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COMMENTARY

On the Reasons for Newborns' Responses to Faces

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Kleiner (1987) carried out a study to examine whether or not the linear systems model (LSM) of infants' visual preferences could predict neonates' preferences among facelike and abstract patterns. Her data showed that for one crucial comparison this model did not predict the data. Despite this discrepancy, claims are being made that Kleiner's data show that newborns' preferences for facelike patterns can be predicted entirely on the basis of the LSM model.

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Kleiner (1987) recently published a study designed to test neonates' preferences among facelike and abstract patterns. The broader context for this study can be found in Kleiner and Banks (1987), who contrasted the *sensory hypothesis* and the *social hypothesis* as accounts of face preference in early infancy. The sensory hypothesis says that "infants are predisposed to attend to stimuli that are readily visible" (p. 594). For the first few months, infants' preferences for a variety of patterns are well predicted by a form of the sensory hypothesis called the *linear systems model* or LSM (Banks & Salapatek, 1981). This model predicts infants' preferences on the basis of a particular kind of analysis of the stimuli, the Fourier transform. Two-dimensional visual patterns are like acoustic patterns in that any pattern, however complex, can be constructed from a combination of sine waves. For any pattern, two functions may be derived: the *amplitude spectrum,* comprising the amplitude and orientation of the component spatial frequencies, and the *phase spectrum,* comprised of the phases and orientation of the components. The LSM holds that newborns' pattern preferences are influenced only by the amplitude spectrum.

The social hypothesis, according to Kleiner and Banks (1987), says that "young infants are predisposed to attend to social stimuli" (p. 594). Kleiner

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and Banks actually evaluated the more restrictive hypothesis that infants' looking preferences are largely determined by the phase spectrum of stimuli, the spectrum which largely determines the pattern of a stimulus and, for adults, determines whether or not it looks facelike.

In the LSM, the amplitude spectrum of any stimulus pattern, collapsed over orientation, is filtered to allow for the limitations of the visual system of the appropriate age group. For a newborn, this effectively removes all information at frequencies greater than about 2 cycles per degree. The LSM uses the sum of the remaining energy to predict young infants' looking preferences. It does very well with high-contrast patterns such as checkerboards (Gayl, Roberts, & Werner, 1983), rectangular gratings (Banks & Salapatek, 1981; Banks & Stephens, 1982), bull's-eyes (Banks & Ginsburg, 1985), and patterns of stripes (Slater, Earle, Morison, & Rose, 1985). Kleiner has recently claimed that it also accounts for young infants' preferences for faces (Kleiner, 1987; Kleiner & Banks, 1987): ". . . Facelike patterns are fixated preferentially because they contain large (low spatial frequency), high contrast features" (Kleiner & Banks, 1987, p. 594). This claim has been repeated by a number of authors (e.g., Aslin & Smith, 1988) but, we will argue, it is not well founded.

In Kleiner (1987), the primary stimuli were a schematic face and a lattice pattern. From these primary stimuli, Kleiner constructed two more stimuli. She first carried out a Fourier analysis of the primary stimuli, to determine for each an amplitude spectrum and a phase spectrum. One of the new stimuli was composed of the amplitude spectrum from the lattice and the phase spectrum from the face, and the second had the amplitude spectrum from the face and the phase spectrum from the lattice. In Figure 1 these are labelled C and D, respectively. Of the two new stimuli, it is C, with the phase spectrum of the face, that looks somewhat facelike to an adult viewer, though its resemblance to a face is somewhat concealed by the lattice pattern. Stimulus D, with the amplitude spectrum of the face, does not look facelike at all. The prediction of the LSM is that newborns' preferences would depend entirely on amplitude spectrum and not at all on the phase spectrum.

Kleiner used a preference paradigm with infants of an average age of 1.7 days (SD = 1.0 days). When presented with the basic face and lattice patterns, the infants looked at the face 67% of the time. With the synthesized stimuli, the infants looked 63% of the time at the stimulus that had the amplitude spectrum of the face and only 37% at the stimulus that had the amplitude spectrum of the lattice. That is, they did not prefer the mixed stimulus which is somewhat more facelike for adults. This result is predicted from the LSM but would not be predicted by any social hypothesis which depended upon adult perceptions of what makes a stimulus facelike or by a social hypothesis defined in terms of the phase spectrum.

