The Regulation of Positive Affect: Gaze Aversion Activity During Mother–Infant Interaction

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The purpose of this study was to examine two aspects of gaze aversion activity in young infants: (a) at what level of positive affect infants employ gaze aversion, and (b) the relationship between maternal activity and gaze aversion activity. Sixty 5-month-old infants were videotaped while participating in a peek-a-boo game with their mothers. The infants’ positive emotion expressions were coded using a microanalytic facial coding system designed to measure the parameters of intensity and duration. Gaze aversions occurring during or immediately following a smile were coded separately, then maternal activity level during peek-a-boo was coded from the videotapes. Results revealed infant smiles of high intensity were associated with more frequent and longer gaze aversions. Moreover, the intensities of smiles to which infants averted their gaze were greater than those smiles to which infants did not change their gaze behavior. These same relationships were found for smile durations. Finally, moderate maternal activity level during peek-a-boo elicited the most gaze aversion activity following a smile. The functional significance of gaze aversion to increases in positive affect is discussed.

Gaze behavior in infancy is one of the earliest regulators of perceptual input (Robson, 1967). Through the visual system, infants have the ability to control the amount and, in some cases, the type of stimulation they perceive. Mutual gaze has been the focus of adult social psychology (Rutter, 1984), whereas the functional significance of gaze aversion in response to emotion-eliciting stimuli has been of interest to infant researchers (Brazelton, Koslowski, & Main, 1974; Field, 1981a; Stern, 1974). Gaze aversion has been proposed to serve as a regulator of internal physiological state (Stern, 1974). Specifically, infants avert their gaze to modulate arousal created by intense, active, or discrepant stimuli. Alternatively, infants may look away from a familiar or redundant stimulus for the purposes of seeking out other stimuli, thereby increasing arousal to an optimal level (Kagan, 1971). Field (1981b), using heart rate change as an indicator

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of physiological arousal, found that heart rate accelerates immediately prior to gaze aversion and returns to baseline levels when the infant averts his or her gaze. Support also comes from the animal (Argyle & Cook, 1976; Chance, 1962) and clinical literature (Field, 1981c; Hutt & Hutt, 1970). Chance (1962), in his observation of rats and gulls, found the use of "cut-off" gazes to regulate conflict and reduce arousal. Research on high-risk infants indicates that preterm infants show more gaze aversion than term infants, the result of less-developed information processing or arousal modulation abilities (Field, 1981c).

Infant gaze aversion is often discussed within the context of negative emotionality. Studies of fear, wariness, and distress use behavioral avoidance, including gaze aversion, as an index of negative arousal (Campos, Emde, Gaensbauer, & Henderson, 1975; Cohn & Tronick, 1983; Waters, Matas, & Sroufe, 1975). For example, in a study of mother–infant interaction during which mothers were asked to simulate depression, Cohn and Tronick (1983) found infants to cycle among the behavioral expressions of wary, protest, and looking away. Each of these studies is based on the assumption that the novelty of the stranger or the still-faced mother increases arousal. Consequently, infants will avert their gaze away from the stimulus presumably to modulate arousal, inhibit a more intense negative response (e.g., crying), and preserve the need to re-approach the novel event. Increases in arousal, however, are not limited to aversive conditions. The build-up of excitement from pleasurable interactions has also been described. Both Stern (1974) and Brazelton (Brazelton et al., 1974) discovered that playful interactions between mothers and infants generated a cycle of infant engagement-disengagement. Interestingly, Cohn and Tronick (1983) also found that during normal conditions of mother–infant interaction, infants displayed an organized pattern of behaviors that cycled from play and brief positive expressions to looking away. Brazelton (Brazelton et al., 1974) suggested that the infant uses these periods of disengagement during pleasurable interactions "as if he were attempting to reduce the intensity of the interaction, to recover from the excitement it engenders in him, and to digest what he has taken in during the interaction" (p. 59). Thus, it appears that, as in aversive conditions, gaze aversion during pleasurable interactions serves to regulate arousal as well as maintain social contact.

