Event-Based Expectations and Local Constraints During Reading: Evidence From Eye Tracking

Nicolás Acuña[1]; Valeria Arriaza[1]

In predictive accounts of language comprehension, pre-activated words are typically assumed to be easier to process than non-predicted alternatives. Consistent with this view, predictable words often elicit reduced N400 amplitudes, a pattern commonly interpreted as evidence of lexical pre-activation. Similar reductions have also been observed for unexpected but event-related continuations (Metusalem et al., 2012; Hintz et al., 2020). These findings have been taken as evidence that event-level knowledge can pre-activate semantically compatible information beyond specific lexical items. At the same time, it has been argued that such effects may not uniquely reflect prediction, but could instead arise from the ease with which incoming input is integrated into an activated discourse representation (Nieuwland et al., 2019). As a result, it remains unclear whether effects typically attributed to prediction can be distinguished from those arising from post-lexical integration, given that both processes may produce comparable behavioral and neural signatures.

A related issue concerns the sources of information that constrain expectations during comprehension. Expectations can be driven by local lexical-syntactic constraints (Levy, 2008) or by global discourse-level representations such as event knowledge (Hintz et al., 2020). While both sources influence processing, it remains unclear how they interact over time when they generate conflicting expectations.

The present study investigates how event-based expectations interact with local lexical-syntactic constraints during online sentence comprehension. Specifically, we examine how event-based expectations influence early and late stages of processing when they conflict with locally supported continuations.

Seventy native Spanish-speaking participants are being recruited to read 42 short narrative texts while their eye movements were recorded. Each item ended in a target word presented under one of three conditions: (1) highly predictable, (2) unexpected but event-related, and (3) unexpected and event-unrelated. For example: Julia spends most of her free time exercising. Her favorite machine at the gym is the treadmill. After every workout, she ended up soaked in *sweat / weights / sofa* on her back. Critically, both unexpected conditions conflicted with the locally established sentence context while differing in their compatibility with the broader event representation. Eye-movement measures included first fixation duration (FFD), regression path duration (RPD), total reading time (TRT), and regression probability. Data were analyzed using linear mixed-effects models with participants and items as random intercepts.

Early measures based on the current dataset (N=22) show only small numerical differences between anomalous conditions (FFD: predictable = 202.7 ms; event-related = 217.4 ms; unrelated = 221.6 ms), suggesting limited or weak lexical pre-activation driven by event knowledge. In contrast, mixed-effects analyses revealed robust effects in later measures. In the target region, both anomalous conditions elicited longer regression path durations ($\beta \approx 0.20–0.21$) and total reading times ($\beta \approx 0.41$) relative to predictable continuations.

Crucially, in the spillover region, event-related anomalies produced greater processing costs than unrelated anomalies (RPD: predictable = 1072.8 ms; event-related = 1596.3 ms; unrelated = 1414.5 ms; $\beta \approx 0.39–0.44$), indicating greater downstream processing costs when global event-based expectations conflict with local constraints.

[1] Department of Language and Literature, Faculty of Education Sciences, Universidad Católica del Maule, Talca, Chile

Table 1. Eye-movement measures across conditions (ms)

Region	Measure	Predictable	Event-related	Unrelated
Target	FFD	202.7	217.4	221.6
Target	RPD	341.1	455.6	440.4
Target	TRT	378.4	613.4	641.7
Spillover	RPD	1072.8	1596.3	1414.5
Spillover	TRT	787.4	1067.3	999

The observed pattern reveals a temporal dissociation between early and late processing stages. In early measures, event-related continuations showed a small advantage over unrelated anomalies (FFD), a pattern that is compatible with partial pre-activation of event-based information. Although this effect is limited in magnitude, it suggests that global event knowledge can bias initial lexical access by activating semantically compatible continuations.

Crucially, this early advantage does not persist. In later measures, particularly in the spillover region, the pattern reverses: event-related anomalies elicit greater processing costs than unrelated anomalies. This suggests that the same event-based expectations that may facilitate early processing are associated with greater downstream processing costs when they conflict with local constraints.

This reversal suggests that event-based expectations may influence early and late stages of processing differently. While early facilitation is consistent with the activation of event-based expectations, the increased downstream cost may reflect the effort required to reconcile a mismatch between global event representations and local lexical-syntactic constraints. Importantly, this pattern suggests that facilitation effects and integration costs can arise from the same underlying source of information but at different temporal stages.

More broadly, the present design offers a way to disentangle processes that are often confounded in studies of predictive processing. Effects that are typically interpreted as evidence for lexical prediction may, in some cases, reflect ease of integration, whereas early facilitation effects may remain undetected without temporally sensitive measures. The present findings suggest that event knowledge is associated with a weak early facilitation and a robust late integration cost under conditions of conflict, highlighting the importance of distinguishing between these processes when interpreting predictability effects.

Taken together, these findings suggest that event knowledge does not uniformly facilitate processing, but instead exerts temporally distinct effects: a limited early bias consistent with pre-activation, followed by increased integration costs when global expectations conflict with local constraints.

References

Hintz, F., Meyer, A. S., & Huettig, F. (2020). Activating words beyond the unfolding sentence: Contributions of event simulation and word associations to discourse reading. *Neuropsychologia*, 141, 107409.

Levy, R. (2008). Expectation-based syntactic comprehension. *Cognition*, 106(3), 1126-1177.

Metusalem, R., Kutas, M., Urbach, T. P., Hare, M., McRae, K., & Elman, J. L. (2012). Generalized event knowledge activation during online sentence comprehension. Journal of memory and language, 66(4), 545-567.

Nieuwland, M. S., Barr, D. J., Bartolozzi, F., Busch-Moreno, S., Darley, E., Donaldson, D. I., ... & Von Grebmer Zu Wolfsthurn, S. (2020). Dissociable effects of prediction and integration during language comprehension: Evidence from a large-scale study using brain potentials. Philosophical Transactions of the *Royal Society B: Biological Sciences*, 375(1791).