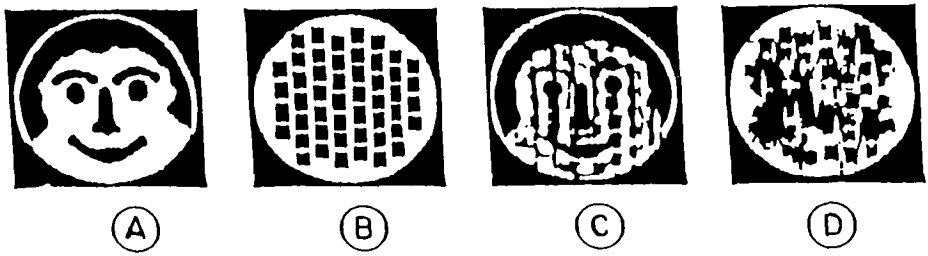

Figure 1. Reproductions of the stimuli used in the Kleiner (1987) experiment. Stimulus C has the amplitude spectrum of the lattice and the phase spectrum of the face. Stimulus D has the amplitude spectrum of the face and the phase spectrum of the lattice. Newborn infants prefer D over C and A over D.

However, Kleiner's data produced one result which is not predicted by the LSM. As we have already stated, this model explicitly claims that the phase relationships will be irrelevant for newborns and thus predicts that the original schematic face (A) will be no more attractive to the infant than the mixed stimulus with the amplitude spectrum from the face and the phase spectrum from the lattice (D). But, in the condition using these two stimuli, the newborns overwhelmingly preferred the face, looking at it 69% of the time. This unexpected finding indicates that newborns' reactions to faces cannot be accounted for solely on the basis of amplitude spectrum or the LSM.

Because of this discrepant finding, Kleiner proposed a hierarchical model involving three stages. The first stage involves a comparison of the filtered amplitude spectra as in the LSM. The final stage involves a comparison of the phase spectra. If this were all, then the model would fail to predict the lack of preference between the pure lattice pattern and Stimulus C, which has the phase spectrum from the face. To allow for this failure of the two-stage model, Kleiner was forced to insert a third, intermediate stage into the model on an ad hoc basis. Not only is the third stage ad hoc, but it introduces a third degree of freedom in a model based on only six comparisons.

Kleiner (1987) concluded her abstract with the following claim. "Neonates' preferences for facelike patterns are governed primarily by stimulus energy and not by the familiarity or social significance of such patterns" (p. 49). Such a summary stresses the success of the LSM in predicting D>C rather than the failure to predict A>D, as does that of Kleiner and Banks when they wrote that Kleiner's results "showed rather clearly that neonates' preferences were predicted from the amplitude spectrum and not from the phase spectrum." Subsequent interpretations of Kleiner's results have lost sight of the discrepancies. As an example, Kleiner and Banks (1987) wrote further: "Neonates' preferences were based on stimulus energy" (p. 595). Dannemiller and Stephens (1988) claimed that Kleiner's

experiment showed that "a reliable preference for faces does not emerge until approximately 12 weeks of age" (p. 214). Aslin and Smith (1988), in the *Annual Review of Psychology,* said, "Kleiner (1987) reported that newborns' preferences for face-like and non-face-like patterns were determined by the amplitude spectrum" (p. 448). Finally, Nelson and Ludemann (1989), in another review article, stated, incorrectly, that "infants . . . showed an equal preference for the schematic face and the lattice that contained the same amplitude information as the face." They reported Kleiner as concluding "that neonates' preferences . . . conform to predictions based on LSM" (p. 193). These errors are in face of Kleiner's own data, which we have already described.

What factor, in addition to amplitude spectrum, could influence young infants' reactions to faces? There are several possibilities, and the three authors of this article do not agree on which is the most likely. Two of us (JM and MJ) favor a different version of the social hypothesis than was tested by Kleiner and Banks (1987).[1] These authors equate "social stimuli" with the phase spectrum of the face and thus rule it out as an influence with newborns. But there are other, formal versions of the social hypothesis that are possible. Suppose that the human infant is born with a template-matching device which is responsive to face-sized stimuli (at optimal distance) with, for example, three high-contrast areas, or "blobs," in a triangular formation corresponding to eyes and mouth. Evidence from other species would support such an idea (Johnson, 1990). Such a mechanism would be responsive to Stimulus A and would lead the infant to turn toward it. However, Stimulus C would contain too many other high-contrast regions to satisfy the criteria for the template and thus would not be particularly attended to by the newborn infant. The greater attractiveness of D over C would be due to the parallel operation of an LSM system. Two such mechanisms operating together could thus account for all of Kleiner's data.

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[1] The third author (DM) is troubled by some studies in which newborns did not show a preference for a facelike stimulus and believes that a full characterization will be more complex.

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