Each of these studies has described the function of gaze aversion during positive interactions, however, they have not identified the degree or threshold of arousal which necessitates the use of gaze aversion. Studies using heart rate change as a measure of arousal suggest that gaze aversion modulates the heart rate acceleration produced by a negative stimulus (Field, 1981b; Waters et al., 1975). Several problems exist, however, that limit the interpretation of heart rate change as an index of emotional arousal, such as individual differences in heart rate responsivity (Porges,
and confounds with somatic activity (Obrist, 1975). An alternative and less invasive method for assessing emotional arousal might be to code the temporal and intensive qualities of an emotional expression. In many cases, it is these emotional response parameters that the caregiver uses to evaluate the state of an infant (Murray, 1985). Recent advances in behavioral coding systems which derive emotion categories from facial muscle configurations now make it possible to confidently identify periods of emotion, including expressions of joy (Ekman & Friesen, 1983; Izard, 1979). Moreover, the microanalytic nature of these systems allows for coding of the intensity and duration of each emotion expression. Several studies of adult emotional responsivity suggest that the examination of these parameters may be an important means for evaluating state (Brown & Schwartz, 1980; Ekman, 1984; Ekman, Friesen, & Ancoli, 1980; Winton, Putnam, & Kraus, 1984). Ekman (Ekman et al., 1980), for example, found that the measures of intensity and duration derived from the EMFACS coding system (Ekman & Friesen, 1983) were related to the subject's reported strength of the emotional experience. Related to the issue of gaze aversion and positive expressivity is an exploratory study by Kendon (1967) which revealed that during a social interaction smiles of high intensity were more likely to be followed by gaze aversions than smiles of low intensity.

Our interest in using the parameters of intensity and duration of an emotion expression as measures of arousal is based on the assumption that the infant's facial expression of emotion accurately reflects his or her internal feeling state (Izard & Malatesta, 1987). The concordance between emotion expression and feeling state, argued Izard and Malatesta (1987), is an innate and adaptive relationship, one which evokes essential caretaking interventions. This concordance is particularly important for the preverbal infant who must communicate his or her feeling state through facial and vocal expression. Over time, however, the child begins to learn strategies for disassociating feelings from behavior.

The purpose of the present study was to determine at what level of positive arousal gaze aversion activity is used by young infants. Toward this goal, we coded the intensity and duration parameters of smiles occurring during a peek-a-boo game between mothers and their 5-month-old infants. We hypothesized that smiles of high intensity and long duration would be followed by more frequent and longer gaze aversions than smiles of low intensity and short duration. Five-month-old infants were studied because they are able to actively participate in the peek-a-boo game, and the concordance between expression and feeling is assumed to be relatively stable at this age.

As a second goal, we were interested in the effect of the interactant's play behavior on the infant's use of gaze aversion. Field (1981b) demonstrated that the relationship between the activity level of the interactant
and gaze aversion was curvilinear such that low-and high-active interactions produced more gaze aversions than moderately active interactions. In the present study, two measures of maternal activity level were used.

METHOD

Subjects
The subjects of this study were sixty 5-month-old infants ($M = 20.20$ weeks, $SD = 1.28$). Twenty-nine of the subjects were male and 31 were female. Subjects were recruited through a university hospital newborn nursery and were healthy full-term infants from predominantly white, middle-class families.

Procedure
To elicit positive reactivity, infants participated in a peek-a-boo interaction with mother (Sroufe & Waters, 1976). The procedure took place in a 9' × 12' (2.74 m × 3.66 m) room with a one-way mirror. Infants were placed in an infant seat situated at eye level across from mother who was seated on a stool. Mothers were instructed to interact normally with their infants and, upon a cue from the experimenter, begin playing peek-a-boo for 90 seconds. The only requirement other than "to play peek-a-boo as you normally would" was for mother to elicit her infant's attention by calling his or her name or making sounds before exposing her face and smiling. Videotaping was done through a one-way mirror. A second camera was situated in the laboratory and used to record the mother's behavior. Both camera lines were fed through a split-screen generator and a time code generator which superimposed a digital clock on the video image.

Positive Affect. Positive emotion expressions were coded using EMFACS (Ekman & Friesen, 1983), which is an anatomically based affect coding system based on the microanalytic system, FACS (Ekman & Friesen, 1978). EMFACS is an a priori system which identifies those facial configurations that in combination represent certain emotions. EMFACS is also designed to code the parameters of duration and intensity.

