PREDICTION IN INFANTS AND ADULTS: A PUPILLOMETRY STUDY

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RESEARCH HIGHLIGHTS

1. The first study to use an identical learning task to compare prediction and prediction error for infants and adults.

2. Infants and adults exhibit strong parallels in time-course and magnitude of prediction error, as indexed by the pupil dilation response.

3. Computational modelling revealed that infants and adults experience and use prediction error to help them make more accurate predictions in similar ways.

4. These findings suggest a continuity of predictive processing between infancy and adulthood.

METHODS

PARTICIPANTS

27 6-months-old infants and 32 adults, completed an implicit learning task designed to help learn associations between sounds and pictures.

PUPILLOMETRY

Pupil dilation response (PDR) was measured using an eyetracker (Eyelink 1000)

LEARNING MODEL

We used the **Rescorla-Wagner (RW)** model (Rescorla & Wagner, 1972), a well-established associative learning theory that measures how prediction error affects the strength of predictions.

We assumed average PDR of each trial reflects the magnitude of prediction error in that trial (Nassar et al., 2012; Sirois & Jackson, 2012).

Prediction error is calculated for each trial (t) where O(t) is the appearance (or omission) of visual stimulus at trial (t) and P(t) is the predicted probability of that appearance:

$$\delta(t) = O(t) - P(t)$$

Predictions are updated for each trial based on the prediction error and learning rate, where α is the learning rate:

