Differences in Transitional Saccades in 4-month-olds When Viewing Pairs of Possible and Impossible Objects

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Introduction

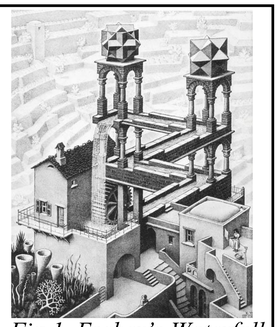

Fig 1. Escher's Waterfall

We use impossible figures as an experimental model for evaluating the nature and development of local and global object processing mechanisms.

Perceiving objects as complete and coherent in 3D space is a fundamental achievement of the developing visual system. Previous work has found infants can distinguish between possible and impossible *cubes*, i.e., 4-month-olds fixated to a greater extent specifically within the critical region of impossible cube displays (Shuwairi & Johnson, 2013). The findings suggested that young infants selectively respond to vertex information (T- and Y-junctions) that is diagnostic of structural coherence.

Research Questions

(1) Do 4-mo's respond with increased visual interest to impossible cubes, and will this effect generalize to other images of impossible objects?

(2) Will there be reliable differences in transitional shifts of gaze between the inner and outer regions, upper and lower halves, or left and right regions of stimuli as a function of possibility?

Materials and Methods

Participants: n=15 (7 M, 8 F), 4-month-old infants

Eye-Tracking was used to test differential looking of infants in response to ten pairs of various structurally matched possible-impossible stimuli pairs.

Stimuli: pairs of possible and impossible figures. Order (impossible or possible first) was randomized across participants and stimuli pairs.

Impossible figures were predicted to evoke increased visual attention and oculomotor activity in order to ascertain global structural integrity.

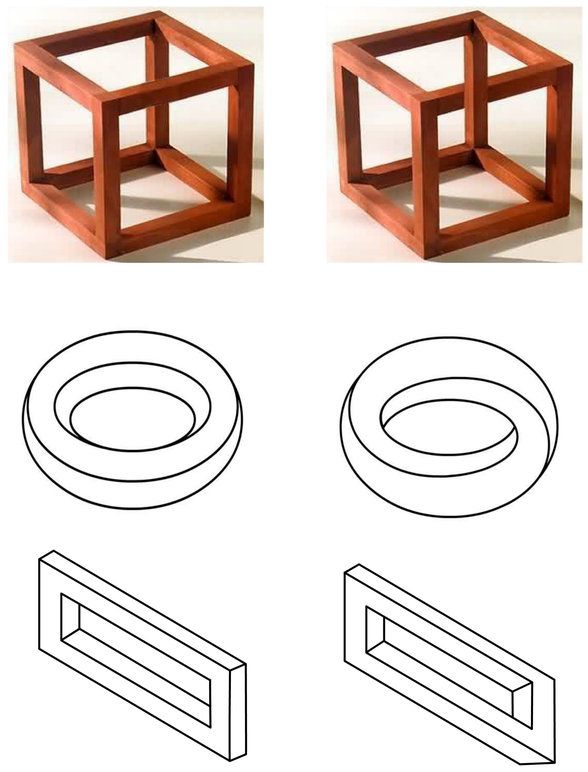

Figure 2. Possible (left) and impossible (right) paired object stimuli.

Results

Transitional saccades were coded offline from video and compared between regions of pairs (e.g., inner vs. outer, upper vs. lower, left vs. right).

Infants produced reliably more transitional saccades between the **interior critical region and neighboring regions of the impossible cube**, relative to the possible cube ($p < .006$).

There were also reliable differences in transitional shifts in the **inner and outer regions of the impossible oval** ($p < .05$) and the **left and right regions of the impossible rectangle** ($p < .01$) relative to their possible counterparts.

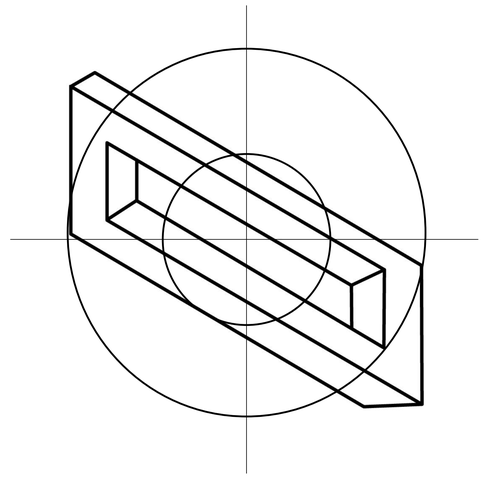

Figure 3. Example of regions of interest.

Discussion

We speculate that the high degree of variability in infants' fixation behaviors toward these shapes may be due to individual differences in selective looking or emerging sensitivity to pictorial depth information. This may also be a stimulus-dependent response that manifests exclusively with certain shapes (e.g., impossible cubes with salient manipulations of T- and Y-junctions).

By 4 months, infants are beginning to hone their selective looking mechanisms to adequately register shape defining contours and line junctions cues in static images, which enables them to detect conflicting local depth relations and distinguish between pictures of possible and impossible objects.

These findings also suggest that some of the mechanisms for registering pictorial depth and representing 3D object coherence are available soon after birth and continue to develop rapidly within the first several months.

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