

## The espresso left: Using eyes with brains – Co-registration of eye movements and ERPs during the processing of ad-hoc metonymies

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Research on metonymic expressions like “reading Dickens” suggests that understanding a metonymic sense can be as *straightforward* as understanding the corresponding basic sense (e.g. “meeting Dickens”), at least as long as the different senses are already known to the reader (e.g. Frisson & Pickering, 1999). In contrast, certain metonymic interpretations must be inferred ad hoc, illustrated by “the espresso” in (3), which is used by a restaurant supervisor to refer to a customer associated with this item (similar to Nunberg’s (1979) famous *ham sandwich* example). These types of meaning extensions have been reported to exert *processing costs* (e.g. Schumacher, 2011). Here we ask whether this difference is due to the type of expression tested – i.e. conventionalized extensions vs. ad hoc extensions – or is tied to the methods applied – i.e. eye-tracking in the former case and electrophysiology in the latter case.

The present research sought to align findings from these separate methodologies through the co-registration of eye movements and event-related potentials (ERPs). **Experiment 1** (N=19) considered the processing of novel metonymies such as “the espresso” in (1). We split our participants into two groups: those that show a higher and a lower number of eye movement regressions to earlier parts in the sentence (high and low regressors; see also Metzner et al., 2017). Compared to non-metonymic control sentences (2), metonymic expressions elicited early and later eye movement disruptions. In addition, the ERP data showed a sustained N400 effect (from 250ms post-onset of first fixations) in high regressors, but not low regressors (Fig. 1a and 1b).

**Experiment 2** (N=19) examined the role of context in the processing of metonymic expressions (3) and their controls (4). When metonymies were contextually-licensed, early eye movement disruptions disappeared, but later eye movement effects remained.

- (1) **Neutral context, metonymic expression:** *Claire asks Liam who it was who left without paying. Liam replies that **the espresso** left without paying.*
- (2) **Neutral context, control expression:** *Emma asks Jim what it is that's new on the menu. Jim replies that **the espresso** is new on the menu.*
- (3) **Supportive context, metonymic expression:** *The attendant asks her supervisor who it was who left without paying. Her supervisor replies that **the espresso** left without paying.*
- (4) **Supportive context, control expression:** *The waitress asks her boss what it is that's new on the menu. Her boss replies that **the espresso** is new on the menu.*

Additionally, a right frontal negativity (250-750ms post-onset) and a posterior positivity (450-850ms) emerged in the ERP data in high regressors (Fig. 1c and 1d), while the low regressors showed a sustained right frontal negativity (from 250ms).

In light of these results, we argue that early effects observed in eye-tracking and ERP studies may represent the same underlying cognitive mechanism: an expectation-based prediction error that is modulated by the contextual manipulation (Exp.1 vs. Exp.2). The presence of supportive context (Exp.2) is sufficient to eliminate early processing costs. This is in line with

previous reports of context sensitivity of novel metonymy (Frisson & Pickering, 2007; Schumacher, 2014).

By contrast, our results do not confirm context-independent findings of later effects during the processing of this type of metonymy (Late Positivity in Schumacher, 2011; 2014). In particular, only high regressors showed Late Positivity effects. This finding is compatible with Metzner et al. (2017), who report positivity effects in association with high regressors. Furthermore, a sustained frontal negativity emerged for both groups of participants. This suggests that later processing costs seen in response to ad hoc metonymies may depend on the task demands associated with stimulus presentation (RSVP presentation in Schumacher 2011, 2014 vs. availability of the entire text in the present study). The frontal negativities may be due to greater demands posed by metonymic expressions during natural reading.

This research complements previous research by indicating that (i) ad hoc metonymies exert processing demands reflected in both eye-tracking and ERP measures, (ii) differ from more established lexical metonymies (“espresso” vs. “Dickens”), and crucially (iii) that presentation mode influences the underlying neural mechanisms involved in interpretation.

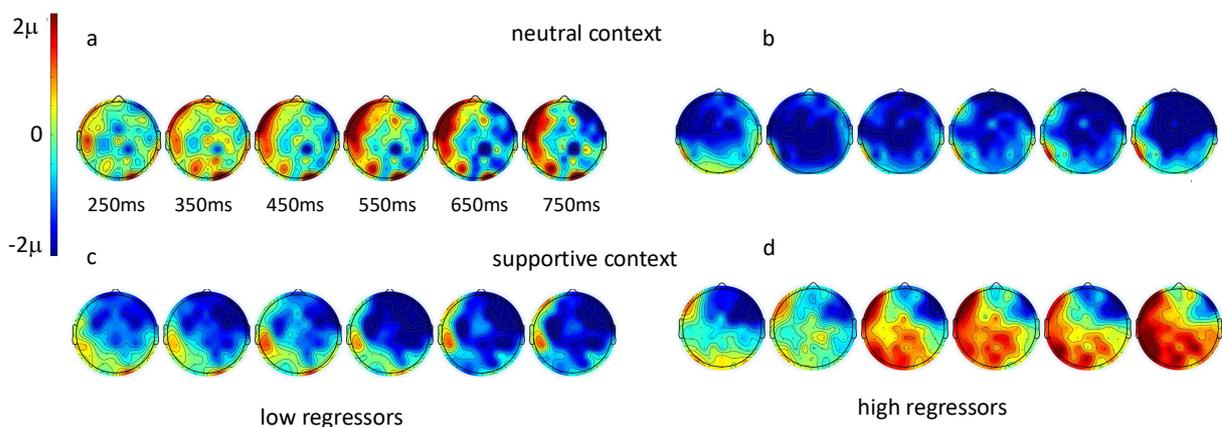


Figure 1. ERP responses to neutral and supportive context for low and high regressors (depicted in bins of 100ms length from 250-850ms post-onset of first fixations).

## References

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