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Stimulus Energy Does Not Account for 2-Month-Olds' Face Preferences

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We examined the determinants of 2-month-olds' preferences among facelike and abstract patterns. Observed preferences were compared with the predictions of two preference models—one based on stimulus energy (as measured by the amplitude spectrum) and the other based on stimulus structure (as measured by the phase spectrum). It is known that the phase spectrum is the primary determinant of perceived identity to adults. Twenty-five 2-month-olds saw six pairings of four patterns: a schematic face, a lattice, a pattern composed of the amplitude spectrum of the lattice and the phase spectrum of the face, and a pattern composed of the amplitude spectrum of the face and the phase spectrum of the lattice. Only patterns with the face's phase spectrum look facelike to adults. Unlike the preferences of newborns (Kleiner, 1987), 2-month-olds' preferences could be predicted from the phase spectrum but not from the amplitude spectrum. In other words, the 2-month-olds preferred the patterns that looked facelike to adults. These results offer clear evidence that 2-month-olds' preferences for facelike patterns are not governed by stimulus energy.

It is well known that human infants prefer to look at some patterns over others. One of the most interesting preferences is the one for faces or facelike patterns. For example, newborns spend more time looking at a schematic face than at abstract patterns such as a bull's-eye (Fantz, 1961). Two hypotheses have been offered for this early face preference. One is that young infants are predisposed to attend to social stimuli and, consequently, prefer to fixate facelike patterns over nonfacelike patterns. Proponents of this view, which has been called the *social hypothesis* (Banks, 1985), include Bowlby (1969) and Gibson (1969). The other hypothesis is that infants are predisposed to attend to stimuli that are readily visible. Proponents of this view, which has been called the *sensory hypothesis* (Banks, 1985), argue that facelike patterns are fixated preferentially because they contain large (low spatial frequency), high-contrast features that are arranged symmetrically (Banks & Ginsburg, 1985; Fantz, Fagan, & Miranda, 1975; Haith, 1978; Karmel & Maisel, 1975).

These two hypotheses have been surprisingly difficult to differentiate experimentally. Fantz and Nevis (1967) tried by studying the importance of the arrangement of facial features. They showed infants two schematic faces. The features were arranged properly in one face and were scrambled in a symmetric fashion in the other. Newborns did not prefer one arrangement over the other, but by the age of 2 months a clear preference for the proper arrangement emerged. Others have also observed the emergence of a preference for the normal version of schematic faces (Haaf & Bell, 1967; Kagan, Henker, Hen-Tov, Levine, & Lewis, 1966; Maurer & Barrera, 1981). These observations have been taken as evidence that the social hypothesis is the best account of preferences among facelike patterns at ages of 2 months and older. Such an interpretation is unjustified, however, because rearranging facial features also affects stimulus dimensions that are critical to some versions of the sensory hypothesis. For example, the spatial frequency structure of a schematic face is altered when features are rearranged, and the predictions of a successful sensory-based model of preferences (Banks & Ginsburg, 1985) are greatly affected by changes in frequency structure. Kleiner (1987) developed a technique that allows a rigorous test of these two general hypotheses. We have used this technique to reexamine 2-month-olds' preferences for facelike patterns over abstract patterns. We asked whether 2-month-olds exhibit a preference for faces in accordance with the social hypothesis or whether their preferences are better explained by the sensory hypothesis.

The most successful model of early pattern preferences has been the linear systems model (Banks & Ginsburg, 1985; Banks & Salapatek, 1981; Gayl, Roberts, & Werner, 1983; Slater, Earle, Morison, & Rose, 1985). In this sensory model, an engineering technique, linear systems analysis, is used to describe any two-dimensional, achromatic stimulus and the relevant sensory capabilities of any visual system (for detailed discussions, see Cornsweet, 1970; Gaskill, 1978; Georgeson, 1979). The linear systems model of preferences is implemented in the following way (see Banks & Ginsburg, 1985, for details): The Fourier transforms of the patterns of interest are computed in order to determine the spatial frequencies, contrasts, orientations, and phases of their constituent sinewave gratings. Two functions result: (a) an amplitude spectrum, which represents the amplitudes (contrasts) and orientations of the sinewave components at different spatial frequencies, and (b) a phase spectrum, which represents the phases and orientations of the components at

