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Patterns of Brain Electrical Activity During Facial Signs of Emotion in 10-Month-Old Infants

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This study examined electroencephalogram (EEG) asymmetries during the presence of discrete facial signs of emotion. Thirty-five 10-month-old infants were tested in a standard stranger- and mother-approach paradigm that included a brief separation from their mother. Infant facial expression was videotaped, and brain electrical activity from left and right frontal and parietal regions was recorded. The videotapes were coded with two different discrete facial coding systems. Artifact-free periods of EEG were extracted that were coincident with the expression of the emotions of joy, anger, and sadness. The data revealed different patterns of EEG asymmetry depending on the type of facial expression and vocal expression of affect that was observed. Expressions of joy that involved facial actions of both zygomatic and orbicularis oculi were seen more often in response to mother approach, whereas smiles that did not involve the action of orbicularis oculi were seen more often in response to approach of the stranger. The former type of smile was associated with relative left frontal activation, whereas the latter type was associated with right frontal activation. Facial expressions of anger and sadness exhibited in the absence of crying were associated with left frontal activation, whereas these same facial expressions during crying were associated with right frontal activation. These data underscore the usefulness of EEG measures of hemispheric activation in differentiating among emotional states associated with differences in facial and vocalic expressivity.

Recent evidence from the adult neuropsychological literature indicates that the cerebral hemispheres are differentially lateralized for the expression of certain positive and negative emotions (Bear & Fedio, 1977; Davidson, Schwartz, Saron, Bennett, & Goleman, 1979; Gainotti, 1969, 1972; Sackeim, Weiman, Gur, Greenberg, Hungerbuhler, & Geshwind, 1982; reviews by Davidson, 1984; Leventhal & Tomarken, 1986; Silberman & Weingartner, 1986). Evidence both from normal (e.g., Davidson et al., 1979; Tucker, Stenslie, Roth, & Shearer, 1981) and from brain-damaged subjects (Bear & Fedio, 1977; Kolb & Milner, 1981; Robinson & Benson, 1981) indicates that it is specifically the frontal region that shows this differential lateralization, with left-sided activation observed during certain positive emotions and right-sided activation associated with certain negative emotions.

In a series of studies, we have demonstrated the presence of this differential hemispheric asymmetry in newborn and 10-month-old infants (Davidson & Fox, 1982; Fox & Davidson, 1986; Fox & Davidson, 1987). These studies examined electroencephalogram (EEG) asymmetry during a variety of elicitors that produced a range of positive or negative emotions. In each of these previous reports, EEG was extracted and analyzed in response to the elicitor rather than on the basis of the subject's response to the stimulus. For example, Fox & Davidson (1986) presented water, sucrose, and citric acid solutions to newborn infants while recording frontal and parietal brain electrical activity. The solutions reliably elicited facial expressions of interest and disgust. EEG was analyzed, however, during the entire stimulus epoch (for 30 s after administration of the taste) and included, for that reason, periods of time during which the desired expression was present as well as periods when the expression was absent. This was necessitated by the fact that the target expressions were short in duration and occurred during periods of gross motor movement that produced artifact in the EEG.

Similarly, Fox and Davidson (1987) found that infants displayed a range of positive and negative facial affects in response to either approach of mother or stranger. During either approach a number of different discrete facial expressions and blends were present. Thus, brain electrical activity recorded during that entire epoch would naturally have included periods containing different emotions. Although these data demonstrated the existence of changes in brain activation asymmetries in response to different stimulus conditions, they did not address the fundamental question of the patterning of brain activity during different discrete expressions of emotion. The purpose of the present study was to explicitly examine EEG during the presence of discrete facial signs of emotion so that the precise lateralized changes in the EEG that are associated with different emotions could be specified. In addition, we compared EEG during facial signs of emotion that differed in vocalic ex-

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pression. We specifically predicted that facial signs of positive emotion that accompany approach behavior would be associated with left frontal activation, whereas facial signs of negative emotion that accompany withdrawal would be associated with right frontal activation (see Davidson, 1984; Fox & Davidson, 1984).

Method

Subjects

Thirty-five 10-month-old female infants (*M* age = 10.2 months, *SD* = .14), each born to two right-handed parents, were observed in this study. Parental handedness was assessed using the Edinburgh Handedness Inventory (Oldfield, 1971). The restriction of the sample to only infants born to two right-handed parents is a function of the fact that hemispheric specialization is known to differ in right- versus nonright-handed populations (e.g., Zangwell, 1960), and infants born to two right-handed parents are very likely to develop a right-handed bias later in life. In light of data suggesting that sex differences are present in hemispheric specialization, (McGlone, 1980) we decided to test only female infants.

