Action Anticipation Relates to Action Production in 12-Month-Olds

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Introduction

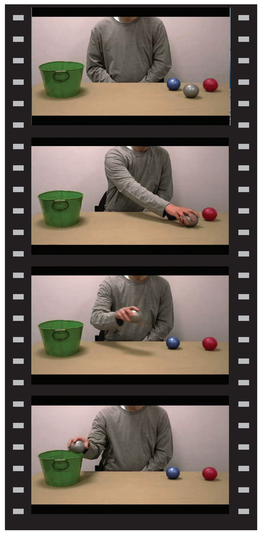
Anticipating actions is essential for smooth social interactions, engagement in shared, collaborative activities, and, more generally, in shaping one's own actions with respect to others. Many theoretical perspectives have suggested shared representations for producing and perceiving action (e.g., Decety & Sommerville, 2003; Gallese & Goldman, 1998). Empirically, Flanagan & Johansson (2003) found adults gaze prospectively not only when producing an action themselves, but also when viewing the similar actions of others, suggesting engagement of the same system. Moreover, adults' predictive gaze to others' actions is disrupted by concurrent self-produced activity (Cannon & Woodward, 2008).

Less is known about the development of action anticipation, and whether the action system plays a developmental role. Visual habituation paradigms have shown infants' own action experiences are related to their understanding of others' actions (Sommerville, Hildebrand, & Crane, 2008; Sommerville, Woodward & Needham, 2005). A similar relationship has been suggested for action anticipation (Falck-Ytter, Gredeback, & von Hofsten, 2006), but has not been directly tested. Falck-Ytter et al. (2006) used an eye-tracking system to show adults, 12-month-olds, and 6-month-olds a person putting objects into a container. The adults and 12-month-olds anticipated the person's action by looking ahead to the container before each object arrived, but 6-month-olds did not. The lack of anticipatory gaze found in 6-month-olds to the human agent was attributed to their lack of a motor representation.

In Study 1, we replicated these findings for the human agent, and in Study 2 we sought direct evidence of a relationship between 12-month-olds' own actions and their anticipation of another agent's actions.

General Method

Eye Tracking (ET) Task: (Study 1 & 2)



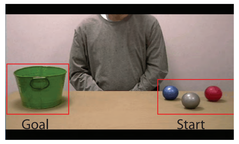
Materials & Procedure

13.5 second film clip of a Human agent moving 3 balls into a bucket.
Transport time for each action was 1.10, 1.08, and 1.33 s.

Tobii 1750 17″ eye tracker
9-point calibration
9 trials, each preceded by a 3-4 s attention-getter centering gaze.

Data Reduction and Analysis

Areas of Interest (AOIs): Start & Goal



Time window for collecting a data point:

- Symmetrical time window according to length of transport (e.g., 1.1 s pre-transport, 1.1 s transport to Goal AOI, 1.1 s post Goal arrival)
- Gaze must fall in Start AOI followed by a gaze arrival to Goal AOI
- Data point = (Time of Ball arrival to Goal AOI) - (Time of Gaze Arrival to Goal AOI)
- Anticipation = data points > -200ms
- Inclusion: All subjects with greater than 33% of all possible data points were included in analyses.

Dependent Measure

ET Score: Median data point for each participant

Behavioral (Beh) Task: (Study 2)

Materials & Procedure.

Each infant was given up to 2-minutes to put objects into container, or a maximum of 12 put-in actions per set.



Dependent Measures.

- Mean number of objects put into container per set
- Latency: Mean amount of time from start of trial until the first object was placed into a container.

Study 1

Study 1: Falck Ytter et al. (2006) Replication*

Participants

Adults, 12-month-olds (11;0-13;0), 6-month-olds (5;0-7;0)
N = 36, 12 per age group

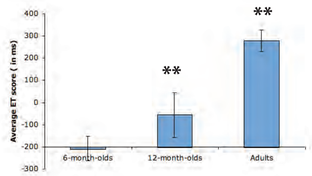
Procedure

See General Methods ET Procedure
* Our events differed from those of Falck-Ytter et al. in that we did not include artificial "end effects." Participants heard the natural sound of the ball landing in the bucket.

Prediction

Predictive looking to the Goal AOI (> -200ms) for adults and 12-month-olds, but not for 6-month-olds.

Results



**ET score > -200 ms, ts (11) > 4.8, ps < .001
-A one-way ANOVA of Age Group on ET scores: $F(2, 33) = 29.98$, $p < .001$.
-Posthoc (LSD) tests revealed each of these groups were significantly different from each other, ($p < .05$).
-Adults and 12-month-olds were able to anticipate the goal of another human, but six-month olds were not.

Study 2

Study 2: Do self-produced actions relate to anticipation of other's actions?

Participants

N = 26 12-month-olds (M = 12;11; range = 12;2-13;0; 15 males)

Procedure

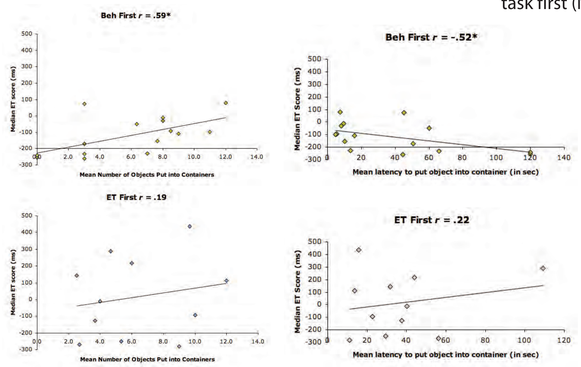
Infants were randomly assigned to a task Order: the ET task first (N = 11), or the Beh task first (N = 16). See General Methods.

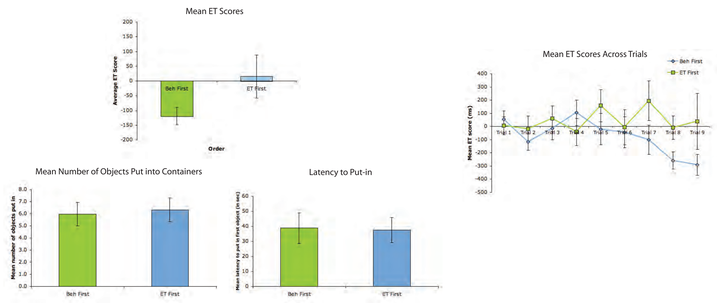
Results

-Mean Objects put into container & ET score, $r = .32$, $p = .10$

-ANCOVA of Order and objects put in on ET score revealed a marginal effect of Order, p = .08.

*p < .05





Conclusion

In Study 1 we replicated the general findings Falck-Ytter et al. (2006) without the use of artificial end-effects. These findings lend further support to the conclusion that infants' anticipation of containment actions becomes robust toward the end of the first year of life. In Study 2, we found a moderate positive correlation between infants' engagement in containment actions and their anticipation of others' containment actions. This relationship was especially strong for infants who received the Behavioral task first. This result suggests that infants' action production may have primed their subsequent anticipation of observed actions.

We also found a trend for infants' anticipatory responses to vary depending on whether they received the behavioral or the eye-tracking task first. Infants who received the behavioral task first showed a decline in anticipation in the last trials of the eye-tracking task, whereas infants who received the eye-tracking task first showed no decline across trials. This result may be due to fatigue in the Behavioral-first condition. Infants in this condition have been in the laboratory for longer before the eye-tracking task begins, and this fact alone may lead to fatigue. Alternatively, infants' prospective attention to actions may be selectively fatigued by their engagement in prospective actions prior to the eye-tracking task. Further research is needed to investigate these possibilities.

References

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