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different frequencies. The amplitude spectra are then filtered by the contrast sensitivity function (CSF) of the appropriate age group. (The phase spectrum is not directly involved in the linear systems preference model.) Filtering by young infants' CSFs attenuates high spatial frequencies more than it does low frequencies. Simple decision rules are then applied to the filtered amplitude spectra to derive a predicted preference value for each pattern. It should be noted that various decision rules could be used and that different rules might lead to different predictions (see Gayl et al., 1983, for a discussion). However, with the most plausible rules, the model simply predicts that infants prefer patterns whose filtered amplitudes are greatest.

Banks and Ginsburg (1985), Banks and Salapatek (1981), Gayl et al. (1983), and Slater et al. (1985) have shown that with this simple model one can predict the visual preferences of young infants for a wide range of stimuli. For instance, Banks and Ginsburg reanalyzed the size and number study of Fantz and Fagan (1975). They used 1- and 3-month-olds' CSFs to filter the stimuli and to predict the preferences of 5- and 10-week-olds. The agreement between the predicted and observed preferences was very good; thus the linear systems model was in fact able to account for changes in infants' preferences among size and number stimuli.

The linear systems model, as it currently exists, does not incorporate stimulus meaning into its predictions. In other words, it would not predict a preference for facelike stimuli over other patterns except to the extent that the filtered face provides spatial frequency and contrast information that fits the infants' visual "window"—the CSF—better than does the pattern with which it is paired. In contrast to the linear systems model, the social hypothesis predicts that a pattern whose configuration or structure is facelike should be highly preferred. Capitalizing on these observations, Kleiner (1987) developed a technique that allows one to contrast the predictions of the social hypothesis with those of the linear systems model. The technique involves dissociating phase and amplitude spectra. Once the spectra are dissociated, the phase spectrum of one stimulus may be recombined with the amplitude spectrum of another stimulus, thereby forming a new pattern. Such hybrid images were originally created by Oppenheim and Lim (1981) and Piotrowski and Campbell (1982). Piotrowski and Campbell combined the amplitude spectrum of a military tank with the phase spectrum of a face. To adult observers, the resulting pattern looked like a face and not a tank. Piotrowski and Campbell also found that an image with the amplitudes of a face and the phases of the tank looked like a tank. They concluded that the phase spectrum of a stimulus was the primary determinant of its perceived identity.

Kleiner (1987) used Piotrowski and Campbell's technique to create hybrid images for a preference experiment with newborns. She noted that according to the linear systems model of preferences (which is a sensory model), only amplitude spectra matter to infants. In other words, two patterns with identical amplitude spectra but different phase spectra should be equally preferred. Kleiner also noted that if newborns respond in a fashion similar to adults, perceived identity should be more closely associated with phase spectra than with amplitude spectra. She outlined a hypothesis that infants' preferences are determined by structure: Patterns whose structure or configuration are facelike should be highly preferred. This hypothesis is related to the social hypothesis described by Banks (1985).

Kleiner (1987) asked whether neonates' preferences among facelike and nonfacelike patterns are better predicted by the linear systems model (as indexed by the amplitude spectrum) or by the structure hypothesis (as indexed by the phase spectrum). Forty-eight 2-day-old infants viewed six pairings of four stimuli (see Figure 1): (A) a schematic face, (B) a lattice, (C) a pattern composed of the amplitude spectrum of the lattice and the phase spectrum of the face, and (D) a pattern composed of the amplitude spectrum of the face and the phase spectrum of the lattice. According to the linear systems model, stimuli with the amplitude spectrum of the face would be preferred. The structure hypothesis suggested that neonates should prefer patterns with the phase spectrum of the face: patterns that look like faces to adults. The results showed rather clearly that neonates' preferences were predicted from the amplitude spectrum and not from the phase spectrum. The correlation between observed preferences and those predicted by the linear systems model was .75. The observed–predicted correlation for the structure hypothesis was only .23. Thus the neonates seemed to respond on the basis of stimulus energy.

