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Examining Emotional Expressivity in Early Infancy: A Microanalysis of Infant Facial Expression at 2, 4 and 6 Months of Age

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EXAMINING EMOTIONAL EXPRESSIVITY IN EARLY INFANCY: A

MICROANALYSIS OF INFANT FACIAL EXPRESSION AT

2, 4 AND 6 MONTHS OF AGE

A DISSERTATION SUBMITTED TO

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DEPARTMENT OF DEVELOPMENTAL PSYCHOLOGY

BY

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Chapter I

INTRODUCTION

We are continually confronted with glimpses of human experience that convey to us without words, the thoughts, feelings, and intentions of those around us. Without dialogue, explanation, or verbal communication, nonverbal messages often signal emotional responses that will direct in significant or subtle ways subsequent behavior. What is meant by an emotional response? How is it that we are able to interpret signals of state, of deception? By what course have we come to be able to show feelings that are interpreted by others as reflecting a reaction to a particular event? How does the relationship between individuals contribute to the interplay of signalling and interpreting and how does this interplay influence the relationship? What are the developmental vicissitudes in the emotion signalling system that suggests similarity and difference across the life span? Finally, what is the correspondence between the expression of an emotional state and the emotion itself?   These questions highlight some of the major issues confronting those interested in the study of emotion. How these questions are to be answered will depend upon the definitional criteria of emotion one chooses to utilize. For both the researcher and research consumer it becomes necessary then to address the fundamental question of what is meant by emotion. Review of the

literature describes emotion in terms of having four central components that are physiological, behavioral, experiential and functional in nature.

The physiological component of emotion is defined as the occurrence of an emotional state. That is, the arousal of autonomic, visceral, glandular and chemical processes. The particular pattern of neural activity accompanying the activation of emotional receptors by emotional elicitors is an essential feature of this component of emotion (Cannon, 1927; Fox & Davidson, 1984; Langsdorf, Izard, Raycas & Hembree, 1983).

The behavioral component of emotion, often described in the literature as the motor component, consists of the observable features that accompany the occurrence of an emotional state. It is the visible expression of emotion; the overt neuromuscular discharge. This activity communicates feelings and intentions to the social surround as well as provides feedback to the expressor (Darwin, 1872; Ekman, 1972; Ekman & Friesen, 1972; Izard, 1977, 1980, 1990).

The experiential component is the individual's subjective feeling state; how do I feel? It is the conscious or unconscious interpretations of one's state or expression. For some investigators, cognitive and motivational variables are an integral part of this component of emotion (Freud, 1915; Izard, 1972; Kagan, 1978; Lewis & Michaelson, 1983;).

Finally, the social function of emotion is the interactive consequence of an emotion expression. Central to this component is the issue of how the nonverbal behavior of one individual transacts with the behavior of another (Sameroff & Emde, 1989; Stern 1984; Sroufe & Waters, 1976).

An example seems in order. When one observes a "smile" on the face of an infant, child, or adult, what image is created? Is the smile a behavioral manifestation of some inner "feeling state"? Is the individual happy? Did something happen to elicit the smile? What does the smile elicit within us as observers? Clearly, having observed a smile (or created a mental image of one) each of these inquiries is suggested and each embraces a different dimension of emotional responsivity. Conceptualizing emotion in this manner allows an appreciation of the difficulty in arriving at a clear definition of what is meant by emotion. Given these considerations, in its attempt to illuminate our understanding of emotional behavior and development, research on the emotions has targeted one or more of the emotion components. Theoretical orientation will dictate how these components become integrated within the individual and to what "level" of emotion a particular study is aimed. Each of the emotion components will be revisited (and reevaluated) as one examines the historical, theoretical and design

considerations important to any understanding of contemporary research on the emotions.

The present investigation examined the development of expressive behavior in early infancy. Investigators have attempted to construct theoretical models identifying the infant's subjective experience (Mahler, 1975; Stern, 1990). While affective meaning for the infant remains an unsettled issue, it is clear that the infant's world has yet to be penetrated with dialogue and explanation. How the infant reaches out to the social surround and in what ways we enter in is dependent in part upon the clarity and strength with which the infant can elicit response from his environment. Undoubtedly, other important factors involved in infant development such as, the caretaker's interactional style, familial structure, the infant's birth condition, will influence subsequent infant/environment transaction. However, if we can clearly articulate the nature of emotional expressivity in infancy, we might better understand how affective signals are perceived and in so doing provide a richer taxonomy for describing the infant's affective repertoire. The present report focussed upon the overt behavioral component of emotion. 24 mother-infant pairs were videotaped in a laboratory setting. Two groups of infants (full term and preterm) interacted with their mothers at 2, 4 and 6 months of age in a structured interaction sequence. The interactive sequence was

comprised of 3 events that instructed the mother to: (1) Sit
motionless and expressionless facing her infant (still-
face); (2) Get her infant's attention and; (3) Imitate
her infant's facial expression. The infant's facial
expressions were coded using an objective coding system
(Izard, R/1983) that allowed a trained observer to record
the discrete categories of emotion displayed by the infant
participants across the interactional events and over time.
The present report is an attempt to offer empirical evidence
that will clarify our understanding of adult perception of
infant facial expression. Analyzing the microstructure of
infant emotion expressions, we can extend the current
interpretation of the nonverbal world within which the
infant grows and develops.

Chapter II

THE COMPETENT INFANT EXAMINED WITHIN THE CONTEXT

OF MOTHER/INFANT INTERACTION

Pertinent to the present investigation, two critical issues must be addressed to begin our interpretation of the infant's nonverbal world. The first is an appreciation of our current view of infancy. The second (intimately linked to the first) is an understanding of the dynamic relationship shared between mother and infant. Early conceptions of infancy viewed the infant as passive, perceptually and behaviorally disorganized, thereby continually confronted with the nearly insurmountable task of making sense out of sensory chaos. Further, the notion of the infant as a creature to be shaped by the environment found easy acceptance in an era concerned with self control and orderly development. "Natural propensities to evil must be corrected early and the infant prevented from acquiring bad habits" (The Maternal Physician, 1811). Years of research on infant development have engendered new questions and concerns about the healthy development of infants. Our current view considers the newborn infant to be active, capable of organizing complex information, selectively attentive and a rapid learner. Much of what we know about the abilities of the young infant has come from direct and systematic observation. As the quintessential observer,

Piaget (1952, 1954) considered the infant to be an active participant in environmental exchanges and credited the infant with selective, directed, and persistent behavior.

Studies of the infant's perceptual systems (visual and auditory modalities) have revealed remarkable function, seemingly preadapted to characteristic features of human behavior. For example, in the visual modality (assessed by preferential looking and visual habituation studies), young infants have been found to be particularly attentive to movement (Carpenter, 1974; Fagan, 1979; Haith, 1966), borders of high contrast (Salapatek, 1968; Salapatek & Kessen, 1966) and face like stimuli in preference to other forms (Haaf & Bell, 1967). Typically, adults interacting with young infants will exaggerate their facial expressions, move their heads, and position themselves at a distance from where newborns are believed to focus best (7-9 inches). In face-to-face mother-infant interactions, mother's face comes just about as close as anything can to meeting exactly those stimulus requirements to captivate infant attention. Similarly, the infant's auditory system is attuned to the type of sounds characteristic of the human voice (Eisenberg, 1976). The infant comes to prefer voices over sounds (Kagan & Lewis, 1965) and can make some discriminations unique to speech perception (Eimas, Siqueland, Juscyk & Vegouto, 1971; Trehub & Rubinovich, 1972). Again, these attention-getting features are maintained and elaborated when adults vocalize

to infants, capitalizing upon the skills and preferences of the infant.

Finally, the infant's physical characteristics (cuddliness and the typology of characteristics that fit the "babyishness" ideal) are thought to influence the strength with which an infant elicits responses from his environment (Boukydis, 1981). This ability of the infant's physical appearance to evoke responses from adults was investigated in a study of the perceived attractiveness of preterm and fullterm human infants (Maier, Holmes, Slaymaker & Reich, 1983). From pictures taken of newborns at 3 different conceptional ages (fullterm, one month before term, and two months before term) composite drawings were made (one for each gestational age). College-aged subjects rated the composite drawings on the basis of overall impressions, perceived functional evaluations and judged behavioral inclinations. Physical characteristics of the composite drawings differed as a function of conceptional age with the fullterm composite possessing proportionally wider eyes and rounder heads than the preterm composites. Drawings depicting the fullterm characteristics elicited much more favorable responses from the adults (more likable, attractive, cute, normal) than those of the preterm infants. We have indeed come a long way in our understanding of the infant as competent and capable. However, it is clear that the infant remains dependent upon caretakers for survival.