FACS has been adapted for use with infants (Oster & Rosenstein, in press). This adaptation describes the subtle variations in facial expressions due to excess fatty tissue present in the young infant's face. For the purposes of this study, the FACS adaptation was extended to the coding of affect expressions using EMFACS. FACS and EMFACS have been adapted for use in several studies of infant emotional reactivity (Fox & Davidson, 1988; Oster, 1978; Rosenstein & Oster, 1988; Stenberg, Campos, & Emde, 1983).
The EMFACS coding of the peek-a-boo procedure yielded two emotion parameters which were used in the present study—duration and intensity. Duration was coded from the onset of the expression through its apex to the time any facial configuration changed or returned to a neutral state. Intensities were coded for each facial configuration and ranged from 1 (low intensity) to 5 (high intensity). The intensity scoring is based on the degree of facial muscle contraction.

Reliabilities were calculated for 10% of the sample on the emotion translations (type of emotion coded from the observed facial configurations), the duration of each emotion expression, and the intensity of facial action units. Prior to the present study, the two coders and the experimenter were tested for reliability on the FACS system. The kappa coefficients for the duration and intensity variables were .67 and .63, respectively. Reliabilities on the timing of an emotion expression, that is, whether the coders saw a codable expression at the same time, and the emotion translations were computed by percent agreement and ranged from 74% to 82%. Any discrepancies between the two coders on the subjects coded for reliability were corrected in conference with the experimenter.

Gaze Aversions. Two types of gaze aversion were coded. The following criteria were used to distinguish gaze aversions occurring in response to positive arousal from other gaze aversions: (a) The infant must avert his or her gaze after the exposure of the mother’s face, (b) the gaze aversion must occur during a smile or within 1 s after the infant has smiled in response to mother, and (c) gaze aversion should involve active looking away. Active looking away was defined as clearly shifting the gaze in another direction, looking down which gives the appearance of closed eyes, or changing the position of the head and/or body resulting in the aversion of gaze. These behaviors must have occurred for a period of 1 s or longer. A gaze aversion episode ends when the mother returns to covering her face or the infant directs his or her attention elsewhere. The frequency and duration of gaze aversions which did not meet the above criteria were also coded, such as those occurring during or immediately following negative expressions or those occurring before mother face exposure.

The coders used for the gaze aversion data were different from the facial expression coders and were blind to the emotion translations and intensity levels of the EMFACS codings. The kappa coefficients for the frequency and duration of gaze aversion variables were .66 and .88, respectively.

Activity Level. To investigate the relationship between the activity level of the interactive partner and the infant’s gaze aversion behavior, the degree of mother activity during the peek-a-boo interaction was coded
using a 7-point scale. This scale included varying levels of verbal, facial, and body activity ranging from very low activity (1) to nearly constant verbalizations, body movements, and smiling behavior (7). The percent agreement for this measure was 80. As a convergent measure of activity level, the number of mother face exposures—how many times mother exposed her smiling face to the infant during the peek-a-boo—was also coded.

RESULTS

Two questions directed the data analysis: (a) What is the relationship between smile intensity and duration and the number and duration of gaze aversions, and (b) is the activity level of the mother related to the number and duration of gaze aversions. The smile duration, smile intensity, and gaze duration variables were individually derived by averaging each of these measures across the 90-s peek-a-boo session for each subject. The gaze frequency variable was created by summing the number of gaze aversions observed for each subject. Tests of relationships and differences on these variables, therefore, were performed on the sample mean of the individual subjects' mean score. All of the following analyses were done with Sex as an independent variable. No significant main or interaction effects for Sex were found.

