Early infancy is a period of dramatic growth in learning how to negotiate through the environment. Within approximately 14 months, the immobile newborn becomes the racing, exploratory, pan-toppling toddler, accomplishing, along the way, the skills of precision reaching, sitting, creeping, standing, and walking. These postural accomplishments depend more on visuospatial anchoring than we might suspect. For example, infants who have recently learned to walk will fall when the room they are in appears to move forward or backward even though they are on a stationary surface (Lee & Aronson, 1974). A similar dependence of postural stability on visual cues can be found in prewalking babies who are tested in a sitting position (Butterworth & Hicks, 1977).

In considering infants’ acquisition of the ability to negotiate space and to interpret the meaning of changing relations between themselves and, for example, the walls and ceilings of a room, one must ponder how spatial knowledge emerges. Newborn infants are pitifully incapable of self-induced motion through space or purposeful manipulation of items in it, so one might suppose them to be largely undiscriminating of the spatial characteristics of their world. Certainly, classic pieces of research have demonstrated the contribution of self-initiated movement to the acquisition of skill in moving one’s body through a spatial frame of objects (Held & Hein, 1963). Nevertheless, human infants do possess action schemes of a sort, at birth, which could provide them with cues concerning the direction and position of objects. Such action schemes include eye and head motion. Although substantial development occurs over the first few months of life in both the neuromuscular and neurosensory components of the human visual system, infant eye movements are more similar to those of the adult than for any other action system. As Bullinger (1979) has noted, the operation of these action schemes provides the infant an opportunity to learn how the body’s instruments

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of exploration work, as well as the properties of the world and the intersection between the two.

Although our research on the interface between visual perception and action in the human newborn and infant has not focused on questions about spatial knowledge, our study of infant eye movement activity has revealed several relevant phenomena, and our findings are presented from this perspective.

Appreciation of Spatial Relations

An important step for the infant, in organizing the visual world, involves the appreciation of spatial relations among visual elements. Elements that go together must cohere, perceptually, to enable the infant to fractionate the visual field into separable whole objects. We used subjective contour arrays (Figure 10-1) to inquire about the infant's ability to appreciate spatial relations among identical elements (Bertenthal, Campos, & Haith, 1980). Subjective contour stimuli are quite useful because it is possible to modify only the relation in the spatial orientation among elements to destroy the illusion. Thus, one can avoid confounding factors that often weaken the interpretation of studies that purport to manipulate spatial relations among visual elements; such factors include changes in the total area that elements occupy, contour density, the elements themselves, their orientation, and so on.

For one nonillusion array, NI, in Figure 10-1, the elements along one diagonal in the original illusion array have been exchanged; for NI2, the diagonals have been exchanged. Thus, there is as much difference, in terms of element change or rotation, between NI1 and NI2, as there is between array I and array NI1, and twice as much change as between I and NI2. Through a comparison of the effects of these various arrays on infant looking, we asked whether the illusion array has any special status; if so, we are in a position to argue that babies are sensitive to the spatial relations among elements that comprise a "stimulus."

We showed combinations of these patterns to babies 5-7 months of age. The design of the study is shown in Table 10-1. At each age, there were three subgroups who were first familiarized with the I, the NI1, or the NI2 stimulus. The familiarization stimulus was first shown for a series of trials that were terminated when the baby looked away from the stimulus. Babies normally look at new stimuli for a relatively longer time and look less as the stimuli become more familiar (a process termed habituation). The familiarization series was continued until the baby reached a habituation criterion, defined as two successive trials for which the average looking time was 50% of the average for the first three trials. Then one-half of the babies in each subgroup, the change subjects, were shown a changed stimulus for two postcriterion trials.