Procedure

Infants were exposed to three stimulus situations, including approach of an unfamilar person, approach of the infant's mother, and maternal separation. Table 1 presents the experimental design. The stranger exhibited a neutral facial expression during her approach sequence. The infant's mother exhibited a smiling, happy facial expression during her approach sequence. These different facial expressions were chosen to maximize the likelihood of differential response to mother and stranger. The stranger entered and exited from a door located at the end of the experimental room. The mother, at the beginning of her approach, got up from her chair and walked to the end of the room where she turned and faced the infant. This began the sequence of her approach. During each of these approach sequences, infant behavior, including facial expression, was videotaped.

In addition, EEG was recorded from the left and right frontal (F) and parietal (P) scalp regions referred to a common vertex (F3, F4, P3, P4, referred to Cz). We recorded from frontal and parietal regions to compare the infant data with previously established adult findings (Davidson et al., 1979; Davidson, Schaffer, & Saron, 1985; Tucker et al., 1981) and to compare results to our studies of newborn (Fox & Davidson, 1986) and 10-month-old infants (Davidson & Fox, 1982; Fox & Davidson, 1987). Subjects wore a lycra, stretchable cap that contained all of the 10/20 electrode placements to record EEG. Each of the four EEG leads was directed into its separate amplifier channel (Grass Model P7D). The output of each EEG amplifier was displayed on separate channels of a Grass Model 7 polygraph and recorded on separate channels of a Vetter Model D FM Instrumentation recorder for subsequent analysis.

An observer, stationed in the experimental room behind a screen and hidden to both mother and infant, timed each of the epochs of the experiment and depressed a button at the onset and offset of each epoch of the conditions. The output of the button press went to one channel of the Vetter FM Instrumentation recorder and onto one channel of the audio track of the videotape. In this manner, behavioral and physiological data could be synchronized and the onset and offset of different conditions and epochs could be noted for subsequent analysis.

Facial Behavior

The videotaped data were coded by an observer, blind to the nature of the experiment, using Izard's Maximally Discriminative Facial Action Coding system (MAX; Izard, 1979). The onset and duration of discrete facial expressions were computed from the coded facial-action data. The MAX system describes and illustrates 27 facial movement units or appearance changes, which in various specified combinations identify 10 affect expressions. Appearance changes included in MAX are limited to those involved in the expression of nine fundamental emotions as defined by differential emotions theory (Izard, 1977) and the infant's response to pain. We also coded infant smiles using Ekman and Friesen's EM-FACS (1984) system, because it provides a more fine-grained differentiation among smile types. Ekman and Friesen (1982) reported on the presence of different types of smiles depending on the social context. We were interested in examining infant smiles to stranger and mother in order to see if infants expressed different smile patterns to familiar and unfamiliar adults.

Table 1
Overview of Experimental Design

Condition	Epoch	Duration (in s)
Baseline		30
Stranger approach (mother present)	Enter	15
	2 steps	15
	2 steps	15
	reach	15
Mother approach	At door	15
	2 steps	15
	2 steps	15
	reach	15
Maternal separation		60
Stranger approach (mother absent)	Enter	15
	2 steps	15
	2 steps	15
	reach	15
Mother returns—experiment ends		

EEG

The EEG was low pass filtered at 44 Hz (48 db/octave) to prevent aliasing (i.e., higher frequencies being detected as low frequencies because of the sampling rate) and then digitized off-line with a PDP 11/34A computer at a sampling rate of 125 samples per second. All epochs confounded by either gross-motor or eye-movement artifact were eliminated prior to further analysis. Eye-movement artifact was removed on the basis of examining both channels of frontal EEG for the presence of synchronous potentials associated with eye blinks and eye movements. This procedure was adopted rather than recording the electrooculogram (EOG) because we have found that infants of this age do not tolerate EOG electrodes very well and often try to remove them from their face. Of the 35 infants, 19 had sufficient periods of artifact-free EEG across the different experimental conditions to warrant further analysis.