Neonates' preferences were based on stimulus energy, and so it is important to examine whether older infants' preferences are similarly governed. One might expect the determinants of facial preferences to change as the visual system matures and as the child acquires more experience with faces. Some investigators cite the emerging preference for the properly arranged face as evidence that such a developmental shift occurs by 2 months of age (Fagan, 1979; Olson & Sherman, 1983). If this is the case, models like the linear systems model that rely only on the physical aspects of the stimuli and the contrast sensitivity of the visual system should be unable to account for preferences for facelike over nonfacelike stimuli. In contrast, a structure hypothesis that relies on the "faceness" of these patterns might make more accurate predictions for infants in this age range.

Dannemiller and Stephens (in press) tested this possibility. They created two pairs of patterns, one facelike and the other abstract. One of the stimuli in each pair was presented normally, and the other was phase-reversed. The normal facelike pattern was a face in which the background was white and the features were black (phase-normal), and the reversed pattern was a face with a black background and white features, as in a photographic negative (phase-reversed). The phase-reversed face did not look nearly as facelike to adults as the phase-normal one did. The normal and reversed members had identical amplitude spectra but different phase spectra. Consequently, the linear systems model predicted no preference for one member over the other. Neither 6- nor 12-week-old infants exhibited a preference for one abstract pattern over the other. When the facelike pair was presented, the 6-week-olds again did not show a significant preference for the phase-normal version over the phase-reversed version, but the 12-week-olds did. The absence in the 6-week-olds of a preference for the phase-normal patterns is consistent with the linear systems or stimulus energy model. However, the 12-week-olds' preference for a phase-normal over a phase-reversed face is inconsistent with that model. Dannemiller and Stephens's observations suggest that as infants become older, the structural aspects of facelike stimuli (as indexed

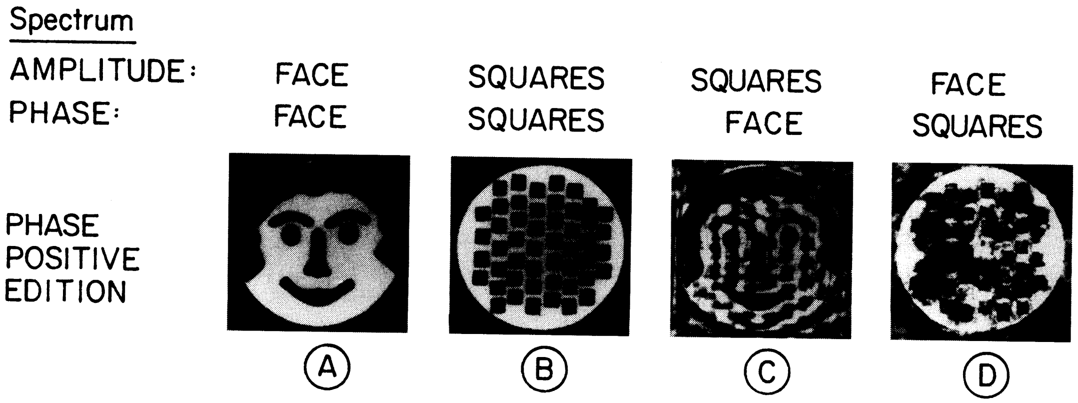

Figure 1. The four stimuli used in the present experiment: Stimulus A (first pattern) has the amplitude spectrum of the face and the phase spectrum of the face; Stimulus B (second pattern) has the amplitude spectrum of the lattice and the phase spectrum of the lattice; Stimulus C (third pattern) has the amplitude spectrum of the lattice and the phase spectrum of the face; Stimulus D (fourth pattern) has the amplitude spectrum of the face and the phase spectrum of the lattice.

by the phase spectrum) play an increasingly important role in pattern preferences. This age change may reflect an increasing sensitivity to or familiarity with meaningful stimuli.