As we have come to appreciate the infant as an active participant in his own development, we realize development does not occur in a vacuum. For many researchers, the process of development has best been examined within the context of the relationship shared between a mother and her infant (Brazelton et al, 1975; Thoman et al, 1979). The interactive system shared between parent and child has been described as a "dialogue" in which each partner contributes to the continuation or cessation of the interaction (Lewis & Rosenblum, 1977). As one partner "speaks" the other must "listen" and respond. The emotional style of the caregiver (pattern of verbal and nonverbal emotional expressiveness and responsivity) as well as the nature of the caregiver's expectations for the infant, will exert an influence upon the way affect is socialized in the infant. The infant's later expression and experience of affect will reflect the nature of the early infant-caregiver relationship.

Much of the work on infant affect has concentrated on the communicative value of affective expressions. In the early months of life, social communication between infant and caregiver is primarily accomplished by facial and vocal expression (Emde et al, 1976; Sroufe, 1979). While historically psychologists have been reluctant to assign meaning to the expressions of young children, it is clear that caretakers do not share this reluctance. Emde (1980) found mothers to readily apply the entire range of

categorical emotions (a few relatively simple basic emotions such as joy, anger, sadness, and fear) to their 2 month old infants.   In her description of expressivity, Zivin (1985) argues: "Expression involves behaviors emitted by an individual that are interpreted inferentially or automatically, rightly or wrongly, to convey information about the internal state of that individual. Expression therefore assumes some relationship between an inner state and the behavior that accompanies it." If, for example, the correspondence between particular expressive behaviors and particular states were random, their usefulness in communicative transactions would be completely foregone. Imagine the infant never responded "as if" distressed, happy, or surprised. If such were the case, the infant would be denied invaluable learning opportunities eventuating in effective coping with environmental demands and contingencies. Instead, the outcome would be characterized by chaotic, noncontingent, infant-environment exchanges which can powerfully influence the healthy development of infants (Brazelton et al, 1975; Cohen & Tronick, 1987; Emde, 1981; Field et al, 1986; Holmes, Reich & Pasternak, 1984; Lewis & Rosenblum, 1979; Sameroff & Chandler, 1975).

Researchers began to emphasize the importance of contingent learning experiences in facilitating infant development. The term contingency or contingency experience

has been generally used to mean experiences controlled by or
dependent upon the infant's behavior. Such contingencies
allow the infant to learn his own effectance, which in turn
enhances exploration and the practicing of new skills. The
notion that feelings of efficacy play an important role in
infant development is not a new one. White (1959) discussed
the infant's "general need" to interact effectively with the
environment. Relying heavily on Piaget's observations of
infants, he suggested the infant embraced an intrinsic
motivation to be competent, in the absence of rewards and
often in the face of repeated punishment (e.g., the many
falls endured in the infant's learning how to walk). Once
again we witness a "fit" between behavior observed in the
infant (e.g., the search for environmental contingency) and
subsequent adult behavior (e.g., the playing of games with
infants that incorporate inherent contingent dimensions).
"An infant is however competent to the extent that he or she
is effective in eliciting attention and appropriate care
from the environment. Thus a newborn's repertoire, though
efficient in the age appropriate sense, can be totally
ineffective when paired with an unresponsive caretaker.
Similarly, a newborn with distinct limitations or handicaps
may be extremely effective when complimented by an unusually
sensitive and responsive caretaker" (Goldberg, 1977). Both
Lewis & Goldberg (1969) and Ainsworth & Bell (1974) provide
data from their laboratories showing that infants whose

mothers were more attentive and responded promptly to cries were developmentally advanced relative to infants of unresponsive mothers. The need to more clearly articulate in what ways infant-environment exchanges might attenuate early capacity or jeopardize subsequent developmental outcome has provided a wealth of empirical investigation. Consequences of aberrant dyadic interaction may be evident in the type and range of affects displayed, the frequency, intensity and duration of the infant's emotional expressions and the specific contexts within which affects are elicited (Izard, Kagan & Zajonc, 1984).

Given these considerations, as the present investigation examines the development of expressive behavior in early infancy (appreciating that the infant's expressive displays are a means to elicit response from the social surround), emotion expressions play an important role in the survival and well-being of the infant. Several investigations have illustrated how infant and mother emotionality arise out of the quality of their interaction. To examine the effect of nonreciprocal signaling between mother and infant, Cohn & Tronick (1983) asked mothers to depress their affect during face-to-face interactions. Twenty-four 3 month old infants and their mothers were observed and recorded while their mothers were asked to: (1) depress her affect ("act as you do on those days you feel tired and blue") and; (2) act normally with her infant.

From their videotaped recordings, six infant affective state were coded: look away, protest, wary, social monitor, brief positive and play. Data demonstrated a clear relationship between the quality of maternal affective displays and the infant's behavior. The normal interaction episode evidenced a more positive emotional cycle while the "depressed" condition cycled among more negative infant responses. When maternal affect was experimentally depressed, infants organized their emotions differently and they too began to look depressed. The finding that infants were more upset in the normal interaction episode if they had experienced the depressed interaction episode first provides empirical support for the transactional nature of human discourse. Not only do mother and baby interact, they clearly adapt their behavior to signals displayed by their partner, creating dynamic transactional exchanges. Similar findings were reported by Field (1986) who found newborn infants of mothers identified as depressed prepartum to show depressed activity levels and limited responsivity to social stimulation on the Brazelton Neonatal Behavioral Assessment Scale (Brazelton, 1973). Addressing, the issue of whether or not the depressed infant behavior of depressed mothers was exclusive to interaction with her, Field found that indeed infant behavior did not differ as a function of interacting with the depressed mother versus a non-depressed adult. Further, the infants depressed interactional style

seemed to elicit depressed-like behavior in the non-depressed adult.

Tronick, Richs and Cohn (1982) showed that the quality of the infants' interactive experience related to the patterns of infant coping. The aim of their study was to challenge the infant's interactive capabilities with age appropriate stress, check the infant's response, and offer some maternal correlates to individual differences observed in the infant. Mothers and their 6 month old infants were videotaped during an interaction episode where mother was instructed to interact with her infant in a natural (typical) fashion and then distort that sequence by maintaining a still-face (mother stares at her infant, motionless, expressionless). The episodes were assessed according to behaviors observed in the infant and behaviors observed in the mother. Three patterns of infant behavior were demonstrated: (1) Positive Elicit (the infant sends normal cues to mother as would produce a positive response); (2) Negative Elicit (fuss/cry); and (3) No Elicit (the infant looks away or at mom with no eliciting behavior).

Similarly, three patterns of maternal behavior were demonstrated: (1) Elaborates (mother was responsive to her infants attempt to elicit behavior; mothers imitated, exaggerated their facial expressions and "pulled-back" when her infant was no longer attentive); (2) Overcontrolling (mother intruded and maintained persistent engagement even

when her infant was looking away); and (3) Undercontrolling
(mother displayed hesitancy and withdrawal during
interaction).

Several interesting findings emerged. Infants who
elicited their mothers during their still-face episode were
the infants of mothers who interacted with them more
sensitively during normal interaction (elaborating mother
interactive style). By contrast, infants who made no
elicits to their mothers during the still-face episode were
infants whose mothers were either severely overcontrolling
or undercontrolling in their interactional style.
Additionally, the infant's eliciting behavior at 6 months
seemed to be related to the infant's attachment
classification at 1 year in that those infants who elicited,
were more likely to be securely attached at 1 year. The
conclusion, then, was that mother's interactional style (as
assessed to be elaborating, over or undercontrolling) was
related to the infant's reaction in a stressful situation
(the still-face episode). "Thus at 6 months and at 1 year
infants of more sensitive mothers came into a stressful
situation with a sense of their own effectance, expecting
that what they do will make a difference. Infants at 6
months and 1 year whose mothers have been nonreciprocal in
their interactions came into new stressful situations with
feelings of helplessness" (Tronick et al, 1982).

The still-face procedure and variations of it have been

used with infants ranging in age from 2 to 9 months of age. As one of the interactional events incorporated within the context of the present design, further evaluation and description of the procedure is warranted. Joanne Gusella (1988) and her colleagues conducted a series of investigations to address some fundamental concerns about the procedure and the interpretation of its findings (that infants display loss of visual regard and positive affect in response to mother's still-face). The authors suggested that several issues needed to be resolved in order to clearly establish that the infant's response to the still face mother was directly related to the change in her behavior (not the product, for example, of increased upset over time). In addition, their objective was to ascertain what specific change in mother's behavior was the infant responding to as her still face (totally noninteractive) included the absence of facial, vocal and tactile components. In order to establish baseline responding, no-change control groups (infants not exposed to the still face) were included in their experimental design. Two groups of infants, 3 and 6 months of age, participated in their first study (Study 1). Mothers were instructed to interact with their infants normally, then assume a still face and resume normal interaction (the typical still face paradigm). The dependent measures included the total percentage of time the infant spent smiling, the total

percentage of time the infant spent gazing at his mother,
and the frequency of grimace (the latter occurring too
infrequently to allow any proportional analysis). Their
second study (Study 2) was identical to the first (with a
different sample of 3 and 6 month old infants) with one
exception: mothers were instructed to interact normally with
their infants during the periods of normal interaction but
not to touch them. A final study (Study 3) was uniquely
designed to manipulate independently mother's face and voice
by presenting mother to her infant over a closed circuit
T.V. This presentation made it possible to manipulate one
interactive component (voice or face) without disrupting the
other. To tease apart the influences of facial and vocal
components, each were independently manipulated resulting in
four conditions presented to the infant: still-face with no
voice, still-face with interactive voice, interactive face
with no voice, interactive face with interactive voice.
Further, the T.V. image of mother presented to the infant
maintained her size and positioning similar to that of
mothers in their previous studies.

