

Learning Display Rules: The Socialization of Emotion Expression in Infancy

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This study presents data on changes from 3 to 6 months in the type and frequency of infant facial expression. 60 mother-infant dyads were videotaped during play and reunion following a brief separation. Mothers' and infants' facial expressions were coded using the Max muscular components method. The mothers' verbal responses to infant expressiveness were also analyzed. Infants at both ages display a wide range of expressions and a high rate of change. Mothers respond contingently to 25% of infant changes, patterns of contingent responding varied slightly as a function of infant age and sex. Mothers show more contingent responding to older sons' smiles (vs daughters' smiles) and follow sons' (vs daughters') expressions with imitative expressions of their own. The only expressive difference between boys and girls at this age is that girls show more frequent interest expressions. Age-related changes included an attenuation of negative affect and a slower lability of expression change for older infants. The mothers' part in these age-related changes is revealed in the following results: Maternal expressions are limited to positive emotions, especially toward younger infants, mothers show less nonverbal and verbal acknowledgment of older infant expression change and do not acknowledge certain infant negative expressions. Finally, we report mother-infant dyadic similarities in expressiveness, including particular expression types and preferential use of the brow or mouth region in expressiveness. These results indicate that socialization of affect expression is occurring during early infancy and that the infants' expressiveness is becoming appropriate according to cultural, gender, and familial demands well before the first birthday.

According to the theories of Ekman and Friesen (1975), Izard (1971, 1977), Sroufe (1979), and Tomkins (1962, 1963), children develop the ability to modulate their emotional expressions in the course of growing up, emotion expression becomes "socialized." Ekman and Friesen (1975) have suggested that unwritten codes or "display rules" govern the manner in which emotions may be expressed, and that different rules may be internalized as a function of an individual's culture, gender, or family background. For example, different cultures require that particular emotions be concealed and other emotions expressed dramatically (Ekman 1972, 1979, Eibl-Eibesfeldt 1979). Within cultures there are also gender-related rules for children and adults that govern the types and frequencies of certain expres-

sions (Buck 1977, Haviland & Malatesta 1981, Weitz 1976, Zuckerman & Przewuzman 1979). In addition to these group codes, people may acquire "personal display rules" (Ekman & Friesen 1975)—expression codes that are idiosyncratic to an individual and, it is assumed, learned in the context of a particular family or experience.

Since there is so much variation, though rule bounded, it is clear that there is a good deal of plasticity in emotion-expression socialization. What is not known, however, is how and when display patterns develop. As Ekman and Oster (1979) have pointed out in a recent review of the literature, there are few objective data on the amount and kind of social feedback even infants and children receive for their expressions in face-to-face interaction and little

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knowledge of the extent to which parents and others serve as direct models

The present investigation develops a methodology for studying emotion socialization and examines the synchrony of mother and infant expressions in order to determine whether "instruction" in display rules is already well under way in early infancy and what its short-term effects on infant expression might be. We are defining "instruction" as both modeling and contingent responding. We ask what expressions mothers are modeling and whether mothers respond contingently to infant expression changes.

Several studies of early mother-infant interaction suggest that young infants are exposed to modeling and instrumental learning conditions during face-to-face play with their mothers, these conditions conceivably constitute the very first occasions for learning display rules. For example, various investigators have noted that mothers present highly articulated, slow-paced facial expressions to infants (Brazelton, Koslowski, & Main 1974, Kaye 1979, Stern 1974, Tronick, Als, & Adamson 1979). However, what is not yet known is the *range* of expressions shown by mothers and the relative frequencies of these expressions. Do mothers model positive emotions exclusively, or do they demonstrate negative expressions as well?

There seems to be no literature on instrumental learning in the context of face-to-face play. Do mothers use their own expressive behaviors to modify infant emotional expressions, and if so, what expressions are modified? While neonates can produce the muscle configuration patterns of certain categorical emotional expressions including interest, distress, disgust, and joy (Izard 1978, Pieper 1963, Steiner 1973), and, within the next few months if not earlier, other fundamental emotion expressions also are observed in the infant's repertoire (Hiatt, Campos, & Emde 1979, Izard, Huebner, Risser, McGinnes, & Dougherty 1980), it is not clear how the expression or frequency of expression might change during this period of early infancy. Because these expressions are linked to central motive states (Tomkins 1962) and occur in highly motivating situations, there is an optimal learning occasion for socialization, particularly if the caregiver responds contingently and with some degree of immediacy. Mothers frequently do respond to infant expressions by imitating them, and this seems to increase the amount of time infants spend gazing at their mothers (Field 1977, Kaye 1979, Moss 1967, Francis,

Self, & Nobel, Note 1). Whether it also influences the infant's own expression is not known.

The following study examines early changes in infant expressiveness and the mother's role in socializing infant expression. We selected two infant ages for study in order to gauge how slowly or rapidly infant emotional expressions and maternal behaviors change, we anticipated that change would occur in a relatively short period of time. In addition, because of the reported sex differences in emotion expression for children and adults, we anticipated that the mother's behavior would vary according to the sex of her infant. Therefore, the following questions became the central foci of the present investigation: (a) What are the types and frequencies of facial emotional expressions exhibited by infants and mothers during face-to-face interaction, and what are the contingencies between maternal and infant expressions? (b) Are there sex-related differences in the patterns of infant expressions and in the types and frequencies of expressions mothers display to male and female infants? (c) Does a mother's expressive behavior toward her infant shift with infant age and do infants themselves display early changes in affective expression?