Smile Intensity/Duration and Gaze Aversion Activity

Three intensity groups (low, moderate, and high) were created by trichotomizing the distribution of the mean intensity scores (range = 1.0-4.4). This procedure resulted in adequate cell sizes for the comparison of low- and high-intensity groups. Analyses of variance were computed with intensity group as the independent variable and either gaze aversion frequency or gaze aversion duration as the dependent variable. A priori contrasts were also computed comparing the low- and high-intensity groups on the number and duration of gaze aversions during smiling. The results showed a significant effect for the frequency of gaze aversion, $F(2,49) = 12.07, p < .001$. The means and standard deviations for these data can be found in Table 1. A priori contrasts revealed that infants exhibiting high-intensity smiles during the mother peek-a-boo interaction averted their gaze more often than infants exhibiting low-intensity smiles, $t(49) = 3.32, p < .005$. It is important to note that moderately intense smiles also produced more gaze aversions than smiles of low intensity, $t(49) = 4.72, p < .001$, but that the difference between high- and moderate-intensity smiles was nonsignificant.

The relationship between smile intensity and gaze aversion duration was also tested and though the model was not significant, $F(2,49) = 2.52, p < .09$, a significant difference was revealed between low- and high-
intensity smiles on the length of gaze aversion, $t(49) = 2.21, p < .05$. Infants averted their gaze for a longer period of time after expressing a high-intensity smile than after expressing a low-intensity smile (see Table 1).

Using Pearson correlations, the relationship between smile duration and the number and duration of gaze aversions following a smile was tested. A positive significant association was found for smile duration and the number of gaze aversions, $r(55) = .53, p < .001$. The same association was revealed for the duration of the gaze aversion. Infants averted their gaze for longer periods after a smile of long duration than after a smile of short duration, $r(55) = .63, p < .001$.

The relationship between smile intensity and gaze aversion is further illustrated when comparing the intensity of smiles that were followed by gaze aversions to the intensity of those smiles that were not followed by gaze aversion activity. The intensity of smiles elicited in a peek-a-boo game after which the infant averted his or her gaze ($M = 2.54, SD = 0.80$) was greater than the intensity of smiles after which no gaze aversion was exhibited ($M = 2.14, SD = 1.00$), $t(51) = 2.85, p < .05$. A similar difference was found for smile durations, $t(49) = 2.06, p < .05$. The duration of smiles after which the infant averted his or her gaze ($M = 2.79, SD = 1.40$) was significantly longer than the duration of smiles that were not followed by gaze aversion ($M = 2.34, SD = 1.40$). A closer inspection of the infants who smiled but did not exhibit any gaze aversions during peek-a-boo revealed that their smile intensities were significantly lower ($M = 0.81, SD = 0.47$) than the smile intensities of the infants who averted their gaze ($M = 2.09, SD = 0.74$), $F(1,58) = 11.42, p < .001$.

**Maternal Activity Level and Gaze Aversion**
The activity level of the mother during the peek-a-boo game was coded in two ways, ratings on a 7-point scale and the frequency with which the mother exposed her smiling face. The correlation between these two measures was significant, $r(58) = .55, p < .01$.

**TABLE I**
Means and Standard Deviations of the Frequency and Duration of Infant Gaze Aversions Following a Smile for the Three Smile Intensity Groups

<table>
<thead>
<tr>
<th>Smile Intensities</th>
<th>LOW</th>
<th>MODERATE</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
</tr>
<tr>
<td>Frequency of gaze aversions</td>
<td>2.15</td>
<td>1.90</td>
<td>6.00</td>
</tr>
<tr>
<td>Duration of gaze aversions</td>
<td>1.18</td>
<td>0.30</td>
<td>1.35</td>
</tr>
</tbody>
</table>
Three activity groups were formed using the 7-point scale. Differences between low- (ratings 1–3), moderate- (ratings 4 and 5), and high- (ratings 6 and 7) activity mothers on the number and duration of gaze aversions exhibited after a smile and the total number of gaze aversions exhibited during mother peek-a-boo were tested. A significant effect was found for the number of gaze aversions displayed after a smile, $F(2,49) = 4.80$, $p < .01$. A priori contrasts indicate that, contrary to our hypothesis, moderately active mothers elicited significantly more gaze aversions after smiles than low-activity, $t(49) = 2.25$, $p < .05$, and high-activity mothers, $t(49) = 2.52$, $p < .01$. See Figure 1 for a graphic representation of these data. No significant differences were found for the gaze aversion duration.