A two-way analysis of variance assessing group (3 month
old infants, 6 month old infants) X period (normal
interaction, stillface, normal interaction) was their
standard statistical test. The authors' cumulative findings
provided a convincing demonstration that 6 month old infants
in all three studies responded to a change in mother's

interactive behavior by decreasing their time spent smiling and gazing at her during the still face period. Alterations in mother's face, voice or both communicative channels revealed similar results. Without the benefit of mother's tactile stimulation (Study 2) there were no significant differences for 3 month old control or still face exposed infants, suggesting the important role of "touch" in maintaining the young infant's attention. As these studies did not control for the "movement" inherent in normal interaction, and void in the still face episode one cannot rule out the possibility that it was mother's movement (or lack of it) that the infant had responded to, rather than a change in mother's affective display. Given, however, the rigorous empirical design of Gusella's investigation (in addition to its incorporation in several other studies), the still face phenomenon has proven robust across many procedural variations.

Further evidencing the mother-infant dyad as the model context within which to explore salient issues pertinent to the process of affective development, the concept of social referencing has engendered rigorous investigation. An entire body of research focuses upon how the emotions influence both intrapsychic processes and interpersonal interactions. Social referencing, as indexed in the literature, typically places the child in a position of uncertainty. A prototypic situation to study infants, with

limited verbal capacity, is the visual cliff paradigm (Schwartz, Campos & Baisel, 1973). In this situation, the infant will look to mom and her affective state to modify and determine his own. The infant's early affective social referencing relies upon nonverbally expressed emotion (i.e., facial expression) to gain information about persons and objects. Examining communication patterns and social referencing in a group of 12 month old infant-mother pairs, Adamson & Bakeman (1988) found affective social referencing to influence proximity to novel toys. When mothers' expression was happy the infant moved closer to the novel toy in comparison to when her expression was fearful. In addition, the authors suggest that mothers' affective responding served to balance the infants' exploration and attachment behaviors.

As has been shown, numerous studies have probed the dynamics of manipulating maternal behavior on infant responsivity (e.g., still- face, simulated depression, clinical depression, positive/negative and neutral displays) during the course of mother-infant interaction. Empirical evidence supports the view of mother-infant face-to-face interaction as a mutually regulated system (Brazelton & Bertrand, 1990). Both mother and infant appreciate the quality of their partner's signals (e.g., expressive behavior) and modify their own displays in accordance with salient interactive goals, continually established and

reestablished during their interaction. While it is beyond the scope of the present investigation, it must be kept in mind that the establishment of mutuality in the mother-infant dyad is dependent on both partners; if one or the other fails to play his role, the interaction becomes unpredictable and disintegrates. The breakdown can originate with either member of the dyad or because the "fit" between them is out of synchrony, (Bruner, 1973; Holmes, Reich & Pasternak, 1984; Lamb & Easterbrooks, 1981; Massie, 1982). Pertinent to the objectives of the present investigation is the suggestion that consequences of aberrant dyadic interaction may be evident in the type and range of affects displayed by the infant, the frequency, intensity and duration of the infant's emotional expressions, and the specific contexts within which the infant's affects are elicited (Izard, 1980).

A picture then emerges from the literature of an infant capable of organized behavior, clearly an active participant in his/her own development sensitive to influences from the caretaking surround, and at the same time capable of influencing that environment. The infant's expressive repertoire is a powerful control and response system. Clearly the effectiveness of the interplay of signalling and interpretation (primarily nonverbal for the infant whose verbal capacity is limited) becomes a central issue in understanding infant/environment transactions. The aim of

the present investigation was to record the infant's expressive repertoire and discuss the correlates of infant condition (fullterm and preterm infants) and environmental input (the structured interactional events) on those expressive displays. The implication remains that the infant who appears less well equipped to display meaningful affect may not elicit positive response from the caretaking surround and may jeopardize or alter the course and duration of subsequent developmental sequences. It has been suggested that differences in facial musculature, atypical neural activity and variations in the speed of information processing may delay the emergence or affect the appearance of certain facial expressions (Cichetti & Pogge-Hesse, 1981; Ekman, Friesen & Ellsworth, 1972; Izard, 1990). Indeed such developmental differences have been observed in the population of high risk infants (e.g., premature infants), thereby negatively impacting the very characteristics important for the smooth operation of affective signalling and responding (e.g., infant appearance and behavioral organization, mother sensitivity, and a diminished capacity to respond appropriately to environmental stimulation). Research supports, then, the importance of examining expressive behavior in populations of infants who might be expected to display aberrations in the development or appropriate use of emotional response patterns. While there has been limited systematic investigation of the social-

emotional development in atypical populations of infants, the infant born prior to term has been the target of considerable interest to the developmental psychologist.

Chapter III

THE PREMATURE INFANT: BIRTH CONDITION AND ITS IMPLICATIONS

FOR EMOTION SIGNALLING AND RESPONSIVITY

The premature infant is one segment of the population
of high risk infants, a broad category of infants with
widely differing psychological and environmental problems.
Premature infants are not a homogeneous group but vary
considerably in gestational age and the severity of
prenatal, perinatal, and postnatal medical complications.
In order to integrate research findings and ascertain what
infant characteristics impact later developmental outcome,
it becomes of critical importance to clearly define what
population of high-risk infants has been examined. The
premature infant, often born sick and far too soon spends
his first weeks or months of life in an intensive care
nursery. Als and her colleagues (1979) offer some insight
into the dynamics involved in parents' interaction with
their premature infants. "Parents seem biologically
programmed to expect fullterm normal newborn behavior. Not
only are parents of preterm infants deprived of the
realization of this expectation by having a premature
infant, but, they are at a premature stage of development
themselves, deprived of the last weeks and months of
readying themselves for interaction with their infant....
We thus are dealing with two premature subsystems of an

interactive feedback system in which both subsystems may be showing distorted behavior patterns." Earlier it was suggested that the infant is competent to the extent that the caretaking surround is able to be sensitive to cues from the infant. The additional stress and emotional burden placed on parents of atypical infants certainly influences the caretaking process. In a longitudinal study, Parmelee & Haber (1973) concluded that developmental outcome was only indirectly related to prenatal and postnatal complications in infancy. Rather, the quality of mother-infant interactions (which in turn was affected by birth condition) evidenced an ameliorating effect on subsequent development.

Divitto and Goldberg (1979) set out to explore the social interactive consequences of prematurity. The authors postulated that harmonious social interactions would be facilitated by high levels of parent confidence and infant social competence. Further, they suggested as medical complications of the infant increased, parent confidence and infant social skills would decrease, resulting in more problematic interaction. They found that early interactions were indeed affected by premature birth, medical condition and prolonged hospitalization. Their research demonstrated that mothers of premature infants and fullterm infants interacted quite differently with their babies. Mothers of premature infants worked harder and were more active in carrying the "interactive burden". In so

doing, these mothers seemed to be compensating for their infant's relative passivity in the interaction dialogue. Often this compensation on the part of the mother continued even when her baby's behavior had become more active and organized.

In her observations of mothers and their preterm infants interacting, Field (1979) demonstrated a similar interactive pattern. Mothers attempted to engage their relatively passive and inactive infants by offering greater amounts of stimulation to them that led to diminished responsivity on the part of the infant. Field has suggested that this pattern identifies the infant as embracing a narrower threshold of stimulation to which he responds positively (optimal threshold). Consequently, such maternal overstimulation was counterproductive. To ascertain why mothers of preterm infants seem to respond and behave differently with them, it becomes necessary to discuss certain infant characteristics that might affect subsequent maternal and infant behaviors. The present report will examine more closely those preterm infant characteristics expected to impact subsequent affective signalling and responding (infant appearance and behavioral organization, atypical neural activity, and the speed of information processing).

It has been established that infant appearance in general is a powerful elicitor of response from the

environment (Boukydis, 1981; Field et al, 1979; Hildebrandt & Fitzgerald, 1979; Maier et al, 1984; Ritter et al, 1988; Stern & Karraker, 1988). Recall the study by Maier et al (1984) that demonstrated that on the basis of the infant's physical appearance alone observers were willing to discriminate cute, attractive and normal infant behavior. In that study, premature infants were rated less favorably than their fullterm comparisons. A study from our laboratory examined infant smiling behavior in a sample of preterm and fullterm infants. Although smiling infants were rated more positively by observers than those infants not smiling, the preterm infant smile seemed less effective in eliciting a positive response from observers compared to the smiles of their fullterm counterparts (Holmes, Reich & Lauesen, 1986). It remains ill understood why it is that the smile observed in the preterm infant seemed less effective in eliciting a positive response from observers. Studies recording the microstructure of the infant's facial expressions (as is the design of the present investigation) seems an heuristic avenue to search for empirical evidence that might offer some insight into observer interpretations.