In order to explore these questions, samples of the behavior of mothers in face-to-face play with their infants were required. To ensure that a wide range of infant expressions would be obtained, negative expressions as well as positive, both a play and a separation/reunion episode, were included in the study. These episodes were videotaped for later systematic coding of facial behaviors. Maternal speech to infants during the laboratory session was also recorded and analyzed in order to evaluate what mothers say to their infants about the expression of emotion.

Method

Subjects

Subjects were 60 mothers and their young infants. They were recruited by appeals to parent groups, pediatricians, and maternity ward patients. The study was framed as an exploration into infant personality development. There were 30 3-month-olds and 30 6-month-olds with equal numbers of males and females in both age groups. Three- and 6-month-olds were chosen for study since the period from 3 to 6 months has been identified as a peak time in mother-infant face-to-face play (Field 1977). Two-thirds of the mothers were breast feeders,

one-third bottle feeders, 45% were primiparous and 55% were multiparous. Parity and feeding-mode differences were distributed approximately equally over the two main factors of the study—sex and age of infant. Social class was heterogeneous but skewed toward the upper (professional/managerial) social status level.

Equipment and Laboratory Procedure

Video recording took place in a 12 × 12-foot room. A comfortable straight-backed chair was provided for the mother, a high chair was available for 6-month-olds and an infant seat for the 3-month-olds. A set of five toys was provided. The video-recording equipment consisted of two Panasonic cameras whose output went to a Panasonic special-effects generator set for a split-screen image. The resulting image was recorded on reel-to-reel tape using a Sony AV3650 video recorder. An overhead microphone recorded mothers' speech to infants.

An appointment for the laboratory visit was scheduled around a time the mother expected her infant to be rested and alert. On arrival at the laboratory, the goals and procedure were reviewed and a consent form signed. The mother and infant were seated and the mother was asked to arrange her chair at a comfortable distance from the infant. She was told to feel free to talk to, touch, sing to, and otherwise play with her infant as she would at home and to use the toys provided if she liked. Mothers were asked to distract or gently dissuade their infants from mouthing toys or hands during the taping so the infant's face would not be obscured. The cameras were located approximately 5 feet each from the mother and infant and not hidden from view. The special-effects generator and video recorder, monitored by the experimenter during the taping, were behind a curtain in the same room. Taping began when the infant was securely in place. If the infant became fretful for more than 5–8 sec during the session, taping was interrupted, after the mother had comforted her child, taping resumed. The frequency of these interruptions was not very high and occurred at approximately the same rate for males and females, there were more interruptions for young infants.

At the end of 15 min of taping, the mother was signaled to leave the room, and the experimenter remained in the room and out of sight of the infant. The mother was signaled to return and comfort her infant after 10 successive sec of fret crying by the infant, and taping resumed for an additional minute.

Coding Procedure

A second-to-second digital display was edited onto copies of the tapes for timing coded behaviors. The middle 5 min of the mother-infant play behavior and the 1 min of reunion were coded for instances of facial expression changes using an adaptation of Izard's (1979) Maximally Discriminative Facial Movement Coding System (Max). This system codes facial movements or appearance changes in each of three regions of the face. The codes, used in conjunction with formulas provided in the Max manual, distinguish eight fundamental emotions on the basis of component muscular movements—interest, joy, surprise, sadness (distress), anger, disgust, contempt, fear, and the motive state of discomfort/pain. In addition, we coded knit brow (brows drawn slightly down and together—occurs in predistress conditions and under conditions of apparent concentration) and brow flash (rapid eyebrow raising of less than ½-sec duration) since these expressions occurred frequently in our sample but are not covered by the Max system (See Izard [1979] for a full description of the Max affect coding system). After coders were trained on the Max system to achieve reliability, they were then rechecked for reliability, with samples of data tapes used in the study (Intercoder reliabilities, assessed before and during the coding of data tapes at random intervals, ranged from .80 to .98). All coding was done blind with respect to infant age and sex. Coding was conducted without sound and mother and infant were coded separately to maintain objectivity. The narrative of the entire 16 min of play and reunion was transcribed verbatim and coded for instances of affect encouragement, affect discouragement, and simple acknowledgment of affect. Intercoder reliabilities for the narrative coding were at or above 90%.

Results

Facial Expressions of Infants

Infant facial expressions during the 6 min of the play and reunion were found to fall into eight categories: interest, enjoyment, surprise, sadness/distress, anger, knit brow, discomfort/pain, and brow flash. No fear or disgust expressions were observed. Separate 2 (age) × 2 (sex) factorial ANOVAs for each category of infant expression were performed. A summary of these tests is presented in table 1. There was a highly significant main effect for sex in the interest expression with females showing more interest faces than males. There were main effects for age in the knit-brow and dis-

comfort/pain expressions, with younger infants showing both more pain and knit-brow expressions. An ANOVA on total infant expression changes showed a significant age effect also, with older infants displaying significantly fewer expression changes, $F(1,56) = 4.17$, $p < .05$. Three-month-olds averaged a change in their facial expressions every 7.2 sec, 6-month-olds every 8.82 sec.