To investigate whether the difference in maternal activity level and infant gaze aversion following a smile was due to differences in smiling behavior, post-hoc analyses were performed on the frequency, duration, and intensity of smiles and maternal activity during the peek-a-boo session. Differences in nonpositive gaze aversions were also tested. Table 2 lists the means and standard deviations for these data. A significant relationship between maternal activity and the frequency of smiles was found, $F(2,57) = 4.50$, $p < .02$. Moderately active mothers elicited more smiles than low-active mothers, $t(57) = 3.49$, $p < .003$. The difference between high-active and moderately active mothers was nonsignificant, however, as seen in Table 2, high-active mothers also elicited fewer smiles. Differences were also revealed for the intensity of smiles, $F(2,49) = 9.91$, $p < .001$. Moderately active mothers elicited more intense smiles than high-active mothers, $t(49) = 6.32$, $p < .001$, but the difference between low-active and moderately active mothers was nonsignificant. Finally, the duration of smiles elicited by mothers was also differentiated by the mothers' activity level, $F(2,47) = 3.39$, $p < .04$. As can be seen in Table 2,
moderately active mothers elicited longer smiles than high-active mothers, \( t(47) = 3.58, p < .001 \). The difference between moderate- and low-active mothers was not significant, though low-active mothers had lower values. No significant differences were found for nonpositive gaze aversions.

Activity level as measured by the number of smiling face exposures of the mother was tested using Pearson correlations. The results showed no association between this variable and the number and duration of gaze aversions.

**DISCUSSION**

The results of this study suggest that during a peek-a-boo game with their mothers 5-month-old infants are positively aroused and that gaze aversions displayed during this interaction are related to the level of positive arousal the infant exhibits. Using the intensive and temporal parameters of a smile as measures of positive arousal, we found high positively aroused infants to exhibit more frequent and longer gaze aversions than infants showing low positive arousal. This is further illustrated by the finding that those smiles followed by gaze aversion were of higher intensity and longer duration than those smiles not followed by gaze aversion. Furthermore, a small sample of infants who showed no gaze aversions after a smile was also found to display smiles of very low intensity.

The frequency with which gaze aversions accompany increases in positive arousal is in keeping with the research literature that infants use these periods of withdrawal to regulate their internal state (Brazelton et al., 1974; Field, 1981c; Stern, 1974). The role of gaze aversions in reducing or modulating arousal is primarily discussed in relation to aversive conditions, and as such gaze aversions are believed to function to remove the infant from the stimulus for the purposes of reducing arousal and inhibiting a more intense response. The use of gaze aversions within the context of a positive interaction may function in a similar manner. In the present study, gaze aversions were observed in conjunction with or immediately following expressions of high positive arousal. Gaze aversions

<p>| TABLE 2 |
|-----------------|------------|-----------------|------------|
| <strong>Means and Standard Deviations for the Frequency, Duration, and Intensity of Infant Smile Behavior and Nonpositive Gaze Aversions for the Three Levels of Maternal Activity</strong> |</p>
<table>
<thead>
<tr>
<th><strong>Maternal Activity Level</strong></th>
<th>LOW</th>
<th>MODERATE</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency of smiles</strong></td>
<td>5.20 3.40</td>
<td>9.64 4.30</td>
<td>7.64 5.20</td>
</tr>
<tr>
<td><strong>Duration of smiles</strong></td>
<td>2.59 1.40</td>
<td>3.11 1.50</td>
<td>1.87 0.70</td>
</tr>
<tr>
<td><strong>Intensity of smiles</strong></td>
<td>2.37 0.90</td>
<td>2.82 0.80</td>
<td>1.67 0.40</td>
</tr>
<tr>
<td><strong>Nonpositive gaze aversions</strong></td>
<td>2.70 1.90</td>
<td>1.83 1.90</td>
<td>2.69 1.80</td>
</tr>
</tbody>
</table>
in this context were quite short, generally lasting a second or two. This brief, often subtle, interruption appears to give the infants a method for maintaining both a postural and social approach toward the positive stimulus while modulating their level of arousal. In other words, gaze aversions act as momentary breaks from the interaction which allow the infant to keep his or her body oriented toward the interactant as well as to reduce arousal so that the interaction with the pleasurable stimulus may resume. Moreover, these behaviors—smiling, approach orientation, and short periods of gaze aversion—clearly convey the message that the infant is enjoying the interaction and wants it to continue.