Another clear signal to the caregiver that the infant needs attention is infant crying. Frodi (1978) found that premature infants cry less often and that their cry is perceived as more aversive to adults than the cry of fullterm infants. A study by Moss and Robson (1968)

demonstrated that 80% of mother-infant interactions at 1 month of age were initiated by infant crying. As the premature infant cries less, he elicits less attention and it is less likely that he will receive adequate stimulation. Based upon empirical investigation, these patterns of results evidence once again the diminished strength with which the preterm infant elicits positive response from the social surround.

Earlier it was suggested that the healthy fullterm infant seemed born with coordinated physiological systems well adapted to survival. These adaptive systems may be altered in the population of premature infants. For example, Brazelton (1973) has argued that an infant's behavior is organized in particular ways over time. The infant's sleep/wake cycle or state pattern establishes this organization. With the recognition of these state patterns it has been demonstrated that infants behave differently and predictably in different states; specific responses no longer appeared chaotic. The premature infant appears at a disadvantage. In their observations of infants, Holmes and her colleagues (1984) found that premature newborns sleep significantly more than fullterm newborns (21 1/2 hours per day for the sample of preterm infants compared to 18 hours for the fullterm infants). In addition, they observed the premature infant to spend less time in the alert inactive state (the state of processing) thereby reducing the

opportunities to attend and process environmental stimulation. Suggestive of atypical neural activity (a lack of maturity/integrity of the infant's central nervous system), the overall organization of state and the clarity with which different states were expressed was altered in the premature infant. Overwhelmed by quick state changes and a difficulty in maintaining an alert state, the behavior of the premature infant was less likely to elicit appropriate care from those around him. Neonatal neurobehavioral assessments (e.g., Brazelton Neonatal Behavioral Assessment Scale) tend to bear out these differences in the degree of adaptive readiness of the premature infant. The greatest differential responding between preterm and fullterm infants on these type of exams have been those items dealing with interactive processes and state organization. In addition, these findings are implicated in a study by Fantz, et al (1975) whereby preterm and fullterm newborns showed differential responding to a visual presentation (checkerboard). The premature infants looked longer at the display (fixation time) in comparison to the fullterm infants. These findings were interpreted as the premature infant's inclination to process information more slowly.

In sum, it has been established that the preterm infant deviates in several ways from the fullterm infant (e.g., appearance, threshold for stimulation, medical condition) (Bakeman & Brown 1979; Karger, 1979; Maier, Holmes,

Slaymaker & Reich, 1983). Difficulties in reflexive behavior (e.g., sucking), state control (e.g., maintaining an alert state in these infants is often problematic) and the ability to respond appropriately to social stimulation are evidenced in the premature infant (Brazelton, Tronick, Adamson, Als & Wise, 1975; Goldberg, 1979). The effect of infant condition on parent-infant interaction and subsequent developmental outcome has been explored by several investigators (Bakeman & Brown, 1977; Devitto & Goldberg, 1979; Field, 1977). In addition, prematurity appears to influence the strength with which the infant elicits positive response from the caretaking surround (Field et al, 1986; Holmes et al, 1986; Holmes, Reich & Pasternak, 1984; Sameroff & Chandler, 1975; Stern, 1984).

Based upon review of the characteristics of the infant born prior to term, it was anticipated that the preterm infant's expressive repertoire (as recorded in the present investigation) would be altered, as compared to their fullterm counterparts. The mother-infant dyad, has been chosen as the context within which to examine the microstructure of the infant's facial expression. A sample of preterm and fullterm infants were observed, and their facial expressive displays recorded, as they interacted with their mothers in a structured interaction sequence. To appreciate the design of the present investigation, it is first necessary to review the historical and theoretical

underpinnings relevant to the current course of
investigation.

CHAPTER IV

HISTORICAL AND THEORETICAL PERSPECTIVES

The Beginning: Charles Darwin

The empirical study of nonverbal behavior began with Charles Darwin (1879). Darwin's primary interest focussed upon the communicative use of expressive signs by way of systematic observation of the behavior of an organism in different states. Darwin speculated and formed hypotheses about the origins of expressive movements, based upon the observations of his own children and that of animals (particularly primates). While his was a comparative approach and his findings descriptive, the empirical rigor with which he approached his inquiries (observation, deduction, experimentation) produced significant contributions to our current view of the ontogenesis of facial expression and emotional development. The observations of his own children, the first in a series of "baby biographies" which were to follow, was intended to observe emotional development by recording the timing and appearance of certain facial expressions. Darwin embraced the position that to understand adult behavior requires solid knowledge of the ontogenesis of the behavior observed in the infant and child. He observed that the majority of adult facial expressions were already present in the infant and young child (before any learning could take place).

With the theory of evolution as the fundamental underpinning to his hypotheses, he concluded the expressions were stereotyped in nature and "universal throughout the races of man" (Darwin, 1879).

In order to support these conclusions, Darwin embarked on two distinct courses of inquiry. The first was his discovery (once again based upon his own and zookeepers observations) that some expressions made by nonhuman primates were similar to those of man. He argued that expressive behavior was innate in the sense that it evolved from more primitive forms. Expressions were functional in animals, as in man, as they were essential to attract animals to one another, keep them together, and regulate their social interactions. As such, Darwin was the first to recognize and articulate the communicative value of facial expression. These observations led Darwin to outline how the natural selection process shaped the evolutionary history of facial expression. Darwin emphasized the facial musculature as determinant of expression, based upon his understanding of the relationship between form and function. For example, Darwin suggested that the appearance of extensive facial musculature in new world monkeys (apes) was closely tied to new functional developments. As these primates evolved from primarily nocturnal, to monkeys of the grasslands, visual communication (where the face could be seen) became of paramount importance for survival

(survival value). With this evolution, there came an increase in the size and number of muscles in the midfacial region to accommodate adaptation to the demands of group living in the grasslands. He recognized the continued differentiation of the midfacial musculature in man, with a reduction in the size of the muzzle musculature, jaw bones, and teeth (speculating this was related to the use of tools where such strength no longer was necessary). Such differentiation in the facial musculature allowed for much greater variability in the forms of expressions signifying particular states and later speech production.

Darwin's second course of inquiry was to obtain cross cultural evidence on the universality of facial expression, seeking to verify his argument that facial expressions were innate. Darwin sent questionnaires about facial expressions to people (friends, missionaries) living in other countries. Understanding the potential problems inherent in relying on questionnaires (validity, reliability) to settle the issue of universality, Darwin chose instead a different strategy to verify his hypothesis. Darwin was the first to study observer judgements of facial expressions (observers were shown photographs and asked to identify what emotion was displayed in the photograph) to ascertain whether or not emotions could be identified similarly cross culturally. Finding such cross cultural interpretation was indeed evidenced, he became convinced that facial expressions were

biologically determined and a product of evolution. Darwin did not however deny that culture and the social structure strongly affected nonverbal behavior. In sum, Darwin concluded that movements of expression were: (1) important in their own right for the welfare of the individual, whatever their origin might be (survival value); (2) the first means of communication between mother and infant; (3) a mechanism to strengthen mutual good feeling (functional); and (4) a source that reveals thoughts and intentions more accurately than words (communicative). It will become evident that many contemporary ideas are rooted in Darwin's initial observations. Although we have more powerful methodologies and tools with which to examine the questions Darwin sought to answer, the majority of subsequent research findings either agree or expand upon his original observations.

While the question of the universality of facial expression originated with Charles Darwin (1879), contemporary investigation has explored systematically the possibility of universality in facial expression. Ekman and Friesen (1972) showed photographs of facial expressions to observers in different cultures and asked them to identify what emotion was displayed. Their objective was to confirm that the same facial expressions exist for the same emotions regardless of different persons, expressions and cultures. Based upon the anatomical basis of facial action (what the

facial musculature allows the face to do) 3,000 still photographs were compared with a description of muscle movements relevant to each of six emotions (happiness, sadness, anger, fear, surprise, disgust). From these photographs 30 pictures were selected for inclusion in their study (14 different persons depicting each of the 6 emotions). Each pictorial expression was similarly interpreted by observers from Japan, U.S., Argentina, Chili, and Brazil as conveying a particular emotion. Essentially, cross cultural interpretations of the emotion expressions displayed in the photographs were the same. Up until this point, however, the cultures included for study were literate and able to maintain visual contact with one another. As such, it was not possible to establish, without reservation, that facial expression was universal.