Other age and sex differences in the rates of the various expressions can be observed from the mean frequencies (table 1) when they are rank ordered. As shown in table 1, there is a relative shift in the hierarchy of responses between 3 and 6 months of age. The responses of 6-month-olds are predominantly more positive than those of the 3-month-olds. The patterns are further differentiated by sex. For boys of both ages the most frequent expressions fall in two categories—knit brow and enjoyment, for girls there is more even distribution of expressions in four categories—knit brow, interest, anger, and enjoyment. If we discount age and sex as factors, the rank order for the various expressions is as follows: knit brow, enjoyment, anger, interest, brow flash, surprise, and sadness.

Facial Expressions of Mothers

Mothers' facial expressions were examined independently of, and in conjunction with, the facial changes of their infants. In this first section we report the categories and frequencies of the various maternal expressions. Results of a mother-infant contingency analysis are reported in the next section.

Mothers were found to change their facial expressions at an average rate of 8.05 changes per minute. They showed the same categories of facial expression as infants except that they did not display any discomfort/pain expressions. The ANOVA tests for maternal facial expressions indicated that there was a significant infant age effect only for maternal brow flash (table 2), with mothers showing more brow flashes to younger infants. No other differences were significant. Thus, when one examines maternal expressions categorically and independently of what their babies are doing, it would appear at first that mothers behave similarly toward boys and girls. (This assumption is challenged by a contingency analysis, as reported in the next section.) Examination of the frequency for each of the mothers' expressions in face-to-face interaction with their infants (table 2) indicates that mothers restrict their displays to the positive emotions, in contrast to the wider range of both positive and negative expressions exhibited by infants (table 1). Enjoyment and

interest expressions are the most dominant displays followed by surprise and brow flash—all positive expressions. Mothers rarely display anger, and when such an expression is seen, it looks like "mock" anger enacted playfully, it is an expression mothers tend to show more frequently to older versus younger infants. Sadness is also infrequently displayed, and, as in the case with anger, it tends to be shown more often in interaction with older infants. The apparent trend for mothers to avoid negative affect, especially around younger infants, led to a comparison of mothers' negative versus positive emotional expressions given to 3- and 6-month-olds. In this analysis we compared negative expressions of anger and sadness to positive expressions of joy, interest, and surprise. A one-way ANOVA for negative maternal expressions by infant age disclosed an age trend, $F(1,118) = 2.6$, $p = .10$, but a corresponding analysis of age trend in positive affect display did not indicate a change, $F(1,178) = 1.3$, *NS*. Mothers tend to show less negative affect around younger infants.

As far as sex differences go, mothers do not appear to show different overall response patterns for male versus female infants (as disclosed by ANOVA and by examining the relative rank order of expressions shown to infants). However, within-pair analyses revealed differences as discussed below.

Within-pair Analyses

In the foregoing sections we reported group-level analyses. In the present section we consider the nature of face-to-face interaction at the dyadic level. Within-pair analyses consisted of two kinds of contingency analysis and a correlational analysis of signaling preferences.

Contingency analyses—It was obvious from viewing the videotape records that there was a pronounced tendency for mothers to respond in a contingent fashion to infant expression changes with expression changes of their own. Operationally, a contingent response was coded when a maternal expression changed within a second following an infant expression change, empirically, however, the changes were much more immediate, occurring within a fraction of a second. Twenty-five percent ($SD = .12$) of all maternal facial expression changes were contingent responses using this strict criterion. An event lag contingency analysis (Sackett 1979) was applied to this data. The analysis indicated that maternal responses were nonrandom and contingently related to the ongoing behavior of the infant. The results, in the form of z scores, are presented in table 3. These

TABLE 1

SUMMARY OF ANALYSIS OF VARIANCE TESTS OF INFANT-EXPRESSION
FREQUENCIES ($\alpha = 05$, $df = 1,56$)

INFANT EXPRESSION	AGE EFFECT	SEX EFFECT	AGE X SEX EFFECT	MEANS											
				Male	Female	3-month-olds		6-month-olds		3-month		6-month			
						Males	Females	Males	Females	Males	Females	Males	Females		
Interest	NS	10.81***	NS	7.77	5.40	6.57	3.33	7.47	5.07	8.07	8.27	8.27			
Enjoyment	NS	NS	NS	7.40	7.87	10.07	9.20	6.53	11.87	8.27	8.27	8.27			
Surprise	NS	NS	NS	4.53	3.60	3.17	4.67	2.53	4.40	1.93	1.93	1.93			
Sadness	NS	NS	NS	2.50	2.53	2.07	3.00	2.07	2.00	2.13	2.13	2.13			
Anger	NS	NS	NS	5.96	7.70	8.10	7.93	7.93	3.67	7.47	7.47	7.47			
Knit brow	7.82*	NS	NS	12.63	14.57	7.33	16.47	12.67	8.80	5.87	5.87	5.87			
Discomfort	4.75**	NS	NS	2.67	3.90	1.77	3.93	3.87	1.40	2.13	2.13	2.13			
Brow flash	NS	NS	NS	4.47	4.57	4.27	4.60	4.53	4.33	4.20	4.20	4.20			