The periods of time within each epoch of the experiment in which the presence of a discrete emotion expression was present for at least 2.05 continuous seconds were also entered into the computer because this was the chunk size used for the Fourier analysis. We adopted a chunk size of 2.05 s because we have found that this duration minimizes frequency smearing. Each 2.05 s began with the onset of the facial expression as determined by coding from the videotape unless artifact was present in the EEG at this time. If artifact was present, the analysis epoch was the first 2.05-s nonconfounded epoch. Thus, the facial expression served as the unit of analysis, with the constraint that only expressions that were 2.05 s or greater in duration were extracted for analysis. We decided to focus on the discrete expressions of joy, anger, and sadness. The incidence of other discrete emotions (e.g., fear, disgust, surprise) was low across the experimental episodes, and there were insufficient periods of congruent EEG/facial expression data to permit further analysis. Blends of discrete emotions were also coded, but the predictions for specific patterns of EEG activity for these facial expressions are unclear (Fox & Davidson, 1984).

The periods of artifact-free EEG that coincided with the presence of each of the discrete emotions were extracted with a hamming window and processed through a Fast Fourier Transform. Power density (in uV^2/Hz) was computed in the 3–12 Hz band. We decided to eliminate activity at the very slow frequencies (1 and 2 Hz) because considerable variability is present in delta density in the infant EEG that is unlikely to be task-relevant. EEG power was then log-transformed to normalize the distribution. Our interpretation of the EEG data rests on the assumption that relative suppression of alpha-like activity is assumed to reflect activation. Similarly, supression of whole band activity is commonly taken to reflect increased activation (Lindsley & Wicke, 1974).

Results

The strategy for the examination of brain activity during the presence of discrete facial signs of emotion was dictated by the frequency of occurence of different expressions that were coincident with artifact-free EEG. Facial signs of joy, sadness, and anger occurred with sufficient frequency to permit analysis. The frequency of these facial expressions in the same subjects, however, was insufficient to allow a comparison among the expressions. Rather, we compared two types of smiles *within subjects*, and sadness and anger with and without the presence of crying in separate *between-subjects* analyses. In the event that an infant displayed more than one expression of a particular type that was coincident with artifact-free EEG, the EEG data were averaged across expressions, within subjects.

Joy

We first examined epochs during which facial signs of joy were present as indicated by the MAX system (Izard, 1979). Close inspection of the video records indicated that only some of the smiles involved contraction of the orbicularis oculi muscles. Ekman and Friesen's (1984) EM-FACS coding system differentiates between smiles with and without orbicularis oculi activity: the former are labeled *felt smiles,* the latter, *unfelt smiles.* Although this differential characterization may not be appropriate for the 10-month-old infant we decided to pursue possible differences in brain electrical activity between types of smiles. We therefore used EM-FACS to recode all of the expressions that MAX coded as joy. Using this system, we identified 10 subjects who showed at least one artifact-free period of EEG coincident with each of the two types of smiles—1 with only action of the zygomatic major and 1 with action in this muscle *and* orbicularis oculi. In research with adults, it is only the latter type of smile that has been found to be correlated with self-reports of happiness. Smiles exhibited in the absence of movement in the eye region have been associated with less intense reports of happiness compared to those smiles exhibited with movement in both eye and mouth region (Ekman & Friesen, 1982; Ekman, Friesen, & O'Sullivan, in press). It should be noted that differences in the pattern of muscle movement of the smiles could have been discriminated on the basis of the individual muscle movement data with MAX. However, according to the MAX formula these different patterns were all coded as the identical expression of joy. In addition, the EM-FACS coding system allows scoring of the intensity of facial expression. Both types of smiles were scored for intensity. Examination of the data revealed no difference in intensity between smiles with or without the presence of orbicularis oculi.

An analysis of variance (ANOVA) with Smile Type (with or without orbicularis oculi), Region (frontal or parietal), and Hemisphere (left or right) as factors was performed on the 3–12 Hz log power. Significant effects were obtained for Region, $F(1, 9) = 11.69$, $p < .008$, Hemisphere, $F(1, 9) = 14.58$, $p < .004$, the Smile Type × Hemisphere interaction, $F(1, 9) = 9.91$, $p = .01$, and the Region × Hemisphere interaction, $F(1, 9) = 7.98$, $p = .02$ (see Table 2). The triple order interaction was not significant, $F(1, 9) = 2.10$, $p < .18$. The Region effect was due to less power (greater activation) in the frontal compared with the parietal leads. The Hemisphere effect was due to less power (greater activation) in the left, compared with the right hemisphere leads. The Region × Hemisphere interaction was the result of less power in the left frontal region ($p < .05$, using Newman-Keuls). Although no interaction of Smile and Region was found, we performed separate ANOVAs for the frontal and parietal regions. These analyses were performed to investigate a priori hypotheses based on previous findings (Davidson & Fox, 1982; Fox & Davidson, 1986, 1987). The ANOVA for the frontal leads revealed, as predicted, a significant Smile × Hemisphere interaction, $F(1, 9) = 11.64$, $p < .008$. The same interaction for the parietal data was not significant. Inspection of the frontal data indicated a significant difference in left frontal power between smiles with and without orbicularis oculi activity with greater left frontal activation during period of smiling with orbicularis oculi ($p < .05$).