In order to confirm the universality of facial expression, Ekman, Sorenson & Friesen (1969) set out to ascertain whether similar findings would be obtained if observers were from preliterate, isolated cultures. To pursue their investigation with 2 preliterate cultures, it was necessary to modify the methodology previously employed. Instead of presenting observers with a single photograph of a face (depicting an emotion), the observers were shown 3 photographs and asked to select one that fit an emotion story. In addition, the observers were asked to display the facial expression themselves in response to the

story. These displays were then photographed and shown to U.S. observers who exhibited very little trouble in identifying the intended emotional display. In a separate study, Izard (1971) employed a similar strategy (what has now become the typical judgement-type study asking observers to identify emotional displays) using photographs of different emotion categories, supporting the universality of certain facial expressions.

Interested in finding whether or not the universality of facial expression applied to atypical populations, Freedman (1964) studied the development of facial expressions of emotion in congenitally blind infants. He found smiling behavior to parallel the course of development in sighted infants, and observed increased social smiles of longer duration after 6 months of age. Based upon his research, he concluded that most facial expressions seemed to develop independent of the opportunity for visual learning. In the majority of instances the blind and the sighted did not vary significantly in their facial expressions of emotion when the expressions were spontaneous. Differences did emerge when the expressions were voluntary or posed. This observation is consistent with the literature that suggests spontaneous and voluntary facial expression are two distinct affective systems. As it becomes relevant to the present investigation, this point will be elaborated later in greater detail. Presently,

empirical data from a wide variety of literate and preliterate cultures, individuals born blind, and certain clinical populations have converged to support the hypothesis of universality in facial expression. Cultural differences in facial patterning (expression) are revealed dependent upon the context within which facial expressions are displayed (display rules).

Display rules are the learned rules that govern the management of facial expression to meet the demands of society and control the messages inherent in facial expression. To explore the nature of display rules, Ekman (1973) conducted an experiment with subjects from California and Tokyo. Clearly, Ekman anticipated that display rules would operate differently within these two culturally distinct groups. Subjects viewed a positive (scenery) or negative (surgery) video segment while alone or in the presence of the experimenter. These two viewing conditions provided the context within which Ekman could pursue his fundamental objective: how is facial expression, presumed to be universal (at least for certain emotions) affected by the cultural demands to control (mask, intensify, deintensify) its display? Facial expressions were coded using an objective coding system (Ekman & Friesen, 1976) to identify the facial patterning (expressions) present on the faces of the subjects as they viewed the video segments (alone or in the presence of the experimenter). Data revealed that

viewing in private for both groups of subjects resulted in very similar facial expressions to identical points in the movies (positive facial expressions recorded for the positive video and negative facial expressions recorded for the negative video). However, once subjects were joined by the experimenter and their facial expressions again recorded, the consistent findings for the 2 groups of subjects diverged. The negative video segment no longer produced the similar facial expressions recorded in the earlier private viewing condition. Japanese subjects appeared to engage in masking their negative affect in response to the negative video segment, while American subjects tended not to cover the signs of their negative affect. Such behavior on the part of the Japanese subjects was interpreted as a cultural display rule. These findings led Ekman to conclude that facial expressions are universal and culturally different. Subjects viewing the video segments in private revealed the biologically based, universal expressions of emotion. The experimenter condition showed how different rules about the management of expression can lead to culturally different displays.

As a pioneer into the empirical investigation of facial expression and emotional development, it has been evidenced that Darwin's original observations have remained central to much of the contemporary research on the emotions. Others have also made contributions to current issues still

relevant in the study of emotion.

Waves of Change: New Directions in the Empirical
Investigation of emotion

The end of the "Darwinian Era", nearing the close of
the nineteenth century, witnessed a shift in the scientific
"zeitgeist" to a wave of psychophysiological investigation
to study the emotions. Subsequent research centered upon
the issue of which came first, the "feeling" of an emotion
or the physiological changes associated with it (James,
1890). James proposed that emotional stimuli elicited
physiological responses specific to each emotion. Relying
on recordings of heart rate, facial blushing, respiration
(the subjects' physiological patterning), James proposed the
experience of an emotion was the perception of the
corresponding physiological pattern. The James-Lang theory
(1890) postulated that it was the viscera that provided
information for distinguishing the emotions. Briefly,
emotional information was conceptualized as being furnished
to the individual via an "affective feedback loop."
Sensations aroused by visceral functioning were perceived by
the subject as emotion feelings. In essence, James argued
"the bodily changes follow directly the perception of the
exciting fact, and that our feeling of the same changes as
they occur is the emotion" (James, 1890). It should follow
from James' proposition that there exist clear-cut
physiological discriminators of the various emotions. As
subsequent research failed to find clear patterns
corresponding to the different emotions, such a failure

became a fundamental criticism of James' proposals.

Dissatisfied with the integrity of the James-Lang theory, Cannon (1929) argued several weaknesses in the visceral theme. Because feedback from the viscera was diffuse and response too slow, the viscera could not be charged with providing sufficient information. Further, Cannon demonstrated "emotional" behaviors in animals whose viscera were separated from the CNS. Hoping to find the understanding of emotional behavior in neurology, Cannon (1929) studied the effect of autonomic impairments and brain lesions on emotion functioning. He introduced the idea of the hypothalamus as the "seat of emotion" and thereby influenced generations of neurologists attempting to map various areas of the brain with particular emotional reactions.

In sum, the early theorists (James, Lang, Cannon) sought to determine salient characteristics of emotional experience in the activities of the peripheral (autonomic) nervous system and endocrine system. The importance of the brain was limited largely to the production of appropriate changes in these systems, followed by detection that such changes had occurred. The explanatory power of the early theories were sharply reduced, largely due to the lack of specificity of these peripheral changes corresponding to the particular emotion experienced.

Finally, a landmark study by Schachter and Singer

(1962) catapulted research on the emotions into the "cognitive era" with the suggestion that cognitive factors (cognitive appraisal processes such as interpretation and the appraisal of a given situation) were the major determinants of emotional states (denying any earlier conceptions of a one-to-one correspondence between emotional state and visceral patterning). In this view, an emotional state is seen as a general pattern of excitation (physiological arousal). Cognition, therefore, is seen as allowing the interpretation of one's emotional state to be labeled as "anger", "joy", "fear", etc. Further, the authors postulated that the same state of physiological arousal (for which the individual had no adequate explanation) would be labeled differentially (e.g., fear, anger, joy) dependent upon cognitive aspects of the situation. The reversal of the argument would also be maintained: given the same cognitive circumstance an individual would identify a subsequent emotion only if accompanied by physiological arousal. In order to systematically investigate their hypotheses, the authors needed to manipulate physiological arousal (offering subjects no explanation or an appropriate explanation for such arousal) as well as to manipulate the identification of a given emotion under a controlled situation (provide an emotion inducing cognition). College-aged subjects were recruited for this experiment and deceived about its actual

purposes. To meet the objectives of the study, various experimental conditions sought to manipulate physiological arousal and the subject's cognitive appraisal of the experimental situation. Physiological arousal was controlled by an injection of a placebo (saline solution) or an injection of epinephrine (adrenaline), a drug whose effects mimic the discharge of the sympathetic nervous system (blood pressure increases, heart rate increases, and respiration rate increases). Subjective symptoms experienced by the subject were heart palpitation, tremor, flushing and accelerated breathing. Subjects were either informed about the effects of adrenaline, misinformed, or given no explanation about the injections' effects. While the subject sat alone in a room filling out a questionnaire, he was introduced to a fellow subject. In actuality, this subject was a confederate following a script to provide emotion-inducing cognitions about the experimental situation (presumably allowing the experimenters to manipulate a given emotion). The confederate either exposed the subject to euphoria or anger by becoming increasingly euphoric or angered in his vocalizations and behavior. The "script" for each emotion remained constant for all subjects, with any variation dependent upon the subjects own participation. Measurement included the observation of the subject and the confederate (recording to what extent the subject exhibited euphoria or anger), pulse rate, and a self report measure

assessing the subject's mood at the moment.

Schachter and Singer found that subjects injected with epinephrine showed more evidence of sympathetic arousal than subjects injected with placebos. Further, subjects were more susceptible to assuming the mood of the confederate when they had been given no explanation for their bodily state, in comparison to those subjects provided with an appropriate explanation (effects of the epinephrine injection). While less significant, self-reports of the subjects given no explanation for their arousal, indicated that these subjects were manipulable into disparate feelings of euphoria or anger. In essence, Schachter and Singer's study seemed to confirm that emotion feelings follow cognitive processing and that it was not the physiological arousal per se that identified emotional experience, but the individual's cognition (interpretation) of the situation that determined emotional "feeling" state.