We further explored the relative importance of stimulus energy and stimulus structure in this experiment. Specifically, we asked whether age changes are observed in infants' preferences among the patterns that Kleiner (1987) presented to neonates. Using the same stimuli and procedure as those employed in the neonate experiment, we tested 2-month-olds. We believe that our experimental design is more sensitive than Dannemiller and Stephens's (in press). They paired stimuli that had different phase spectra but identical amplitude spectra. The linear-systems predictions then were simply that no preference should have been observed. Consequently, any factors that lessened statistical power (too few subjects, short looking times, inaccurate response measurement, etc.) would have decreased the probability of rejecting the linear systems model. Our experiment had six stimulus pairings—two that differed only in amplitude spectra, two that differed only in phase spectra, and two that differed in both. Thus both models that we considered made predictions of differential preferences in some conditions and no preferences in others. A diversity of predictions is important in infant research because the variability of the data is frequently great enough to obscure real differences.

Method

Subjects

Twenty-five 2-month-olds (14 male and 11 female) served as subjects. The infants were located through City of Berkeley birth records. All were full term; the mean gestational age was 39.8 weeks (by dates; *SD* = 1.2 weeks). The mean birth weight was 3,548 g (*SD* = 301 g), and there were no complications. The infants' mean postnatal age at the time of testing was 8.5 weeks (*SD* = 0.7 weeks). They were tested in our laboratory at the University. The data from 8 subjects were not usable: 3 because of equipment failure and 5 because they became drowsy or fussy.

Apparatus

Using two projectors, we showed pairs of patterns on a rear-projection screen. An infrared-sensitive video camera, an infrared light source (tungsten bulb plus an infrared filter), and a video recorder were used to record the infants' fixations. The observer, who was unaware of the locations of the stimuli being presented, viewed the infants on a standard TV monitor. A microcomputer was used to sequence stimulus presentations and to record the observer's responses.

Materials

Four stimuli were used. We constructed them by manipulating the phase and amplitude spectra of two patterns—a schematic face (Fantz, 1961) and an irregular lattice of squares (see Figure 1). The original face and lattice were constructed of Colormatch matte art papers. The patterns were created by affixing black pattern elements onto white circles, 16.5 cm in diameter, mounted in gray cardboard squares, 17.8 cm on each side. In each pattern, 39.4% of the area was black and 60.6% was white. Each pattern subtended 13.4° of visual angle from the infants' viewing distance of 88 cm.

The phase- and amplitude-altered stimuli were generated by using Fourier techniques on a PDP 11/34 computer and a 19-in. DeAnza high-resolution graphics monitor. The two original images were photographed. The photographic negatives were scanned by an Optronics International P1700 rotating-drum film scanner. The scanner yielded a digital representation of the stimuli that was stored on magnetic tape.[1] The digital representation was normalized to gray scale values ranging from 0 to 255 (0 corresponded to black and 255 to white). A two-dimensional fast Fourier transform (FFT; Cooley-Tukey algorithm) was used to compute digitally the spatial-frequency content of the original stimuli. The amplitude and phase spectra were then calculated from these discrete transforms. The schematic face (Figure 1A) and irregular lattice (Figure 1B) were modified to produce two new stimuli, one with the amplitude spectrum of the lattice and the phase spectrum of the face (Figure 1C), and the other with the amplitudes of the face and the phases of the lattice (Figure 1D). The inverse Fourier transform was

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[1] The number of sample points was 256 × 256 in the digital images, the fast Fourier transform, inverse fast Fourier transform, and the graphics output.

Table 1

Predictions of the Linear Systems and Structure Hypotheses and Neonates' and 2-Month-Old Infants' Preferences Among Four Stimuli

	Stimuli					
Predictions/preferences	Pair 1: A and B	Pair 2: C and D	Pair 3: B and C	Pair 4: D and A	Pair 5: A and C	Pair 6: B and D
Linear systems prediction	A > B	C < D	B = C	D = A	A > C	B < D
Structure hypothesis prediction	A > B	C > D	B < C	D < A	A = C	B = D
Neonates' preferences[a]						
M	67.1*	36.9*	50.2	30.8*	66.5*	39.0*
SD	27.3	33.3	32.2	26.4	29.0	32.0
2-month-olds' preferences[b]						
M	67.6*	66.8*	37.9*	36.8*	59.6*	50.4
SD	24.3	25.1	18.4	23.7	23.5	22.9

[a] $n = 48$. [b] $n = 25$.

