Long-term declarative memory performance in 14-15 month infants predicts the strength of neural response during associative learning

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Introduction

Deferred imitation (DI) is a robust measure of an early form of declarative memory in preverbal infants and also reflects individual differences in terms of cognitive and language development (Heimann et al. 1996; Heimann et al. 2006). Although research is ongoing, we still do not fully understand these individual differences or the underlying neural processes. Recent research indicates a correlation between memory performance measured by DI and electrophysiological measures (e.g. Meltzoff & Williamson, 2010; Heimann, Nordqvist, Rudner, Johansson & Lindgren, 2013). The present study examines how DI relates to associative learning observed through Event-Related Potentials (ERP), both after a delay of 30 minutes as well as after 2.5 weeks.

Methods

Participants

Participants in the study were 44 typically developing children (mean age 14 months, SD = 0.9), of which 18 children (7 boys) gave acceptable ERP data and are described here.

Procedure

- **Behavioral:** Event memory was measured by DI, with an observation only design. The delay was 30 min and there were three actions on objects to remember. Half of the group (9 children) performed DI again with an additional three actions on objects and a delay of 2.5 weeks.

- **Electrophysiological:** ERP was recorded with a Geodesic High Density Net with 128 electrodes, referenced to vertex and then re-referenced to average. Sampling rate was 250 samples/second. The ERP association learning procedure consisted of a **learning phase** where two pairs of pictures were presented five times (PRES 1-5) and a **test phase** introducing two violations: Two familiar pictures in a new combination (RECOMB) or a combination of one familiar and one novel picture (NOV).

Results

**Behavioral:**
- The children remembered on average two out of three actions for the 30 minutes-delay (M = 2.17; SD = 0.92), which is comparable to previous research that has included controls (e.g. Heimann & Meltzoff, 1996). For the 2.5 weeks delay, children remembered on average 0.44 actions (SD=0.53).

**Electrophysiological:**
- Fronto-centrally (see red markings on montage above) an Nc component was revealed within 300-600 ms post stimuli.
- When comparing the test phase to the last presentation of the learning phase (PRES 5), a significantly higher mean amplitude was observed for RECOMB (p < .05). However, this was not the case for NOV compared to PRES 5.

**Correlation between DI and ERP:**
- DI performance after 30 min delay was shown to correlate with change score in mean amplitude between PRES 5 and NOV (r (18) = -.70; p < .01). Correlation between change score between RECOMB and PRES 5 and DI performance after 30 min did almost reach significance (p = .055).

For the DI after the 2.5 week delay, there were no significant correlations with any of the change scores.

Conclusions

- Overall, we confirm our previous findings:
  - Behaviorally, the children remembered the tasks after 30 minutes but not after 2.5 weeks.
  - Associative learning as measured with ERP was related to deferred imitation after a 30 minutes delay. No relation was found for ERP and DI after 2.5 weeks.

References