* $p < 008$ ** $p < 04$ *** $p < 002$

TABLE 2

SUMMARY OF ANALYSIS OF VARIANCE TESTS OF MATERNAL-EXPRESSION
FREQUENCIES ($\alpha = 05$, $df = 1,56$)

MOTHER EXPRESSION	AGE EFFECT	SEX EFFECT	AGE X SEX EFFECT	MEANS											
				Male	Female	3-month-olds		6-month-olds		3-month		6-month			
						Males	Females	Males	Females	Males	Females	Males	Females		
Interest	NS	NS	NS	7.60	10.07	9.20	8.47	8.67	9.73	6.53	10.40	10.40			
Enjoyment	NS	NS	NS	23.50	21.60	21.77	23.33	21.27	22.27	25.73	20.93	20.93			
Surprise	NS	NS	NS	7.93	7.57	7.23	8.27	7.33	7.13	8.53	8.00	8.00			
Sadness	NS	NS	NS	1.03	57	53	1.07	87	20	1.20	93	93			
Anger	NS	NS	NS	37	20	10	47	00	20	73	20	20			
Knit brow	NS	NS	NS	2.47	2.27	2.57	2.17	3.67	1.47	1.27	3.07	3.07			
Brow flash	3.97*	NS	NS	6.23	5.83	7.93	4.13	8.80	7.07	3.67	4.60	4.60			

* $p = 05$

data indicate the following relationships Infant interest is associated with the elicitation of maternal interest and the inhibition of ignoring, infant enjoyment with the elicitation of maternal enjoyment and the inhibition of interest, surprise, knit brow, and brow flash, infant surprise with the elicitation of maternal surprise and the inhibition of interest and ignoring, infant sadness with the elicitation of maternal sadness and the inhibition of enjoyment, infant anger with the elicitation of maternal anger and knit brow and the inhibition of enjoyment, infant knit brow with maternal ignoring and the inhibition of surprise, infant pain with ignoring and the inhibition of interest, and infant brow flash with the elicitation of maternal brow flash and interest

To summarize, when expression categories are treated individually, results indicate a strong

tendency to "match" or imitate most infant expressions, the exceptions being knit brow and pain, which mothers ignore A sex effect emerges when maternal contingent responses to male and female infants are considered separately, as shown in tables 4 and 5 There is a greater number of significant z values along the diagonal for males than for females, indicating both more matching of male infant facial expressions and a greater inhibition of nonmatching responses compared with females

In order to confirm and clarify the results of the lag analyses, the data were analyzed in two additional ways The first analysis compared matching and nonmatching maternal contingent responses to determine the relative amount of imitative behavior Second, we compared ignoring and responding classes of maternal behavior, such an analysis allowed us to

TABLE 3
SUMMARY OF LAG ANALYSIS OF MATERNAL RESPONSES FOLLOWING INFANT EXPRESSIONS (Summed over Subjects)

INFANT EXPRESSIONS	MATERNAL RESPONSES								
	Interest	Joy	Surprise	Sadness	Anger	Knit Brow	Pain	Brow Flash	Ignore
Interest	11 75*	14	1 08	-1 00	-1 00	-2 00	00	2 13	-4 17*
Joy	-3 22*	8 82*	-3 90*	-2 33	-1 00	-4 50*	00	-2 67*	1 22
Surprise	-2 56*	2 11	10 75*	-1 40	- 67	-1 64	00	-1 00	-4 43*
Sadness	1 63	-3 41*	- 11	5 14*	- 67	69	00	- 31	14
Anger	-2 36	-3 38*	1 27	1 25	5 00*	6 00*	00	-1 86	23
Knit brow	-1 00	-2 50	-3 22*	1 00	-2 00	1 00	00	00	3 37*
Pain	-2 58*	-1 00	-1 76	-1 16	- 67	1 17	00	- 72	4 42*
Brow flash	3 57*	- 68	- 21	-1 40	-1 00	-2 22	00	4 67*	-1 92

NOTE —Values reflect z scores Significant positive values indicate contingent responding significant negative values indicate inhibition of responding Matching responses are shown on the diagonal

* Significant at $p < .01$ level, two-tailed test

TABLE 4
SUMMARY OF LAG ANALYSIS OF MATERNAL RESPONSES FOLLOWING MALE INFANT EXPRESSIONS (Summed over Subjects)

INFANT EXPRESSIONS	MATERNAL RESPONSES (To Males)								
	Interest	Joy	Surprise	Sadness	Anger	Knit Brow	Pain	Brow Flash	Ignore
Interest	5 84*	- 08	- 52	13	00	- 67	00	1 31	-2 47
Joy	-3 25*	7 80*	-3 15*	-1 80	00	-1 00	00	-1 63	00
Surprise	-2 17	1 22	9 25*	-1 28	00	4 00*	00	-1 29	-3 76*
Sadness	2 38	-2 65*	-3 00*	3 10*	00	7 60	00	1 00	- 61
Anger	-1 37	-3 00*	1 29	1 17	00	23 30*	00	-1 09	47
Knit brow	09	-2 64*	-2 92*	1 50	00	18 50*	00	- 71	2 41
Pain	-2 13	-2 65*	-1 88	- 90	00	2 50	00	- 68	4 42*
Brow flash	1 83	-1 00	62	- 01	00	1 67	00	4 92*	-1 51