Several inherent problems with the Schachter and Singer (1962) study must be addressed if we are to evaluate its fundamental hypotheses and implications for research on infant emotionality. First, one must question the author's injection of epinephrine as an adequate operational index of emotional state. While the effects of adrenaline are well known, to suggest such a state mimics an emotional state takes a leap from the empirical page. In addition, because "arousal" and "emotional state" were both operationally

defined as the physiological effects of epinephrine,
finding a correspondence between increased arousal and
increased emotionality was not surprising and this finding
of increased emotionality was distinct from the subsequent
labeling of that "emotionality." Unquestionably the
subjects were aroused, although the authors' assessment
measures were rather global and weak (observation, pulse
rate, and self-report). Further, as the authors themselves
contend, one cannot be sure that the placebo injection did
not manifest arousal as well. Clearly in some cases it did,
as results were weaker or nonsignificant without considering
those subjects the authors identified as "self-informed"
(subjects attributing their bodily state to the injection,
whether or not they had been given an appropriate
explanation of its effects). It is not clear if the
assessment measures described a manipulable emotion
(euphoria or anger) for these subjects. That subjects used
situational cues to determine their emotional state, in the
context of uncertainty, was in no way surprising.
Contextual cues have been argued as an important source of
events for emotional interpretation across development
(e.g., social referencing in the infant). Schachter and
Singer's findings were not so illuminating about the
manipulability of emotional behavior as they were
descriptive of the cognitive processing of a situation, with
cognition providing the individual more sophisticated

alternatives to cope with the emotions.

It is beyond the scope of the present investigation to further evidence the limitations of the report by Schachter and Singer (1962). Their study was presented because of its pinnacle importance in the history of research on the emotions. While the authors claimed that emotion feelings followed cognitive processing, it cannot be denied that like cognition, the emotions regulate the flow of information and the selection of response processes. Campos and Barrett (1984) suggest that unlike cognition, the emotions regulate behavior by way of a prewired, innate communication process. A central thesis is the authors' conviction that high level cognitions are neither necessary nor sufficient elicitors of emotion. While they suggest most emotional reactions are linked to a social goal and the appreciation of goal attainment, they contend that not all goals are socialized; some are prewired and relate to the survival of the neonate. The emotions are regulators of social and interpersonal behavior (signal intent/feeling, facilitate social interaction, provide a basis for certain inferences about the environment). Clearly the emotions are related to the registration, storage and retrieval of information. For example, Bower (1981) presented subjects with lists of material to be learned in each of 4 hypnotically induced states (joy, sadness, anger, and fear). Subjects were then tested for recall while in the same or different state than

that of acquisition. Bower found retention was highest when the state of acquisition matched the state of recall, concluding the influence of emotion on cognitive processing was powerful and widespread. With emotion then regarded as an antecedent variable in human behavior, cognitive coping was the result of emotion.

Although theoretically interesting, the choice among the alternatives (cognition leading to affect or affect leading to cognition) may not be critical to the larger issue of determining the "interface" between cognition and affect, as both shape our existence. Undoubtedly the debate will continue. Clearly, in nearly all conditions emotion is accompanied by cognition. Lewis and Rosenblum's (1978) multiphasic model of the cognitive-affective relationship denies the direction of emotion and cognition as proceeding in one way or another (i.e., emotion giving rise to cognition or vice versa). Instead, affect is viewed as both antecedent and consequent to cognition. Depending upon the point of entry into the observation, each is capable of eliciting and generating the other. The constant interplay between emotion, information processing and cognitive appraisal processes occurs within a single organism as a consequence of that organism's adaptation to a continuously changing environment.

While Schachter and Singer's study (1962) opened a window to articulate the determinants of emotional "feeling"

state, and instigated the lively and continuing debate as to the primacy of affect or cognition (which is antecedent and which is consequent in human behavior), it closed a door on studying the emotions directly. Investigators of the emotions were subordinated to a position of identifying emotional reactions only as indicators of some other kind of developmental issue (usually some cognitive attainment). Researchers in this tradition (Emde, 1980; Emde et al, 1976; Kagan, 1978; Sroufe, 1978) have argued that cognitive appraisal processes shape an emotional reaction by altering the meaning of the person-environment relationship. Kagan (1978) has suggested that the attribution and interpretation by self and others always intervenes between emotional state and experience. Interestingly, Cichetti and Sroufe (1978) found that the level of cognitive development paralleled the level of affective development. In their study, infants who smiled and laughed to more cognitively sophisticated items on the Bayley Scales (e.g., mom drinking a pretend bottle) were those who had the highest Bayley scores (Bayley, 1969). Early laughter was a better predictor of later cognitive development than was the infants' early level of cognitive development. Essentially, affect predicted cognition better than cognition predicted cognition. Investigators Sroufe (1978) and Emde (1976, 1980) have argued that affect expressions in early infancy represented precursors to affect that later emerged in a more fully developed form,

paralleling developments in motor and cognitive areas.
Given, for example, the neurological immaturity of the
neonate, the authors contended that emotional expression and
emotional experience was initially poorly coordinated. As
such, the emotion system follows a developmental course
whereby a capacity early on (e.g., the ability of 3 day old
infants to imitate various facial configurations) submerges
to reappear at higher levels of organization. This
organization was viewed as a complex process (system) and as
such, an emotion could not be equated with a particular
behavioral expression, a particular objective experience or
a particular physiological response. Rather, all were seen
as incomplete manifestations, at different levels, of a
complex and dynamic system. Development was viewed not as
the addition of new capacities then, but in terms of
existing levels of organization that were subordinated and
integrated into new, more complex levels of organization.

     Sroufe et al (1974) have proposed a dynamic tension
model to explain how a response to the same event can
produce widely differing emotional reactions in different
infants. In addition, the same infant may respond
differently, on different occasions, under different
circumstances, or at different points in development.
Specifically arousal was described in terms of tension that
oscillates above and below optimal thresholds of stimulation
producing positive and negative affect. "Emotional

development is in part the development of awareness, anticipation, intentionality, and meaning: the subjective relationship between the infant and the event, and changing sources of arousal or tension" (Sroufe, 1978). In sum, the implication then is that the early affective responses of the young infant reflected merely physiological tensions that only later, when the infant could become cognitively engaged with the stimulus could one speak of affect. Similarly, Campos (1984) has suggested a core of emotions present at birth that become differentiated later in the child's development. The neonatal smile is cited as an example of an expression early on that submerges to reappear at higher levels of organization (Campos & Barrett, 1984).

The fundamental argument made by the nonspecific arousal theorists, suggests that physiological patterns did not correspond to specific emotions, but rather to the intensity of general emotional arousal. These theories tended to share implicitly or explicitly the assumption that such distinctions in the identification of emotional state were the product of learning. Essentially, according to nonspecific arousal theory in its strongest form, without cognition there would be no affect but there still would be arousal. Within the larger frame of the socialization model, theorists argued, to a greater or lesser extent, that facial expression, like a language, is socially learned, culturally controlled and variable in meaning from one

setting to another. It was suggested that the physiological, expressive and experiential components of emotion change with development as does their interrelationship. Viewing emotional state as "undifferentiated arousal" reduced the emotions to a narrow, unidimensional construct. In some sense, conceptualizing emotionality in this manner denied the young infant the possibility of embracing an affective self. As the infant was once conceptualized as an undifferentiated creature to be shaped by the environment, research seemed to be reaffirming that conception in regard to the emotions. The present report has evidenced the adaptive importance of the affective system, with the infant entering the world well equipped to process affective stimulation and to begin to communicate his own emotional states. Researchers still however remain resistant to the attribution of an affective self to the young infant.

These theories fall short in their power to explain the complex and rich organized patterns of facial expression observed in the young infant. In her observations, Malatesta (1985) demonstrated that infants display facial expressions similar to those observed in the adult and that the caregiver uses these facial displays to index the emotional state of the infant. For example, the cessation of the infant's distress cry to caregiver intervention seems to confirm the relationship between facial expression and

affective state. "It seems reasonable to assume that feelings are inherent to human nature and that the process of development is one of struggling to learn more articulate ways of describing our experiences" (Malatesta, 1985). While the newborn neither knows why she is crying, or what will happen next, it has been discussed earlier how the infant quickly begins to make connections between affective state and its antecedents and consequences (contingency). While it remains ill understood how quickly the infant does this, and how many repeated experiences it will take (and with what causes and consequences), investigators have observed the young infant's capacity to make connections between events on the basis of contingency.

Currently then, two broad theoretical models direct the study of emotional development: the socialization model and the biological model. The foregoing review has outlined several "cognitive" theories that are subsumed under the more global socialization theoretical model. As earlier outlined, the work of Charles Darwin pioneered the empirical foundation of the biological model approach to emotion. His work remains as a cornerstone upon which current investigation has continued in this tradition. Many of the assumptions and guiding principles of this alternative model of inquiry lay the theoretical foundation upon which the present investigation was undertaken.