In an attempt to examine the frequency of these smiles during the different experimental conditions, we investigated their incidence with respect to the two different approach conditions (stranger and mother approach). Table 3 presents the data on the number of subjects who displayed these two different types of smiles during stranger and mother approaches. This analysis is based on the total sample of 35 subjects. As can be seen, there was a significant association between person approaching and type of smile. More infants displayed smiles without orbicularis oculi to the stranger than to the mother (Fisher's Exact, $p < .005$). We also compared the duration of the two different types of smiles. The mean duration for smiles that included orbicularis oculi activity was 2.39 s ($SD = 1.49$), whereas the mean for smiles that did not include orbicularis oculi activity was 1.49 s ($SD = .94$), $t(38) = 3.13$, $p < .01$.

Sad

Ten subjects displayed at least one expression of sadness during which there was artifact-free EEG. Five of these subjects were crying during the expression, and 5 were not crying. A Condition (sad without cry or sad with cry) × Region × Hemi-

Table 2
Mean 3- to 12-Hz Log Power for Facial Expressions of Joy

Scalp region	Expression of joy: With orbicularis	Expression of joy: Without orbicularis
Frontal		
Left		
M	1.448	1.782
SD	.716	.323
Right		
M	1.862	1.523
SD	.726	.545
Parietal		
Left		
M	1.529	1.824
SD	.572	.430
Right		
M	2.151	2.030
SD	.678	.444

Note. $N = 10$.

Table 4
Mean 3- to 12-Hz Log Power for Sad Expressions During and in the Absence of Crying

Scalp region	Sad expression: No cry	Sad expression: Cry
Frontal		
Left		
M	1.289	1.646
SD	.528	.958
Right		
M	1.768	1.036
SD	.336	.888
Parietal		
Left		
M	1.636	2.264
SD	.409	.540
Right		
M	2.217	2.087
SD	.386	.777

Note. $N = 5$ per group.

sphere ANOVA was computed on the log power. Results revealed a significant Condition × Hemisphere interaction, $F(1, 8) = 14.93$, $p = .005$ (see Table 4). On the basis of our a priori predictions concerning the locus of the asymmetrical effects, we computed separate ANOVAs on the frontal and parietal data. Both frontal and parietal ANOVAs revealed significant Condition × Hemisphere interactions, $F(1, 8) = 23.44$, $p = .001$, and $F(1, 8) = 5.41$, $p = .05$ (for frontal and parietal, respectively). Post hoc comparisons for the frontal ANOVA revealed that during sadness with crying, infants showed significantly less ($p < .01$) right compared with left frontal power, indicative of right-sided activation. During sad expressions in the absence of crying, infants showed the opposite pattern of frontal EEG, with less power in the left compared with the right lead ($p < .01$), indicative of left-sided activation. In addition, sadness with crying was associated with significantly less ($p < .01$) right frontal (i.e., more activation) and significantly more ($p < .05$) left frontal power (less activation) compared with sadness in the absence of crying. All 5 infants who displayed facial expressions of sadness while crying exhibited right frontal activation, whereas all 5 of the infants displaying facial expressions of sadness in the absence of crying exhibited left frontal activation. Post hoc comparisons for the ANOVA on the parietal leads revealed no significant pair-wise effects.

Table 3
Number of Infants Displaying Felt and Unfelt Smiles in Response to the Stranger- and Mother-Approach Conditions

Condition	Smiles with orbicularis	Smiles without orbicularis
Stranger approach	5	15
Mother approach	21	6

Note. $p = .005$, using Fisher's Exact Test.