NOTE —Values reflect z scores Significant positive values indicate contingent responding, significant negative values indicate inhibition of responding Matching responses are shown on the diagonal

* Significant at $p < .01$ level, two-tailed test

TABLE 5

SUMMARY OF LAG ANALYSIS OF MATERNAL RESPONSES FOLLOWING FEMALE INFANT EXPRESSIONS (Summed over Subjects)

INFANT EXPRESSIONS	MATERNAL RESPONSES (To Females)								
	Interest	Joy	Surprise	Sadness	Anger	Knit Brow	Pain	Brow Flash	Ignore
Interest	4 73*	50	1 67	-1 33	-1 50	-1 00	00	1 45	-3 61*
Joy	-1 68	3 88*	-2 60*	-1 33	-1 00	-2 54	00	-1 64	1 89
Surprise	-1 17	1 61	5 39*	- 67	- 60	-1 40	00	10	-2 55
Sadness	- 06	-2 22	14	6 83*	- 60	10	00	-1 42	1 08
Anger	2 20	-1 93	- 47	1 33	9 00*	4 45*	00	-1 36	07
Knit brow	-1 43	-0 80	-1 68	- 33	-1 50	- 33	00	88	2 00
Pain	-1 64	-2 23	- 54	- 80	- 75	2 29	00	- 29	1 85
Brow flash	3 14*	- 04	- 95	-1 00	-1 00	-1 50	00	1 86	-1 19

NOTE—Values reflect z scores. Significant positive values indicate contingent responding; significant negative values indicate inhibition of responding. Matching responses are shown on the diagonal.

* Significant at $p < .01$ level, two-tailed test.

examine which infant expressions mothers were actively reinforcing with their attention.

1 As indicated above, maternal contingent-expression changes following infant changes could be similar or dissimilar. It was found that 35% of all contingent responses were matches, whereas the remaining 65% were dissimilar responses. The data were further analyzed by affect category. Since infants varied in their rates of expression change, scores on the two variables were proportionated to reflect the percentage (rather than frequency) of responses to infant expressions that fell into either class. Separate 2×2 factorial ANOVAs for each of the affect categories were conducted. There were no significant age, sex, or age \times sex effects, however, there were trends indicating that mothers tend to match more male (vs female) expressions, $F(1,56) = 2.26$, $p = .13$, and tend to show more dissimilar expressions to females, $F(1,56) = 2.32$, $p = .13$, confirming the pattern disclosed by the more powerful lag analyses.

2 By treating the contingency variable as a dichotomous one consisting of contingent responses and ignoring responses to infant expression changes, we could perform multiway χ^2 analyses with sex and age as two-level factors. Table 6 displays the results. There was a significant age \times sex interaction for mothers' contingent responding to infants' enjoyment expressions, $\chi^2(1) = 9.82$, $p < .002$, contingent responding to males increases with age but decreases for females. Examination of what kind of contingent responding was being given most frequently to infant smiling disclosed that it was mainly reciprocal smiling. For the sad in-

fant expression, there was a main effect for age, $\chi^2(1) = 4.10$, $p < .05$, mothers responded more contingently to the sad expression of older infants. The χ^2 s for the interest, surprise, anger, knit-brow, and brow-flash signals were all non-significant ($\alpha = .05$). Responses to infant pain were not evaluated because of the zero frequency cell for the older boys.

Individual mother-infant facial change correlations—The facial change frequency data were subjected to correlational analysis in order to examine commonalities in the expression mode of the individual dyads. Significant correlations between maternal and infant expressions ranging from $p < .002$ to $.0001$ were obtained for the following expressions and regions: surprise, $r = .45$, $p < .0004$, enjoyment, $r = .51$, $p < .0001$, brow region, summed over all types of coded brow-movement changes, $r = .40$, $p < .002$, and mouth region, summed over all types of coded mouth-movement changes, $r = .57$, $p < .0001$. The correlations between mother and infant for knit brow and anger were of zero order, the correlations for interest and sadness, however, approached significance, $r = .20$, and $r = .25$, respectively.

In summary, it appeared that the members of each mother-infant pair shared commonalities in the ways they used their facial muscles. In order to rule out the possibility that maternal contingent matching of infants was inflating the correlations, we reanalyzed the data with all instances of maternal contingent matching deleted. The correlations between mother and infant for brow region, $r = .38$, $p < .002$, and mouth region, $r = .45$, $p < .0003$, remained strong, as did one emotion expression

—joy, $r = .41$, $p < .001$. However, the correlation for surprise, $r = .23$, $p = .07$, was marginally significant. The correlation for sadness, $r = .24$, $p = .06$, once again approached significance and for interest there emerged a weak correlation, $r = .12$, $p = .35$. Thus, the original correlations of face region were robust enough to withstand the elimination of maternal matches, as was one affect, joy.

When we looked at 3- and 6-month-olds separately, the strength of most of the correlations increased between the two ages, indicating the increase in familial expression patterns (interest was .13 at both ages, joy decreased slightly from .42 to .38, surprise increased from .09 to .37, sadness from .12 to .37, summed brow movement from .35 to .40, and summed mouth movement from .41 to .48).