Cognitive theories of emotion (Kagan, 1971; Sroufe & Waters, 1976) argue that smiling behavior acts as a tension release mechanism designed to reduce tension created by the effortful assimilation of a stimulus. This fluctuation in attention, affect, and arousal is supported by several empirical studies of mother-infant interaction (Fogel, Diamond, Langhorst, & Demos, 1981; also see Field, 1981a). Rothbart (1973) has suggested, however, that a transformation from tension produced from an evaluation of the situation to emotional activity takes place and that arousal remains high during periods of intense positive emotion, that is, laughing. This may explain why several studies have shown heart rate accelerations during smiling and laughter (Emde, Campos, Reich, & Gaensbauer, 1978). Our data indirectly confirm this notion by demonstrating that increases in positive arousal as reflected in smile intensity and duration are accompanied and/or followed by gaze aversions.

Our result that moderately active mothers produced more gaze aversions following smiles than low- or high-active mothers provides a different picture than that of Field (1979, 1981b) who found that low- and high-active partners lead to more, rather than fewer, gaze aversions. A closer look at the smiling and gaze aversion data revealed some interesting differences for the three levels of maternal activity. Smiles in response to low- and high-active mothers were somewhat less frequent and of lower intensity than smiles in response to moderately active mothers. Hence, the moderately active mother elicited more smiles of longer duration and higher intensity than the other two types. This result suggests that a moderately active peek-a-boo play style is optimal for creating high levels of positive arousal. Moreover, infants who played peek-a-boo with a low- or high-active mother showed slightly more nonpositive gaze aversions, that is, they displayed gaze aversions that were unrelated to smiling behavior. Thus, it appears that infants interacting with a low- or high-active mother are neither positively aroused nor interested in the peek-a-boo game. This may be easily attributed to the low-active mother because her level of play may not be stimulating enough to evoke high-intensity responses, but what of the high-active mother? One explanation might be
that the high-active mothers' behavior was an effect of the infants' lack of interest or joy rather than its cause. These mothers may have increased their "peek-a-boo" pace because they were sensitive to their infants' lack of interest. Alternatively, these mothers may have been more concerned with performing the required task than responding contingently to their infants.

It is important to note that when comparing the number of gaze aversions exhibited in response to the varying levels of maternal activity, we examined only those gaze aversions occurring during or subsequent to a smile rather than consider all gaze aversions. Other studies did not make this distinction. For example, still-faced, imitative, and attention-getting interactions were used by Field (1981b) to represent the varying levels of stimulation. Although the affective responses of the infants to these situations were not reported, it is well-documented that a still-faced mother produces increasing levels of negative arousal and frequent gaze aversion activity (Cohn & Tronick, 1983; Field, 1984; Tronick, Als, Adamson, Wise, & Brazelton, 1978). The attention-getting interaction used by Field (1981b) did produce increases in arousal as indicated by heart rate accelerations, but again, whether the infant was positively or negatively aroused is not known. Though the results of the Field study may not be comparable to the present results, together these data suggest that the content of the stimulus and the affective response of the infant are important to assessing the relationship between the amount of stimulation and the frequency of gaze aversion.

To summarize, we found that during positive interactions infants when aroused to levels of high and moderate intensity will display gaze aversion activity. These short breaks from a moderately active interaction are interpreted as facilitating the modulation of the infant's arousal so that pleasing interchanges may resume. Our findings were limited to 5-month-old infants during a positive interaction with mother. Others have shown that for older infants the meaning of the stimulus content will change and influence the use of gaze aversion behavior. Gaze aversions may be longer, more frequent, or substituted with more intense withdrawal behaviors (Sroufe, 1979).

Our findings also suggest that the emotion expression parameters of intensity and duration may act as indirect measures of emotional arousal. Their use, however, may be limited to early infancy or to situations designed to elicit intense emotional reactions. In addition, the reliability of these parameters as measures of arousal is untested because no convergent measure of arousal (i.e., physiological index) was used. Future research with infants should consider examining changes in physiological activity associated with the differing levels of intensity and duration of a facial expression of emotion.
REFERENCES


INFANT GAZE AVERSION


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