* $p < .05$, two-tailed t test versus $\mu = 50\%$.

then computed on the modified spectra to obtain spatial representations of the new images. As before, the gray values of the spatial representation were normalized. The original face and lattice and the two modified stimuli were then photographed from the monitor with Kodak Safety 5060 film.[2] These four patterns were then photographically reproduced as slides.

The amplitude spectra of the face and lattice were rather different. When collapsed across orientations, the face's spectrum was greater in amplitude for all spatial frequencies except a band from 1 to 1.5 cycles per degree (c/d). Because 2-month olds are not nearly as sensitive to this band as they are to lower frequencies (Atkinson, Braddick, & Moar, 1977; Banks & Salapatek, 1978; Norcia, Tyler, & Allen, 1986), the linear systems model predicts that stimuli with the face's amplitude spectrum will be preferred to those with the lattice's amplitude spectrum.

Procedure

Each infant was seated in a dark room on his or her parent's lap. Each pair of stimuli was presented for two 5-s periods, with the left–right position of the stimuli counterbalanced. An observer, who was not visible to the infant, viewed the infant in the video monitor and recorded the duration of each fixation during the 5-s interval to each pattern. Each infant viewed six pairs of stimuli (the six possible combinations of the four patterns). The order of presentation of the six comparisons was randomized across subjects.

An experienced observer, who was unaware of stimulus type and position on each trial, recorded the infant's fixations. A fixation was scored when the reflection of a stimulus was centered on an infant's cornea. For 5 infants, the sessions were videotaped and scored by a second observer. The interobserver agreement was high ($r = .87$).

Results

According to the linear systems model, any stimulus that contains the amplitude spectrum of the face will be preferred to any stimulus with the amplitude spectrum of the lattice. This prediction holds no matter how the phase of each stimulus is manipulated. According to the structure hypothesis, any stimulus with the phase spectrum of the face, regardless of its amplitude spectrum, should be preferred to any stimulus with the phase spectrum of the lattice. Therefore, the linear systems model and the structure hypothesis make opposing predictions for many of the stimuli that we used. These predictions are displayed in Table 1.

The index of preference for a given stimulus was the total fixation time for that stimulus divided by the total fixation time to the stimulus and the pattern with which it was paired. Pattern preferences were then scored in terms of the extent to which the first member of each stimulus pair of Table 1 was preferred to the second member of each pair. Thus, preference scores greater than 50% indicated a preference for the first member of a pair, whereas scores below 50% indicated a preference for the second member. Table 1 also shows the mean preference scores that we observed for each of the six pairings.

As expected, the original schematic face was preferred to the original lattice (Pair 1). When presented other stimulus pairs that differed in phase (Pairs 2–4), the infants clearly preferred the ones with the phase spectrum of the face; that is, significant preferences were observed for Pattern C over D (Pair 2), Pattern C over B (Pair 3), and Pattern A over D (Pair 4). Therefore, the 2-month-olds' preferences were dramatically different from the neonates' (Kleiner, 1987). For instance, consider Pair 2. Recall that the neonates looked significantly longer at Pattern D in Pair 2, the stimulus with the amplitude spectrum of the face and the phase spectrum of the lattice. Two-month-olds, on the other hand, preferred Pattern C, the one that had less stimulus energy but looked more like a face to adults. Also of interest are the patterns with the same phase spectra but different amplitude spectra (Pairs 5 and 6). According to the linear systems model, the pattern with the amplitude spectrum of the face should be preferred in both pairs. According to the structure hypothesis, on the other hand, the patterns should be equally preferred. Two-month-olds looked longer at Pattern A in Pair 5, which is consistent with the linear systems prediction. Their preferences for Pair 6 (in which both patterns have the phase spectrum of the lattice), however, followed the structure hypothesis prediction, even though one might expect infants' preferences among abstract patterns to follow the linear systems predictions.

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[2] Previous measurements of intensity distributions of photographs in the image processing laboratory revealed some nonlinearities at the extremes of the intensity range. Therefore, the gray levels of the present stimuli were adjusted to fall within the linear range, thereby minimizing the nonlinearity.