Maternal Speech to Infants

In the previous sections, we examined the mother's use of nonverbal signals in the socialization of affect. In addition to the nonverbal signal, we also had data on the mothers' verbal comments about affect. Mothers clearly respond verbally to many of the infants' nonverbal signals, but do they change their remarks, either the relative frequency or the evaluative type of remark, as the age of the baby changes? To answer this question, the mothers' verbal behavior was coded for three types of response: (a) encouragement of affect, (b) discouragement of affect, and (c) nonevaluative acknowledgment of affect. "Encouragement" is either an attempt to elicit positive affect or a positive statement about the infant's expression (e.g., "Give me a smile," "Laugh for mommy," "Good girl [boy]" [following a display]). Discouragement is a remark telling the infant to stop a display, usually fussing (e.g., "Don't cry," "Don't fuss"). A nonevaluative comment is a simple statement about the infants' affect behavior made to the infant (e.g., "You are cranky," "You're excited," "What's the matter" [given in response to fret-cry]).

Frequency counts of the coded verbal behaviors were subjected to separate 2 (age) \times 2 (sex) factorial ANOVAs for the scores in each of the three coded categories of mothers' references to infant emotional state or behavior, as well as an "affect-reference" score, which was a sum of the three categories (table 7). The average rate of comments about infant affect was 16.8 comments during the 16-min session for 3-month-olds and 9.2 for 6-month-olds. This age difference is not attributable to a decrease in mean utterance length of maternal

speech. A sampling of mean utterance length at 3 and 6 months (first 20 sentences of 10 mothers of 3-month-olds and 10 mothers of 6-month-olds, balanced for sex) disclosed no age differences by one-way ANOVA.

An ANOVA disclosed a significant age effect for the category of affect encouragement, $F(1,56) = 10.35$, $p < .003$, with younger infants receiving more encouragement than the older infants. There was also a significant main effect for age for the overall number of affect-related comments, $F = 8.43$, $p < .006$, and again it was the younger child who received the greater share of comments. There was a marginal main effect for age in the "acknowledgment" class, with younger infants receiving more of these types of comments. There were no main effects for sex or any significant age \times sex interactions for any of the categories.

Discussion

Before we examine our conclusions, let us reconsider the procedure and method of analysis for capturing displays of emotion. Mothers and their infants were requested to play together before our cameras. We therefore have an intensive selection of mother-child play and interaction. We videotaped and then analyzed the nonverbal facial behaviors of the dyad and the verbal behaviors of the mother. This resulted in some extremely detailed second-to-second accounts of mutually sequential behaviors. With these materials we have described some behaviors that we believe are significant in the continuing socialization of emotional expression and, perhaps, personality development. We return to our opening questions.

What are the types and frequencies of facial emotional expressions exhibited by infants and modeled by mothers during face-to-face interaction, and what are the contingencies between maternal and infant expressions? Developmental psychologists have emphasized the stagelike emergence of discrete affects. The muscle configuration patterns of interest, pleasure, distress, and disgust are present at or shortly after birth (Izard 1978), and other expressions are said to emerge as they become adaptive. However, there has been little systematic study of the ontogenesis of other categorical expressions so that we have only very sketchy notions of when these other expressions first enter the infant's repertoire. Hiatt et al. (1979) have found that the expressions of joy, surprise, and fear, elicited under incentive conditions, could be reliably identified in 10-

TABLE 6

SUMMARY OF MULTIWAY χ^2 ANALYSES ON PERCENTAGE OF CONTINGENT RESPONDING BY MOTHERS TO TYPES OF INFANT EXPRESSIONS

INFANT EXPRESSION	χ^2 (df = 1)											
	AGE						EXPRESSIONS RESPONDED TO CONTINGENTLY (%)					
	Age	Sex	Age X Sex	3-month-olds	6-month-olds	3-month-olds	Males	Females	3-month Males	3-month Females	6-month Males	6-month Females
Interest	N S	N S	N S	36	34	34	35	34	40	34	31	37
Enjoyment	N S	N S	9 82*	24	22	25	14	14	21	29	28	13
Surprise	N S	N S	N S	43	34	39	39	39	40	47	38	28
Sadness	4 10**	N S	N S	18	32	28	20	20	22	12	37	27
Anger	N S	N S	N S	23	27	23	26	23	23	24	29	29
Knit brow	N S	N S	N S	19	25	22	20	20	19	19	26	23
Pain/discomfort	No analysis (0 frequency cell)			09	14	04	17	17	05	14	00	23
Brow flash	N S	N S	N S	31	30	31	30	30	32	29	29	30
Combined expressions	N S	N S	N S	24	27	25	25	25	24	25	27	26

* $p < .002$

** $p < .05$

TABLE 7

SUMMARY OF ANALYSIS OF VARIANCE TESTS ON CATEGORIES OF VERBAL AFFECT REFERENCE USED BY MOTHERS IN INTERACTION WITH INFANTS