Anger

There were 10 subjects with facial expressions of anger that were coincident with periods of artifact-free EEG. Five of these subjects were coded during crying, whereas 5 were coded in the absence of crying.[1] A Condition (anger with crying or anger without crying) × Region × Hemisphere ANOVA on the log power data revealed a significant Condition × Hemisphere interaction, $F(1, 8) = 11.33$, $p = .009$, but no other main or interaction effects (see Table 5). Separate ANOVAs were computed on the frontal and parietal data. The ANOVA for the frontal leads revealed a significant Condition × Hemisphere interaction, $F(1, 8) = 23.79$, $p = .001$. No significant effects were obtained for the parietal leads. Post hoc comparisons for the frontal ANOVA revealed that anger with crying was associated with significantly less right compared with left frontal power ($p < .01$) (i.e., right frontal activation), whereas anger expressed in the absence of crying was associated with greater right compared with left frontal power ($p < .05$) (i.e., left frontal activation). In addition, there was less left frontal power (i.e., more activation) during anger expressions in the absence of crying compared with anger expressions in the presence of crying ($p < .01$).

Discussion

The data presented above indicate that EEG asymmetry discriminates between facial and vocal signs of certain discrete emotions. During the expression of smiles with orbicularis oculi involvement, infants displayed left frontal activation, whereas during smiles in the absence of orbicularis oculi activity, infants showed right frontal activity. The difference between

[1] Only 2 of the 5 subjects for whom there were data on anger with crying had EEG and facial data for sadness with crying. Only 3 of 5 subjects for whom there were data on anger in the absence of crying had EEG and facial data for sadness in the absence of crying.

Table 5
Mean 3- to 12-Hz Log Power for Expressions of Anger With and Without Crying

	Anger expression	
Scalp region	No cry	Cry
Frontal		
Left		
M	1.448	2.102
SD	.248	.380
Right		
M	1.724	1.596
SD	.537	.389
Parietal		
Left		
M	1.676	1.914
SD	.465	.442
Right		
M	1.879	2.038
SD	.146	.845

Note. $N = 5$ per group.

these expression periods was a function of differences in left frontal activity, with smiles involving only zygomatic activity associated with less left frontal activation compared with smiles associated with movement in both cheek and eye regions. There was little difference between smile types in right frontal activity.

The difference in EEG asymmetry between smiles with and without involvement of the eye muscles is the first physiological discrimination between these expressions that has been reported. The pattern of EEG that was found to best differentiate between these expressions is precisely the one that was predicted on the basis of our previous data. These findings lend validity to the interpretation of these facial signs first suggested by Duchene and Darwin in the late 1800s (Duchene, cited in Darwin, 1872/1976) as well as in more recent research (Ekman & Friesen, 1982; Ekman et al., in press). Ekman and Friesen (1982) reported differences in subjective feelings of happiness in adults, which they labeled *felt* (with orbicularis oculi activity) and *unfelt* (without orbicularis oculi activity) smiles, with greater happiness associated with felt smiles. Ekman also noted that among the characteristics that differentiated unfelt from felt smiles was duration; felt smiles were longer than unfelt smiles. We confirmed this effect in 10-month-old infants. Smiles with orbicularis oculi activity were significantly longer than unfelt smiles.

Although it may not be appropriate at this time to label these different smiles in 10-month-olds as felt or unfelt, their differential presence in response to stranger and mother approach, the different pattern of EEG activity associated with each type, and the differences in smile type duration do argue that by 10 months infants are producing subtle differences in smiles in response to novel and familiar events.

Ekman and Friesen (1982) have noted that the frequency of felt and unfelt smiles might differ as a function of social context. The data from the current study are consistent with this general suggestion. Smiles without orbicularis oculi activity were seen more often in response to approach of the stranger, and smiles with orbicularis oculi activity were observed more often in response to the mother.

These findings are consistent with previous electrophysiological data in both infants (e.g., Davidson & Fox, 1982; Fox & Davidson, 1986, in press) and adults (e.g., Ahern & Schwartz, 1985; Davidson et al., 1979; Tucker et al., 1981), which indicate differences in frontal activation asymmetry between certain positive and negative emotions. Following Kinsbourne (1978), we have interpreted this asymmetry in frontal activation to reflect the engagement of systems mediating approach (left) and withdrawal (right) behavior (Davidson, 1984; Fox & Davidson, 1984).

Approach of an unfamiliar person in an unfamiliar environment may be a situation that elicits withdrawal or avoidance responses. The unfelt smiles, therefore, may be one expression of the infant's wariness or avoidance and, thus, would be accompanied by greater relative right frontal activation. The felt smiles, by contrast, may have reflected the infant's approach response to mother, hence their association with relative left frontal activation. The presence of these unfelt smiles also indicates that by this age infants are capable of regulating certain emotion expressions and of using subtle facial behaviors in different stimulus contexts. Infants changed their smiling behavior depending on the stimulus situation (c.f. Fox & Davidson, in press).

