1 Baby Experiment Methods

1.1 Stimulus

The infants watched the motion of a set of white rings (1 degree diameter) moving on a black background. One of the rings was selected as chaser and another one as chasee. The remaining rings served as distractors. All rings moved with constant speed of 9 degrees per second and could change their motion with probability of 0.09 on every frame (resulting in change once every 185 on average). In the case of chasee and each distractor, the new motion direction was selected from within 120 degrees around the old motion direction (i.e. from a uniform continuous distribution ranging from 60 degrees to the left to 60 degrees to the right of the old trajectory). The chaser always changed his motion to head directly towards chasee in a heat-seeking manner. The motion of the rings was confined to an invisible square area within the display of size 29 degrees. This meant that the rings would sooner or later hit the invisible wall. These wall collisions were handled as follows. While chasee and distractors bounced of the wall (i.e. the trajectory was mirrored around the horizontal or vertical axis), chaser moved toward chasee upon touching the wall. Since chasee (as all other distractors) was always located within the area, this meant that upon collision chaser altered it's trajectory to move away from wall. The rings were pervasive to each other, so there were no collisions among rings.

1.2 Design

Each infant were shown up to 20 trials. There were 2 types of trials. On training trials the infant was shown a reward after 5 consecutive saccades (3 saccades on the very first trial) targeted the location of Chaser-Chasee (see next section for details). To reward the infants, chaser and chasee pulsated (synchronously) from white to violet and back at 1.875 Hz. Test trials were identical to training trials except that the pulsating color change was not shown. Trial terminated after either 12 consecutive fixations to Chaser-Chasee were made or the infant stopped tracking the chasing pair (see next section for the exact procedure). If the infant looked away from screen for more than 6 seconds an attention catcher was shown (dangling green clover accompanied by a sound). After the infant looked at the screen again, the trial resumed. The experiment terminated after the attention catcher was triggered twice within a single trial.

1.3 Gaze-contingent experiment control

Fixations and saccades were extracted from the stream of the incoming raw gaze data (averaged from both eyes) as follows. Tobii T60 returns gaze data at intervals of 16.7 msec. We filtered the gaze data by exponential smoothing with smoothing factor set to 0.6. From the filtered data we computed the velocity as a first order difference. Fixations were detected as a chain of consecutive

velocity values below velocity threshold of 18 degrees per second. If the chain length exceeded 100 msec, fixation was triggered. Fixation location was determined as an average of the gaze position within the 100 msec chain. Since this computation utilized only few gaze points at the start of the fixation, the obtained average location may be better understood as the saccade target. The saccade target was compared to the location of Chaser and Chasee on the screen. The eye-tracking hardware and the fixation extraction procedure introduced a constant lag between the physical eye-movement and the fixation trigger. In addition, there is a behavioral lag between the saccade programming and the onset of eye movement. The fixation location was compared to Chaser-Chasee location on the screen 187 msec in the past. If the distance between the target and the Chaser or Chasee was less than 3 degrees the fixation was accepted as fixation to Chase. Five consecutive fixations to Chase triggered the reward phase. In the reward phase, if the interval between two fixations to Chase exceeded 2.5 seconds (e.g. because the infant stopped tracking chase) the trial was terminated. Similarly after seven (not necessarily consecutive) fixations in the reward phase the trial was terminated. In addition the algorithm separately handled blinks and very long fixations.

1.4 Procedure

The babies were placed in a high-seat 50-70 cm away from screen (all specifications in degrees of visual angle above are referenced to 50 cm distance) from a Tobii T60 display with built-in remote eye-tracker. The mother, sat nearby and was instructed not to interact with the infant. The experiment started with calibration. Grid of five rotating shrinking and expanding spirals was used as stimulus for calibration. The calibration was repeated until reasonable (¡2 deg) precision for all grid points was obtained. Through a built-in eyetracker camera the experimenter monitored infants behavior and interupted the experiment if the infant got fussy. The experiment took 5-7 minutes. After the experiment parents were offered the option to make data available through Databrary (www.databrary.com). The experiment was presented and controlled with PsychoPy 1.75 (Peirce, 2007) and Tobii SDK 3.0.