A strong biological approach to emotional development

is based upon the assumption that emotional behavior has an evolutionary history engaging specific biological programs. As such, the development of emotion occurs as a consequence of strong biological forces, with maturational changes enabling the child to regulate expression or impose rules about its management. More specifically, the biological model postulates the existence of specific elicitor - receptor connections functioning as innate releasing mechanisms. The connections between receptor and state, state and expression, state, expression, and experience are unlearned. Suggesting fixed neuromuscular connections between internal state changes and facial expressions, several investigators (Ekman & Friesen, 1972; Izard, 1980; Tomkins, 1982) view emotional state as a direct consequence of facial expression. Assuming facial expression and feeling state as direct and innate is certainly the most controversial proposition of the biological model. As such, the role of facial expression in activating and regulating emotion experience has become a lively topic of research and theoretical discussion. Labeled the "Facial Feedback Hypothesis" (Izard, 1990), different investigators have assumed different mechanisms through which expression exerts its influence. Tomkins (1982) has argued that naturally occurring emotion expression determines emotion experience. He has identified receptors in the skin of the face as the primary source of sensory information involved

in emotional experience. Others confirm the Facial Feedback Hypothesis by direct effects of sensory feedback from receptors found in the facial musculature (Lanzetta, Cartright, Smith & Klech, 1974). Zajonc, Murphy & Inglehart (1989) have presented evidence that expressive behavior exerts its influence on affective experience by regulating venal bloodflow in the brain. In all these models expressive behavior was implicated in the activation and regulation of emotional experience. "No model can explain precisely how expressive behavior or any other mechanism generates emotion experience. This would be equivalent to explaining consciousness, or how neurochemical and motor processes achieve awareness" (Izard, 1990).

Recent review of the studies relating to facial feedback (manipulating facial expression activates and regulates emotion experience) has led to divergent conclusions. The most serious criticism of these studies is that subjects are able to make inferences about emotion experiences based upon expression specific movements. For example, while the experimenter does not directly ask the subject to "smile" and "tell me how you feel", less intrusive directives may not resolve the inherent confounding of facial expression and feeling state. The notion of facial feedback has been explored using experimenter manipulated subject expressions and spontaneous, self-initiated subject expressions. The

studies in which the subjects expressions were self-regulated (spontaneous), evidenced more support for the "facial feedback hypothesis" than results from those in which expressions were manipulated by the experimenter. Interestingly, only the spontaneous (involuntary) facial expression system can be assumed to be operative in early infancy. Rusalova et al (1975) used imagery induced expressive behaviors (spontaneous) and measured changes in heart rate and EMG. Their findings demonstrated a close relationship between specific emotion feelings and a corresponding emotion-specific pattern of facial muscle activity (EMG). Recall Cannon's primary objection to James' visceral hypotheses was that response of the viscera was diffuse and too slow to provide the necessary activation of emotion feeling. To the contrary, the highly differentiated patterns of afferent and efferent pathways associated with facial expression seems a neurophysiological mechanism with the required specificity to activate emotion specific feelings. The facial skin is particularly well equipped with receptors adequate to the task. Using the method of microneurography, Johansson, Trulsson, Alsson & Abbs (1988) showed that the mechaneuroreceptors in facial skin respond vigorously to facial movement. All facial muscles insert directly into facial skin mechanoreceptors and are sensitive to the slightest movement. In addition, many facial neurons have visceral convergence in that somatic feedback from the

face plays a role in recruiting visceral activity. Further, Hue et al (1981) demonstrated the coordination of facial and visceral impact to the thalamus and to the cortex. While facial feedback has been considered an important factor in emotion activation in infancy, other mechanisms of emotion activation and emotion regulation emerge with maturation and learning. Taken together, the importance of these studies is that they demonstrate a mounting empirical base supporting hypotheses that suggest a direct correspondence between facial expression and emotional experience (when the subjects spontaneous expressive behavior has been recorded). Given, then, that the neuromuscular substrates of emotion expression are in place at birth (Izard, 1990; Malatesta, 1985), one must be increasingly willing to attribute affective "feeling" states to the young infant as well. The implication of significant importance to the present investigation, is that the cumulative findings of the "Facial Feedback Hypothesis" is suggestive of two distinct affective systems. The first system is concerned with the mediation of involuntary expression as having innate connections to the neural substrates of emotional experience. The second affective system involves voluntary expression controlled by neural pathways more involved with the motor cortex and pyramidal tract.

The work of Caroll Izard has generated a plethora of empirical investigation focussing upon infant affect and the

ontogenesis of emotion. As a champion observer of infant facial expression, Izard supports the foregoing arguments in favor of a direct relationship between facial expression and emotional experience. The Differential Emotions Theory (Izard, 1971, 1977; Tomkins, 1962, 1969) has provided the central theoretical foundation upon which the present study was undertaken. In addition, the theory has yielded the conceptual framework for the measurement system utilized to code the facial expressions of the infant subjects participating in the present investigation. The theory conceptualizes the human personality as a complex organization of six relatively independent interactive subsystems: (1) homeostatic; (2) drive; (3) emotion; (4) perceptual; (5) cognitive; and (6) motor. As such, emotion is viewed as a system that cannot be studied in isolation. Infant development, then, is viewed as a process whereby the systems and subsystems of the "whole person" become effectively organized to produce integrated behavior. Each of these subsystems has motivational properties whose salience varies with different developmental levels, environmental contexts, and self-other interactions. With development these subsystems become integrated into an organized set. The authors argue that the emotion subsystem constitutes the primary motivational system over the life span. Further, a discrete number of fundamental emotions (interest, joy, surprise, sadness, anger, disgust,

contempt, fear, shame, and guilt) are evidenced in infancy, presumed innate, and emerge ontogenetically as they become adaptive in the life of the infant. While Izard argues that the fundamental emotions have innate expressions, this does not mean there is no variability in expressive patterns. Izard affirms that individual variation is basic to the evolutionary process with biology accounting for some of the variability in emotional expression. As a function of the emergence of the discrete emotions, there is an increasing complexity of consciousness. Izard conceptualizes the development of consciousness as moving from primarily sensorial to affective-perceptual to an affective-cognitive interaction over the course of the infant's first year of life. Developmental change is revealed in the relationship of the emotion system to the other subsystems of personality, not the number of discrete emotions. The theory assumes that in normal infants the essential quality of the feeling component of any discrete emotion is activated when the facial movement pattern of that emotion is spontaneously displayed (the Facial Feedback Hypothesis). Changes are evidenced in emotion responsiveness, which in turn is dependent upon the interaction of emotion and cognition at different levels. Clearly, Izard contends that at the neurophysiological level the concordance between facial expression and state is direct (for how long is not explicitly understood). The

implication is that there is no cognitive mediation in the young infant's emotion expressions. It is at the experiential level of emotion (as consciousness is a complex interaction of affective and cognitive structures) where developmental change is witnessed. As such, the cognitive subsystem is indeed a highly important source of events that activate and regulate the emotions. However, Izard suggests that cognition is not the only subsystem capable of this. For example, the homeostatic (physiological) subsystem can also provide emotional regulation. "Fatigue" has been shown to lower the threshold for anger and "interest" can attenuate sadness.

A study by Izard, Hembree & Heubner (1985) demonstrated the continuity in emotion expression from early infancy to the second year. Expression measures averaged over the early infancy ages (2, 4 and 7 months) correlated significantly with those same measures at 19 months of age, (e.g., anger and sad expressions at 2, 4 and 7 months, significantly predicted anger and sad expressions at 19 months). Within the context of continuity, however, developmental change in some aspects of emotion expression result from the interaction of biological maturation, cognitive processes of appraisal and information processing, and experience. After observing infant inoculations, Izard (1977) described how the acutely pained 2 month old can emit only the distress cry. By 6 months of age, observation of

distress wanes with increased observation of the anger
expression. In addition, the older infant can now turn from
the source of pain to his mother and initiate comforting
behavior. These observations demonstrate that eliciting
conditions will lead to different emotions depending on
development in perceptual, cognitive, emotional, and motor
systems. For example, once symbolic processes and language
are developed, affective-cognitive interactions predominate
in consciousness, giving way to an infinite number of
affective-cognitive bonds as a result of the infant's
recurring transactions with the environment.

In sum, Izard (and Tomkins before him) has argued an
innate relationship between activator and response at the
level of discrete behaviors (facial expression). Clearly
there are no innate responses to affect in that one can
learn a wide variety of discrete responses to a particular
affective state. Izard argues that the specific "feeling" of
an emotion is invariant over the life span, yet he concurs
that emotion responsiveness (for example, thresholds for
particular incentive events) changes with development.
Clearly, as such, he does not contend that the quality of
the infants' affective life is the same as that of the
adult. Without the integration of the subsystems of
personality, emotional responsivity remains stereotypic at
the level of discrete behavior and constrained in terms of
variation. For example, the young infant processes

"strangeness" as novel (discrepant from perceptual expectancy) and this leads to expressions of surprise and interest. For the older infant "strangeness" is processed as uncertainty, leading to distress and fear. "While the ontogenesis of emotions proper is mainly a function of age-related biological changes, the development of affective-cognitive structures is primarily a function of ecological variables and learning." (Izard, 1984).

