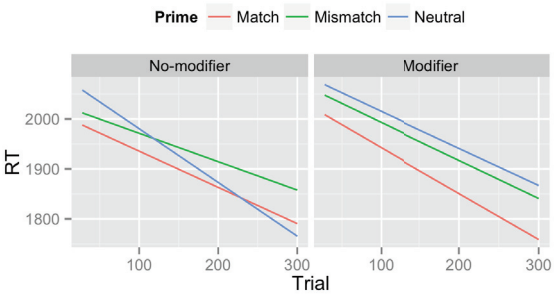


Figure 2: RT by trial, condition, and modifier



Thus in the Neutral condition, participants searched for the goal object of the previous prime trial, even though an object of that color was not present in the target displays. This predictive searching led to a slowing of performance that resembles the slowing on trials where the prime goal object matched a *distractor* object in target displays (Mismatch condition). Since the Neutral condition best reflects real-world comprehension situations (it requires the least coordination of expectations and the world: e.g., searching for apples, then oranges, then bananas in a grocery store), the fact that it is easy to hinder performance in these conditions suggests that prediction is not necessarily supported by a smart adaptive system but that it supports other functions like learning (Dell & Chang, 2013).