One cautionary point should be noted with regard to the localization of these EEG effects. As is well known, one of most serious limitations of scalp-recorded EEG is the poor spatial resolution that is obtained. The skull is a volume conductor that, among other things, may distort location of the brain's electrical activity. It is therefore inappropriate to assume a one-to-one relation between electrode location and underlying source generator. Equally important is the fact that not all source generators are perpendicular to the scalp's surface. This geometrical fact results in difficult-to-predict spatial patterns of scalp-recorded activity. Perhaps the most convincing support linking frontal activity with emotion is the consistency between the electrophysiological findings and the brain damage evidence where frontal specificity for affective change has been repeatedly observed (see Davidson, in press, for a review of this point). Even more convincing will be future studies where different measures of regional brain activation that have better spatial resolution than the EEG (e.g., regional cerebral blood flow) are used in conjunction with the EEG to more precisely specify the locus of these asymmetrical patterns of activation.

The data from this study also revealed differences in EEG asymmetry between certain facial signs of emotion with and without the presence of crying. In general, the presence of crying was associated with greater right frontal activation compared with its absence during both sad and angry facial expressions.

One problem that is raised by these data concerns the possibility that the EEG asymmetries that we have reported to distinguish between facial expressions with and without crying might result from asymmetries in the facial expressions themselves. According to this view, facial expressions are often asymmetrical (e.g., Borad & Koff, 1984), and the asymmetrical muscle activity might reflect asymmetrical cortical activity that is involved in its control. Although asymmetries in facial expression are quite evident in infants of this age, our data do not suggest that these asymmetries consistently differentiate between crying and noncrying periods. However, a more definitive answer to this question would require the measurement of facial asymmetry and EEG asymmetry simultaneously to ascertain whether there is any direct relation between asymmetries in these different response systems. One alternative that we can rule out is the possibility that our EEG data are confounded by asymmetrical muscle artifact. The procedures we have adopted for EEG recording and quantification systematically exclude from analysis all frequencies that might contain myogenic intrusions. However, we cannot conclusively rule out the possibility that our data reflect cortical asymmetries in the control of asymmetrical facial expressions. This possibility must be explored in future research.

These data indicate that vocal expressions of affect must be taken into account when analyzing patterns of facial expression in relation to physiological activation, at least in infants. EEG asymmetry for sad and angry expressions differed as a function of the presence or absence of crying. Vocal signs of distress, such as crying accompanying discrete facial expressions, may denote a different emotional state compared with the same expression in the absence of crying. Certain discrete facial expressions of emotion such as anger or sadness may reflect either approach or withdrawal, depending on the stimulus context and the subject's appraisal of that context. When anger, for example, is displayed in the absence of crying it may reflect a very different state than when this expression is accompanied by crying.

Sadness is a complex response, perhaps involving both approach and withdrawal components. In the absence of weeping or distress a sad facial expression may reflect the individual's attempt to both regain the lost object of attachment while withdrawing from the event that triggered this loss (Fox & Davidson, 1984). Thus, one might expect relative left frontal activation to the extent that the approach system is elicited. Of interest are descriptions by Bowlby (1973) and others (Thompson & Lamb, 1984) of the infant's emotional reaction to separation. Bowlby describes the infant's initial response of distress to separation as an attempt to regain the caregiver's presence and functionally to gain proximity to the caregiver. Sad expressions were observed in our data in response to separation and may have involved the approach system that would be associated with left frontal activation.

The current data represent the first instances in which concurrent changes in EEG activity and patterns of facial behavior, reflecting discrete emotion expressions, have been reported in infants. They reveal the presence of patterns of EEG activation asymmetry during the expression of certain discrete emotions and the presence of these patterns during the first year of life. The pattern of EEG asymmetry may reflect a fundamental difference in the nature of the emotion elicited, with left-sided activation in the frontal region associated with approach behavior and right-sided activation associated with withdrawal behavior.

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Call for Nominations for *Journal of Abnormal Psychology*

The Publications and Communications Board has opened nominations for the editorship of the *Journal of Abnormal Psychology* for the years 1990–1995. Don Fowles is the incumbent editor. Candidates must be members of APA and should be available to start receiving manuscripts in early 1989 to prepare for issues published in 1990. Please note that the P&C Board encourages more participation by women and ethnic minority men and women in the publication process, and would particularly welcome such nominees. To nominate candidates, prepare a statement of one page or less in support of each candidate. First review of nominations will begin March 1, 1988. Submit nominations to

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