$$P(t+1) = P(t) + \alpha\delta(t)$$

RESULTS

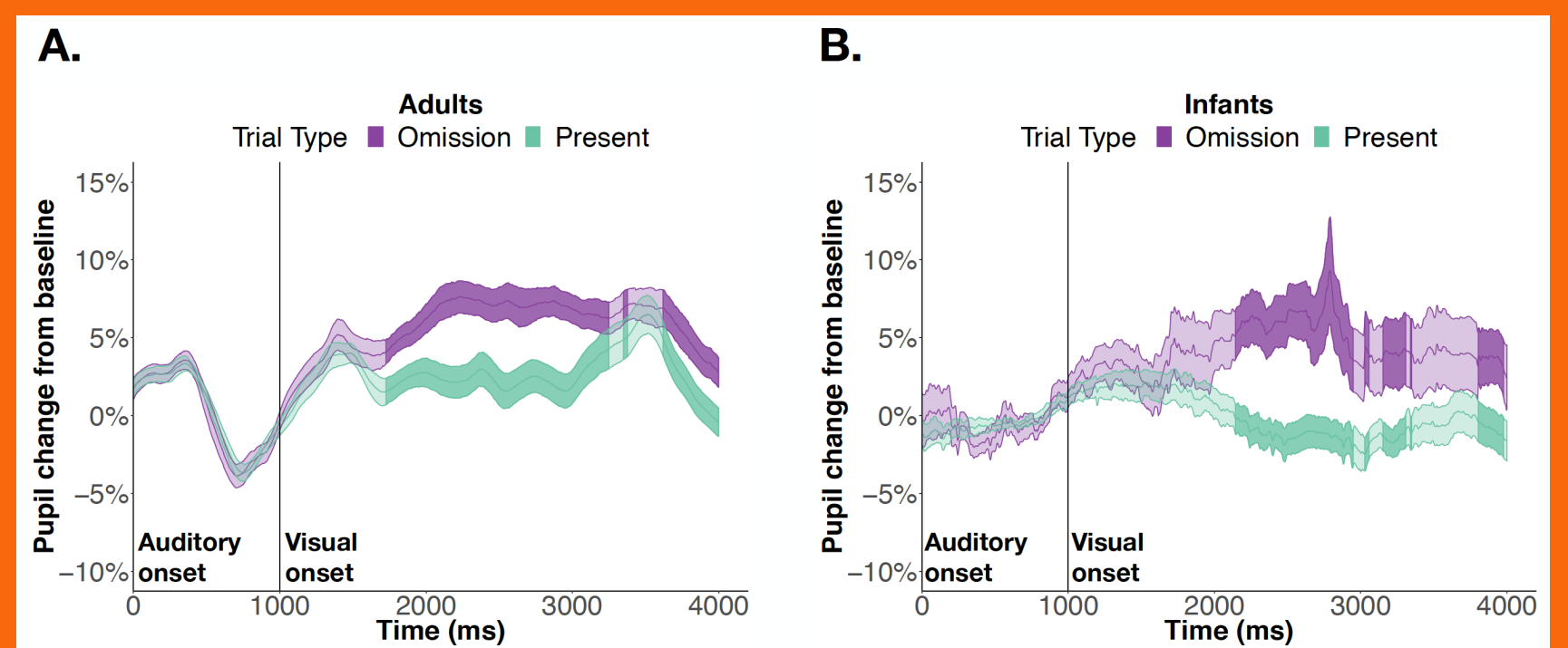**Figure 1.** PDR plotted against time for the two trial types. Significant results, darkened, are identified after FDR correction, pFDR <0.05. (a) Significant differences in adults were found in three periods (b) Significant differences in infants were found in five periods
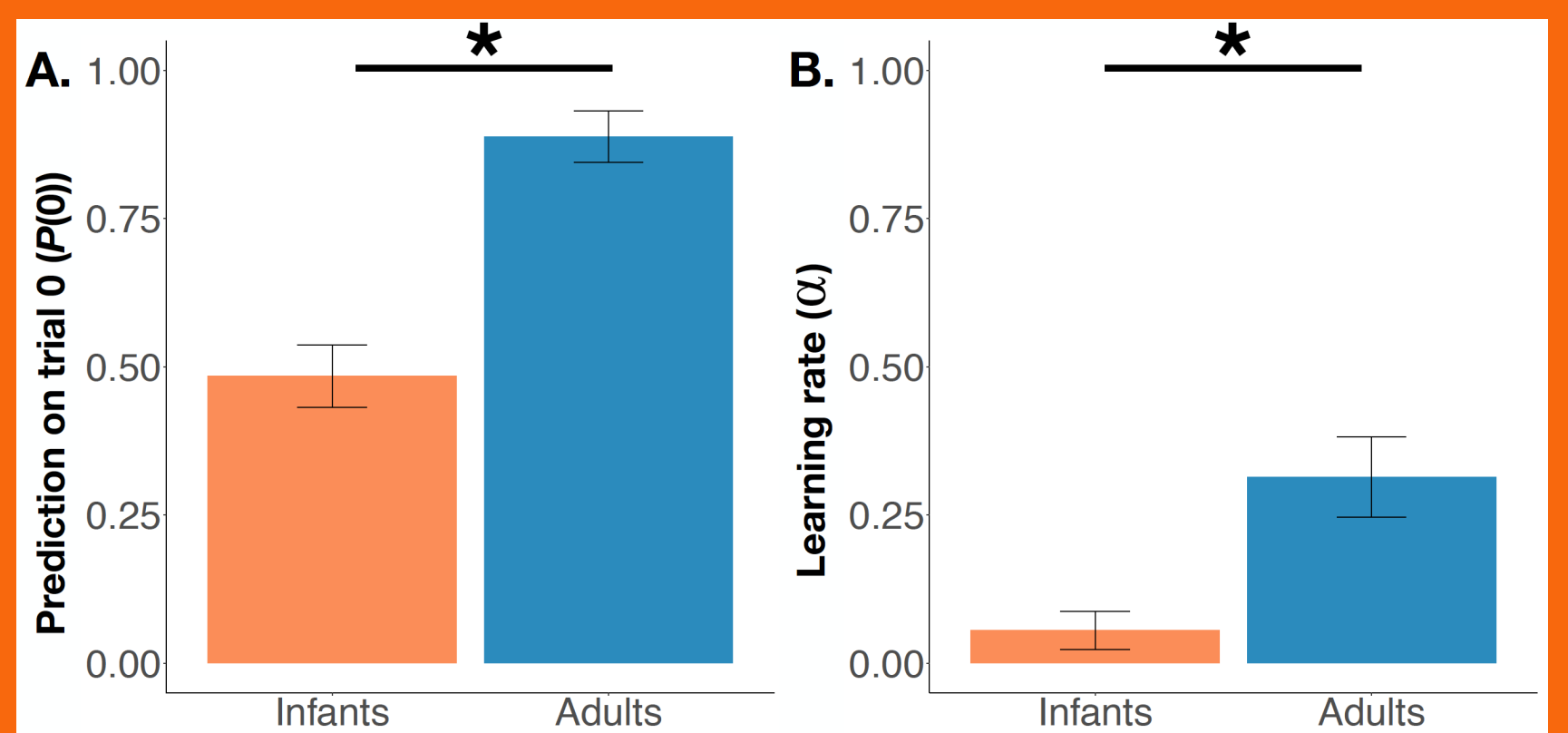

