

Ostensive communication modulates action interpretation at 9 months

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Infants readily learn from other people around them. However, observed actions are not all equally important, and ostensive-referential communication might help infants to identify relevant actions (Csibra & Gergely, 2009, 2011; Csibra, 2003). The presence of these signals does not just raise infants' attention towards actions or referred objects, but also leads to a differential encoding of communicatively presented information (Gergely & Csibra, 2003; Yoon, Johnson, & Csibra, 2008).

In the two experiments presented here we investigate potential learning mechanisms by looking at the electrophysiological activity of 9-month-old infants when watching actions presented in adult- vs. infant-directed contexts. Two groups of sixteen 9-month-old infants were presented repeatedly with four actors that were either communicative (looking directly from screen, infant directed speech), or non-communicative (looking down, adult-directed speech). The greetings were followed by an expectancy violation paradigm in which infants saw an action prime (e.g. actor holding spoon) followed either by the expected outcome (spoon to mouth) or an unexpected outcome (spoon to ear). In experiment 1 the object was absent during the greeting and expected and unexpected outcomes were shown for each actor. In experiment 2 the object was present during the greeting, the actor referred to it and consistently used same object congruently or incongruently. Otherwise the two experiments were identical.

We looked at three ERP components:

- The N400, a marker of semantic expectancy violation (Reid et al., 2009)
- The Pb, which has been reported in similar research on infants' integration of multimodal ostensive signals (Parise & Csibra, 2013)
- The Nc, an infant-specific marker of attention (Reynolds & Richards, 2017)

In experiment 1, we found evidence of an N400 effect for Outcome between 700-900ms ($F(1, 15) = 10.03, p = .006, \eta_G^2 = 0.20$), but no Outcome \times Communication interaction, or main effect of Communication (all $ps > .25$). There were no main effects or interactions on the Pb 200-350ms ($ps > .26$) or the Nc between 350-700ms ($ps > .49$).

In experiment 2 we replicated the N400 main effect for Outcome ($F(1, 15) = 7.09, p = .02, \eta_G^2 = 0.15$). We also found a *Communication* \times *Outcome* interaction on the Pb ($F(1, 15) = 10.24, p = .006, \eta_G^2 = 0.14$), with an increased positive peak for communicative-expected ($t(28.83) = 1.80, p = 0.08$) and non-communicative unexpected outcomes ($t(28.83) = -2.25, p = 0.03$). An Anova with Outcome and Communication as within-subjects factors and Study as a between-subjects factor showed a significant three-way interaction ($F(1, 30) = 8.86, p = .006, \eta_G^2 = 4.83$), indicating that infants' responses were reliably different between the studies. On the Nc, there was marginally significant result for the Outcome by Communication interaction on the Nc ($F(1, 15) = 4.14, p = .06, \eta_G^2 = 0.06$), and no significant main effects (all $ps > .20$).

These results indicate that infants assess actions differently in the presence of communication, but only if the agent makes clear she is referring to a particular object. Furthermore, already by 9months, they take into account the reliability of the actor as expressed by the enhanced Pb for the expected actions (cf. older children: Poulin-Dubois, Brooker, & Polonia, 2011; Zmyj, Buttelmann, Carpenter, & Daum, 2010), but not for the unexpected actions. In the absence of communication, the reversed Pb-response possibly reflects an attempt to maximise learning by seeking novel information (Twomey & Westermann, 2017).

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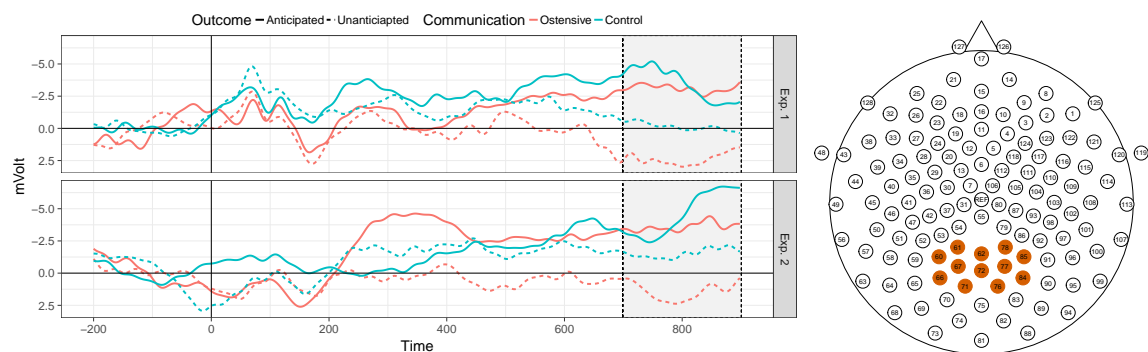


Figure 1. ERPs for Exp. 1 and Exp. 2 in the parietal area representing the action N400 between 600–800ms.

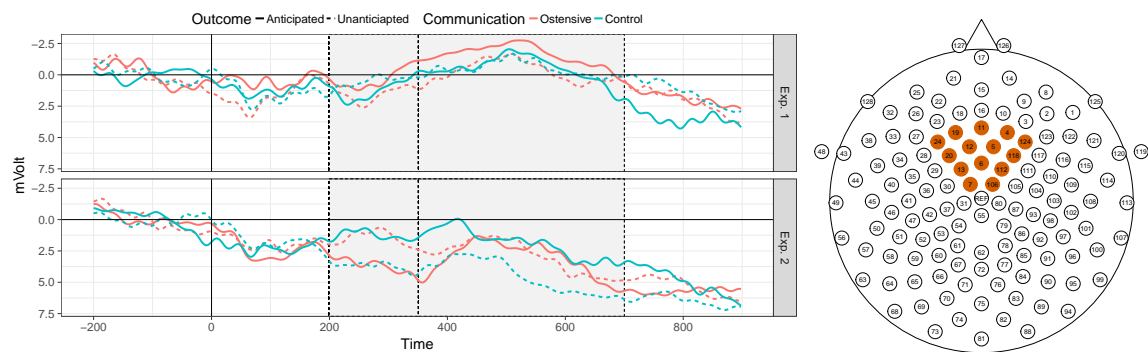


Figure 2. ERPs for Exp. 1 and Exp. 2 of the fronto-central area investigated for the Pb (200–350) and the Nc (350–700ms) components.