CATEGORY	F Value (df = 1,56)											
	AGE						MEANS					
	Age Effect	Sex Effect	Age X Sex Effect	3-month-olds	6-month-olds	3-month-olds	Males	Females	3-month Males	3-month Females	6-month Males	6-month Females
Encouragement	10 35*	N S	N S	4 83	1 07	3 17	2 73	2 73	5 80	3 87	53	1 60
Discouragement	N S	N S	N S	1 27	1 30	1 13	1 43	1 43	93	1 60	1 33	1 27
Undifferentiated comments	3 21**	N S	N S	10 60	6 93	7 87	9 67	9 67	8 53	12 67	7 20	6 67
Summed affect references	8 43***	N S	N S	16 83	9 17	12 10	13 90	13 90	15 40	18 27	8 80	9 53

* $p < .003$

** $p = .07$

*** $p < .006$

1000 Child Development

12-month-olds A study by Izard et al (1980) demonstrated that trained and naive judges could recognize the emotions of interest, joy, surprise, sadness, anger, disgust, contempt, and fear in infants 1-9 months old The present study, while strictly speaking not an ontogenetic study, found that the expressions of joy, interest, sadness, anger, pain, brow flash, and knit brow could be reliably coded in infants as young as 3 months of age Though we cannot infer the presence of internal emotional states from these expressions, we have demonstrated that young infants are able to produce muscle pattern configurations associated with a variety of discrete emotional expressions at an earlier age than had been predicted from previous studies (Bridges 1932, Sroufe 1979) It is also noteworthy that young infants show evidence of a "brow flash," an expression previously reported only in adults Adults in various cultures display this rapid raising of the brows when first encountering a friend or acquaintance, and the expression is regarded as a "greeting" gesture (Eibl-Eibesfeldt 1979) Ekman (1979) indicates that it is also used emblematically during speech as a sign of agreement or acknowledgment Interestingly, we observed that infants gave brow flashes while they attended to maternal speech and social play, and brow flashes were emitted by some infants when mother first returned following the separation phase

We have also been able to describe the relative frequencies of the various facial expressions during play Among infants the knit brow is the most frequent expression, enjoyment is next, followed by anger, interest, brow flash, surprise, pain, and sadness There were sex and age differences in rank order of these expressions as noted in the results section, however, this is a finding that needs to be extended to more varied contexts

Another rather surprising finding with respect to infant expressions was the high rate of change Infant expressions were highly labile, they change at a rate of once every 7-9 sec, at least as measured during face-to-face interaction, an occasion which appears to be highly animating The fact that young infants have such a wide repertoire of expressions in combination with the finding of high lability indicates that caregivers will have multiple opportunities to respond to infant affect and conceivably shape it via instrumental conditioning, a point to which we will return

During play we found that mothers show a density of expression change that is similar to

the rate found with infants However, mothers do not duplicate their babies' wide range of expressions Instead, maternal facial expressions are basically restricted to the emotions of interest, enjoyment, and surprise, and to a brow-flash signal Thus maternal modeling is primarily of the positive emotions and signals Our results may offer some further explanation for infant emotion discrimination studies, indicating that the positive emotions are the first to be discriminated (see Oster [1981] for a review of this literature), such expressions may be easily discriminated because they are more frequently viewed

Mothers make contingent facial change responses to at least 25% of infant facial expression changes The lag between maternal expression change and infant expression change was found to be less than half a second, thus maternal responses fall within the most optimal range for "instrumental conditioning" This simple observation is one demonstration of the importance of molecular analysis such as that performed in this study Mothers selectively respond to their infants' displays in ways that must influence the child's learning of appropriate display rules Contingency patterns differ subtly according to the age and sex of the child The literature on mother-infant facial play has emphasized that mothers imitate the facial expressions of their infants We noted this as well However, we found that imitations are not the only kinds of contingent facial responses mothers make Thirty-five percent are matching responses, but the majority, or 65%, are dissimilar responses Within this pattern there were sex differences

Are there sex-related differences in the patterns of infant expressions and in the types and frequencies of expressions mothers display to male and female infants? The analysis of infant facial expressions indicated that male and female infants showed the same rates of sadness, anger, pain, joy, surprise, knit-brow, and brow-flash expressions However, there was a very significant sex difference for the expression of interest, with female infants displaying interest expressions more frequently than males Interestingly, Haviland (Note 2) found that female infants have more open eyes and higher brow placements than male infants Both are important components of the interest display The popular belief that girls are more "social" than boys (Maccoby & Jacklin 1974) may be partially accounted for by the findings that girls show more "interest" during social interaction The attribution of interest to girls may be due

not only to their active expression of interest but also to slight differences in facial structure. In combination, these two sex-differentiated factors of greater eye openness and more raised-brow interest expressions in infant girls may serve to lead observers to quite different overall impressions about male and female sociability. Wider eyes and higher and more frequently raised brows suggest a more ingenuous, open, receptive, and interested state. The narrower eyes, lower brow structure, and less frequent raising of the brows in males may make male children seem less interested in and receptive toward others than females, and perhaps less inviting and approachable.

A few further sex differences were detected in the analysis of contingency patterns. Generally, mothers model similar frequencies and types of affect expressions to male and female infants during facial play, but within patterns of contingent responding subtle differences in behavior are detected, even at this very young age. Mothers showed a significant increase over infant age in contingent responding (especially contingent smiling) to the smiles of infant males and a decrease for females. In addition, within patterns of contingent responding, mothers were found to match more male (vs female) expressions, and to follow more female (vs male) expressions with dissimilar responses. These differences were confirmed by two separate analyses. It is likely that more globally obvious behaviors would be found with older children.