Figure 2. Comparing parameters from the learning model. (a) Comparing initial prediction, P(0). Adults had significantly higher initial predictions than infants. (b) Comparing the learning rate, α. Adults had significantly higher learning rate than infants
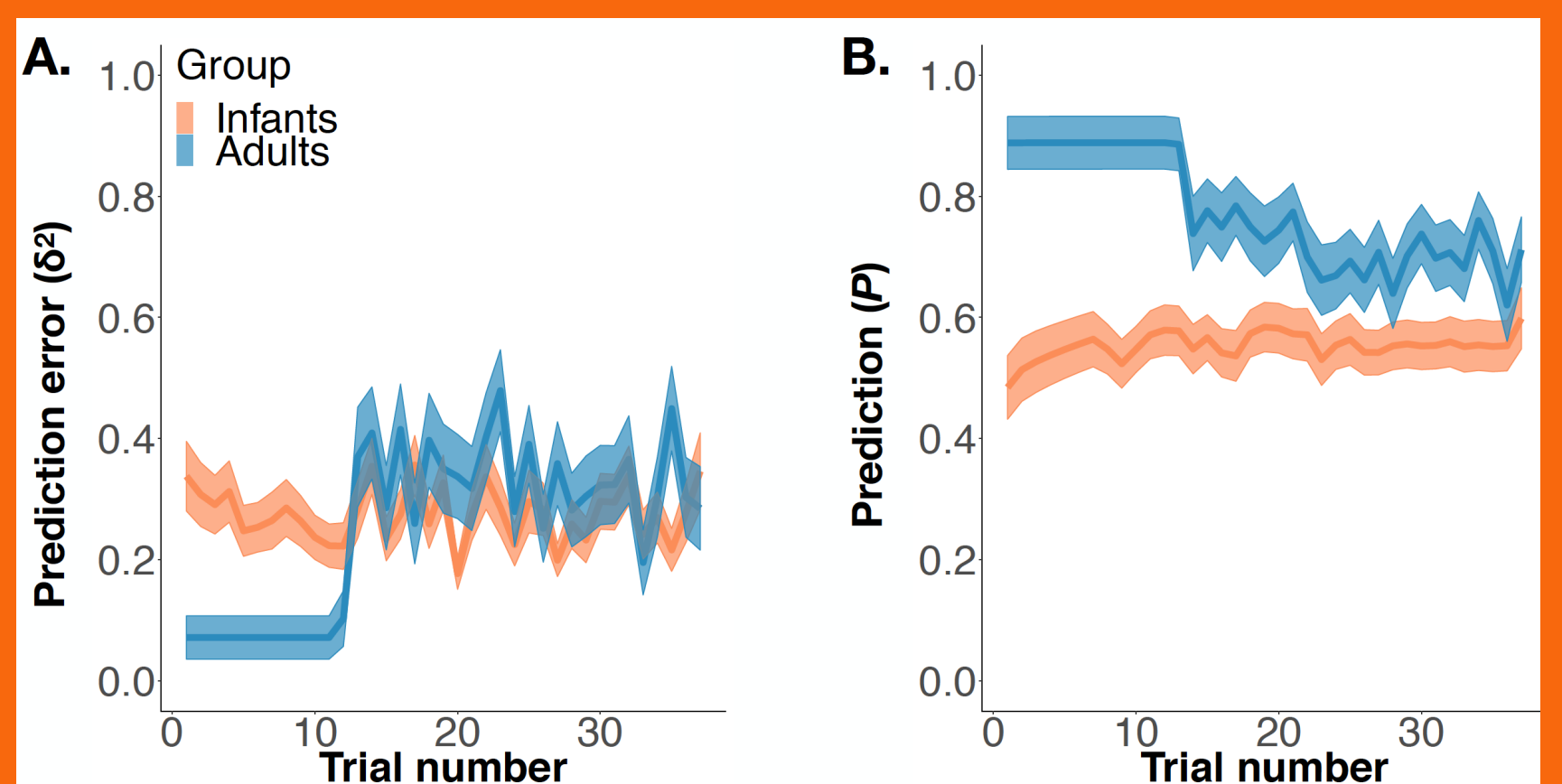

Figure 3. Comparing simulated parameters generated from the infant and adult learning model on a trial by-trial basis. Although infants and adults begin the task with different predictions, they eventually converge. (a) Prediction error. (b) Prediction

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