Correlations between the predicted and observed preferences were computed in order to quantify how well the linear systems and structure hypotheses predictions fit the data. To compute the correlations, we quantified the predictions of the two models (shown in Table 1). Those predictions were based on the 2-month-olds' preference for the unaltered schematic face over the lattice (mean preference score = 67.6%). When the models predicted a greater preference for the stimulus in the first row, the quantitative prediction was set to 67.6%. The prediction was 32.4% when the models predicted a greater preference for a stimulus in the second row and 50% when the models predicted equal preference. Five of the six stimulus pairings were used to compute the correlations; the preference between the unaltered face and lattice were excluded for obvious reasons. Between the observed and predicted preferences, $r(4) = -.16, p > .05$, for the linear systems model, and $r(4) = .96, p < .01$, for the structure hypothesis. Clearly, the 2-month-olds' preferences were predicted better by the structure hypothesis.

Discussion

Kleiner (1987) showed that the linear systems model predicted neonates' preferences among facelike patterns quite accurately; that is, neonates' looking was correlated with the amplitude spectra rather than with the phase spectra of the experimental stimuli. Our 2-month-olds' results, obtained with the same stimuli and procedure, were just the opposite: The older infants' looking was correlated with the phase spectra rather than with the amplitude spectra. In conjunction, these two reports suggest that the determinants of infants' preferences among facelike patterns change dramatically between birth and 2 months of age.

This research is consistent with earlier reports that a fixation preference for facelike patterns develops between birth and 2–3 months of age. In comparison with earlier work on face preferences (e.g., Fantz & Nevis, 1967), however, Dannemiller and Stephens's (in press) and our observations provide more persuasive evidence for a faceness preference at 2–3 months. Our reasoning is as follows: Several previous reports (Banks & Ginsburg, 1985; Banks & Salapatek, 1981; Gayl et al., 1983; Slater et al., 1985) have shown that amplitude spectra alone can predict 2- and 3-month-olds' preferences among a wide range of stimuli. The current study and that of Dannemiller and Stephens, however, showed that amplitude spectra alone could not predict older infants' preferences among *facelike* stimuli. The critical difference appears to be the use of facelike patterns. This is reasonably persuasive evidence for the emergence of a faceness preference because several variables known to influence preference were controlled in our study and in Dannemiller and Stephens's (e.g., contrast, spatial frequency, and orientation in both studies and size and symmetry in Dannemiller & Stephens's). We hasten to point out, though, that these observations do not provide incontrovertible evidence for a faceness preference at 2–3 months. Although several variables were controlled, other variables could conceivably influence 2- and 3-month-olds' preferences among facelike and nonfacelike patterns. We find this alternative interpretation unlikely, though, in view of the fact that we and Dannemiller and Stephens used quite different stimuli and stimulus manipulations yet observed the same robust preference for the more facelike of two patterns.

If one accepts the conclusion that 2- and 3-month-olds exhibit a faceness preference, then there are three plausible interpretations of the developmental shift from energy to face responding: (a) Perhaps faces or facelike patterns carry no special significance to neonates, and so they respond to them as to any other abstract pattern. When they reach 2–3 months of age, faces acquire greater significance, and so a faceness preference emerges. The increased sensitivity to faceness could be due to an accumulation of experience with them or to the maturation of mechanisms that detect and recruit attention to them. As a descriptive aid, we call this the "faces become special" interpretation. (b) Insofar as facelike stimuli are preferred in early life, it is because they happen to have an amplitude spectrum that is preferred. In other words, neonates may not have the visual capacity to respond to stimuli on the basis of their structure or their phase spectra. According to this interpretation, the preference for faces is determined by stimulus properties in neonates that are distinctly different from those in older infants. The preference shift from birth to 2 months of age would be interpreted as the consequence of an increasing capacity to respond to stimulus structure and not the consequence of an increasing interest in facelike patterns. We call this interpretation "preference determinants change." (c) Perhaps, under some conditions, facelike stimuli are preferred early in life, but neonates' contrast sensitivity is so low that they are unable to detect the properties that made Kleiner's (1987) stimuli appear facelike to 2-month-olds and adults. In other words, there may be no developmental shift in preferences for faces or in the rules that govern such preferences. Rather changes in contrast sensitivity may underlie the observed age change. We call this interpretation "faces are special, but contrast sensitivity changes."