The meaning of these differential patterns of maternal responding is not immediately apparent. It is our conjecture that mothers may be more cautious with male infants and more invested in keeping them contented, owing to "male vulnerability" (Beach 1977) and the fact that male infants tend to be more irritable and less consolable (see Haviland & Malatesta [1981] for a review). Sex-related differences in environmental responsivity, with males reacting more negatively, have been reported by Osofsky and O'Connell (1977) with a large sample of urban newborns, and by Wachs (in press) with older infants. These findings suggest that mothers may have to work harder in dealing with the affect of male infants. If males are more irritable and readily upset, it makes sense that mothers should use more contingent responding (especially contingent smiling) to male positive affect. Contingent smiling is, we assume, reinforcing. These reports of greater irritability and ready upset among boys may seem contradictory to our report that boys and girls dis-

played all affects except interest at about the same rate. Our explanation of this apparent discrepancy arises from the data on different maternal behaviors. During the 15-min play session, mothers are able to maintain very playful, positive behaviors in their infants, but mothers of boys and mothers of girls behave differently. This setting is not varied enough or long enough to sample irritable or fretful behavior, generally, and it does not describe the babies' behaviors away from direct interaction with their mothers. Mothers apparently have similar goals for boys' and girls' playful interactions, and mothers are successful in attaining their play goals. The fact that mothers of boys and mothers of girls use different patterns of interaction suggests that the difference in the babies is offset by the interactive pattern. We doubt that there is a real discrepancy between our findings of similar ratios of response and previous reports.

Does a mother's expressive behavior toward her infant shift with infant age, and do infants themselves display early changes in affective behavior? Infants show a significant reduction in the frequency of expression changes from 3 to 6 months and a significant reduction in pain and knit-brow expressions. Overall, there is proportionately more reduction in expressions of negative affect than positive affect. In addition, the degree of correlation between mother and child expressivity within a dyad increases from 3 to 6 months, indicating the growth of individual familial patterns of expression.

With respect to changes in maternal facial behavior, the only pronounced difference was that mothers of older infants showed fewer brow-flash (agreement, acknowledgment) expressions to older infants. We also noted that mothers tend to avoid the display of negative affect around their infants. This is true at both ages studied. However, the avoidance of negative affect was found to be especially marked for the younger infants. The avoidance of negative affect around young infants is a good strategy if, as suggested by differential emotions theory (Izard 1971, 1977, Tomkins 1962, 1963), affect is contagious, that is, readily taken on by another. Quite possibly contagion operates most forcibly with very young infants because they lack counterdefenses to ward off the contagion of negative affect. The young infant may be especially vulnerable to negative affect expressed by a caregiver.

Mothers' verbal behavior also showed changes with infant age that are in concordance

1002 Child Development

with changes in the nonverbal behaviors. Mothers do not compensate for a reduction in nonverbal response with a verbal response. The verbal records showed that mothers make fewer affect comments overall with older infants (as compared with younger infants) and also make fewer statements that encourage affect expression. This may represent a shift in maternal expectations for the older infant. Mothers may encourage emotion expression initially but then expect greater control as the child matures.

To summarize the age changes, we note that mothers show a decline in the verbal acknowledgment of infant affect and they are less likely to encourage affect expression at 6 months versus 3 months. There is also less nonverbal acknowledgment of affect as demonstrated in the reduced amount of brow flashes between 3 and 6 months. Such "affect-reduction" strategies are in accord with cultural ideals dictating suppression of the overt display of affect with age (Tomkins 1962, 1963).

Summary

The descriptive data gathered in this study indicate that infants of 3 or 6 months display a range of discriminable emotions including enjoyment, sadness, interest, anger, distress, pain, surprise and also use brow-flash and knit-brow signals. These expressions fluctuate fairly rapidly, changing every 7-8 sec. Between 3 and 6 months there is an increase in the expression of positive emotion and a slowing of expression changes.

The changes above are ascribed to maturational changes as well as the influence of social contingencies promoting the socialization of affect. Maternal influence appears to be both direct and indirect. Mothers may directly influence the promotion of positive over negative affect by (a) avoiding negative expressions that could spread to the infant and (b) restricting their demonstrations of affect to the positive emotions. With age, mothers are less encouraging of overt expression of emotion and communicate this both verbally and nonverbally.

There is some evidence that mothers are promoting the regulation of emotion along gender lines as well. Although there are few differences between male and female infants in the types and frequencies of the various facial expressions at this early age, girls do display more interest than boys and their mothers are more variable in response to them than to boys. The mothers of boys match their sons' behavior

more and also display more contingent positive affect than the mothers of daughters.

Finally, we found that individual or dyadic styles of expression begin to be established during the first 6 months. Infant-mother pairs were highly correlated in using particular parts of the face expressively and in using certain expressions.

In summary, this study has demonstrated that there are changes occurring in emotion expression during early infancy that are indicative of instruction in facial display. Mothers were found to behave in ways that could easily be construed as attempts to moderate the emotional expressions of their infants. There is evidence that mother-infant interaction could account for the direction of change in display rule acquisition in accord with hypothesized group, gender, and familial demands.

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