The third interpretation (faces are special, but contrast sensitivity changes) is unlikely for two reasons. First, neonates were obviously able to detect at least some of the pattern information in Kleiner's (1987) stimuli because they responded to them differentially. Given this, it seems unlikely that they could not detect sufficient information to discern the patterns' structure. Second, the interpretation is an unlikely account of Dannemiller and Stephens's (in press) findings. Their stimuli were composed of large, high-contrast elements only. Despite 1.5-month-olds' poor contrast sensitivity, the elements were well above the detection threshold. For these reasons, we conclude that the age change that we observed is not the consequence of improvements in contrast sensitivity only.

The data do not allow us to distinguish the first (faces become special) and second (preference determinants change) interpretations, but the second interpretation is consistent with some other recent observations. Braddick, Atkinson, and Wattam-Bell (1986) examined young infants' abilities to distinguish complex grating patterns with similar amplitude spectra but dissimilar phase spectra. Two- and 3-month-olds were able to discriminate the patterns consistently. One-month-olds, on the other hand, were unable to make the discrimination when amplitude cues were eliminated. This discrimination failure is remarkable because the patterns appear strikingly different to adults. Thus it seems that 2- and 3-month-olds, but not 1-month-olds, are able to distinguish simple patterns on the basis of phase differences. This age change is consistent with the second interpretation of our observations, and so the developmental shift that we observed could be due to improvements in the ability to encode phase relationships.

We now consider the implications of our findings for models of infant visual preferences. The linear systems model (Banks & Ginsburg, 1985; Banks & Salapatek, 1981; Gayl et al, 1983) has successfully predicted preferences, among a wide variety of abstract, nonrepresentational patterns, from birth to at least 3 months of age. When representational patterns were used, the model successfully predicted neonates', but not 2- to 3-month-olds' preferences (Dannemiller & Stephens, in press; Kleiner, 1987). Thus the linear systems model accounts successfully for young infants' visual preferences to a wide variety of patterns and for older infants' preferences among nonrepresentational patterns. The failure of the model to predict 2- and 3-month olds' preferences among facelike patterns implies that theories of visual preferences among older infants will have to incorporate the influence of other sensory variables such as structure and perhaps familiarity and meaning.

It is noteworthy that the developmental shift reported here occurs between birth and 2 months of age. Numerous capabilities that are believed to depend critically on cortical mechanisms appear to improve substantially between these ages. These include orientation selectivity (Braddick, Wattam-Bell, & Atkinson, 1986), spatial-frequency selectivity (Banks, Stephens, & Hartmann, 1985), vernier acuity (Shimojo, Birch, Gwiazda, & Held, 1984), phase discrimination (Braddick, Atkinson, & Wattam-Bell, 1986), stereopsis (Fox, Aslin, Shea, & Dumais, 1980; Held, Birch, & Gwiazda, 1980), symmetric optokinetic nystagmus (Atkinson & Braddick, 1981), and scanning and discrimination of internal patterns (Milewski, 1976; Salapatek, 1975). Not surprisingly, several authors have proposed that visual cortical maturation underlies these improvements (Braddick & Atkinson, in press; Bronson, 1974; Haith, 1978; Salapatek, 1975). Conceivably, the age change that we report is a consequence of cortical development, too.

In conclusion, we have shown that 2-month-olds prefer to look at facelike patterns even when the competing pattern has greater stimulus energy. This is new and more persuasive evidence supporting the old claim that a faceness preference exists by 2–3 months of age. We have also shown that neonates' and 2-month-olds' preferences among facelike patterns are governed by different stimulus properties. Neonates' preferences appear to be based on stimulus energy, as indexed by the amplitude spectrum, whereas some 2-month-olds' preferences seem to be based on stimulus structure as indexed by the phase spectrum.

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