It may very well be that no theory to date is broad enough in scope, while maintaining specific empirical hypotheses, to accommodate our current rich and detailed observations of infant affectivity. The present review of our current state of understanding infant expressivity and emotional development has highlighted the salient theoretical issues as well as the unresolved empirical questions that permeate research on the emotions. Every theoretical argument has discussed to a lesser or greater extent the importance of the stimulating event, the physiological underpinnings involved in emotional responding, and the consequences of the individual's response. In addition, all theories suggest the importance of cognition and learning as related to emotional behavior. While the exact mechanisms involved are variable, the outcome is the same: with development, behavior observed in the infant becomes more organized, effective, and infinitely varied to cope with the emotions.

Theoretical differences have been primarily concerned with the degree of cognition necessary for emotional responding and the degree of affective differentiation theorists are willing to attribute to the young infant. Systems theory (Laszlo, 1972; Von Bertalanoffy, 1968) offers a conceptual framework intuitively attractive to the study of emotions. Conceptualizing emotion as a system, development is viewed as a process. Interestingly, a consistent difference between theoretical orientations is the degree to which the subsystems of emotion (component levels) are integrated, and how the emotion system itself becomes integrated with the other subsystems of personality (e.g. cognition, motoric, experiential). Those favoring a socialization model argue the component levels of emotion are separate at birth, with development seen as a process of integration. Theorists espousing a biological orientation suggest that the levels of emotion are in some sense "fused" at birth (because of innate biological mechanisms). As such, the process of emotional development is one of "disconnection". According to Demos (1974) "coherence between state and behavior is easy, it is dissimulation that is difficult and attendant on the maturation of cognitive skills".

The strength of the biological model lies in its robust empirical foundation. Technological advancements in the investigation of emotional behavior and development has

offered greater methodological precision to describe observed behavior patterns (e.g., facial expression). As such, greater precision is demanded of theory to more clearly articulate a phenomenon now exposed to be richer and more complex than heretofore observed. The biological model is presently considered an heuristic avenue to explore emotional behavior and development.

Several major findings are often cited in defense of this model. First, the ability of judges to reliably identify discrete emotion expressions in very young infants is suggestive of a biological foundation in the expression of emotion. Second, the existence of well documented cross cultural evidence of certain emotions having similar facial expressions supports a strong biological underpinning (universality). Recent studies investigating the neurological and physiological patterning accompanying emotional expressivity has demonstrated that the necessary neuromuscular equipment involved in facial expression is in place at birth. There now exists empirical support for at least certain emotions corresponding to identifiable physiological patterning. Direct concordance between facial expression and heart rate, skin temperature changes, and EMG patterning has been demonstrated (Ekman, Levenson & Friesen, 1983; Fox & Davidson, 1984; Izard, 1990; Le Doux, 1987; Zajonc, Murphy & Inglehart, 1988). In addition, several neurological indicators of hemispheric

specialization for the processing of certain positive and negative affects have also been found (Fox & Davidson, 1984). Empirical evidence is mounting in favor of the initial activation of emotion experience as concordant with facial expression. Specifically, receptors in the skin of the face have been described as sufficiently immediate to innervate ANS concomitants in emotional responding (Izard, 1990). These findings have led to the suggestion of the existence of two affective systems. The first a function of an innate correspondence between facial expression and feeling state (useful in describing the "stereotypic" facial expressions observed in the young infant). The second affective system a function of ecological variables and learning.

The biological and socialization theoretical models find common ground in the interactional model that offers a synthesis of these traditional approaches to emotion. The appeal of this orientation lies in its vision to see the unique contribution of both biological and environmental variables in the development of emotion. First, the interactional model shifts the fundamental nature/nurture controversy so that no longer indicates a question. "To view biology/environment interactions from the perspective of both planes simultaneously is to be aware of the warp and woof in one fabric. It is to see no sense in the question of the priority of inheritance or experience" (Zivin, 1985).

In so doing, we might more clearly articulate in what ways the dual developmental forces of biology and experience shape our existence. Second, specific to the present investigation of infant facial expression, the interactional model proposes that biological forces initially determine infant expressive states and behaviors but progressively loosen their influence as the infant becomes increasingly influenced by environmental factors (Zivin, 1985). Malatesta (1985) suggests both genetic determination (prewiring) and contextual flexibility (modifiability) in the development of expression. She describes the existence of innate elicitors of affective reactions (i.e., the observation of disgust expressions in young infants to noxious substances), innate morphology of expressions and predictable timetables for the initial emergence of discrete patterns of emotional behavior (as demonstrated by Izard and rooted in the Differential Emotions Theory). Based upon infant observations (coding infant facial expressions), Izard suggests emotion expressions to emerge in the following order: (1) pleasure, interest, distress/pain, disgust and startle (early); (2) surprise, anger, fear (6-12 months); (3) shame, shyness, guilt (2nd year). In addition, Malatesta recognizes the capacity to acquire learned elicitors of affect (e.g., fear of white furry animals). Also, she notes that behavior can be modified through instrumental learning (e.g., changes in sucking rate).

Stressing the differential signal value and phenomenology of discrete classes of emotional events, Malatesta (1985) concluded that infant facial expressions were not "undifferentiated" as measured by a systematic coding system. The author videotaped 60 infant subjects (3-6 months of age) in a play session with mother that included a separation and reunion episode. Infant facial expression was coded using the Maximally Discriminative Facial Movement Coding System (MAX) (Izard, 1979/R 1983). Malatesta found the young infant's emotion expressions to be labile, with a change every 8 seconds. In addition, there was a reduction in the expression change rate from 1 every 7 seconds (at 3 months) to 1 every 9 seconds (at 6 months). A primary developmental change from 3-6 months was a reduction in knit brow (lowering of brows drawn together) and the pain expression. Further, De Casper and Carstens (1981) have demonstrated that 3-day old infants could learn to space their sucking bursts in order to turn on the singing of a female voice, thus perceiving the relationship between the stimulus and their behavior. Similarly, Sullivan (1983) coded the facial expressions in a sample of 6 month old infants during a contingency learning task. The task was an armpull device designed to put on a slide of Sesame Street with an accompanying song. The data indicated clear learning, with matched comparisons (in a noncontingent paradigm) failing to exceed base rate armpulling.

Interestingly, results demonstrated that different emotional and self-regulatory behaviors emerged during learning as the consequence of mastery (joy) and the prerequisite for learning (interest, surprise).

Examining discrete categories of emotional behavior has proven to be heuristic in strengthening the empirical foundation in emotion research. Equally compelling is the evidence that reminds us that across the life span we live in a social world. The emotions are inextricably linked to the active and purposeful strivings of the organism. As the individual becomes more competent motorically and cognitively there come new capacities for coping with emotions. Facial expression is a single dimension of emotional behavior that conveys to others our response to a particular event and in so doing clarifies our own perception (i.e., social referencing). In its power to embrace robust evidence from both the socialization and biological models, the interactional model affords the researcher a wider lens within which to observe developmental coherences.

CHAPTER V:

DESIGN CONSIDERATIONS IN NONVERBAL BEHAVIORAL RESEARCH

In recent years advances in our understanding of
several aspects of child development have come from the
close scrutiny of what actually happens in natural settings
(Charlesworth, 1982; Jones, 1972). Again, it was Charles
Darwin (1872) who pioneered the functional analysis of
behavior that characterizes modern ethology (i.e., deriving
the underlying functional significance of an observed
expressive behavior). An ethological strategy to pursue
one's research efforts often includes a detailed description
of the nature and frequency of the behavior observed. In
addition, a central research consideration is to determine
the underlying neurophysiological mechanisms involved in the
occurrence of a behavior. Contemporary developmentalists
engage this strategy with greater enthusiasm and suggest the
integration of ethology and developmental psychology is
indeed timely. These strategies have combined to lend new
sophistication and precision in the observation and
recording of behavior patterns. For instance, earlier
studies investigating the infants "fear of strangers" were
based largely upon global ratings and averaged responses
over time (usually the infant's "crying" recorded as the
primary indicator of the presence or absence of "fear"). By
contrast, recent investigations have recorded detailed

behavioral sequences and reactions as well as information about the frequency and duration of observed behavior patterns. In so doing, the researcher is empowered to more richly articulate the phenomenon under study. As in this example, "fear of strangers" now includes a variety of infant responses from smiling, to wariness, to crying, dependent upon a variety of contextual cues (e.g., speed of the stranger's approach, proximity to mother, etc.).

Close observation and analysis of moment-to-moment changes in naturally occurring facial behavior has led to the discovery of organized patterning both in the configuration of the facial features and in the timing of facial movements. Using different experimental designs, a number of infant researchers (Field, 1982; Izard, Huebner, Risser, McGinnes & Dougherty, 1980; Oster, 1978) have demonstrated that infant facial expressions are not random occurrences, but organized facial patterns (specific facial expressions) appropriate to the situation. The systematic analysis of the facial musculature has led to the development of theory based, microanalytic methods for recording facial expression. Trained observers score an observed facial display by judging the presence or absence of designated movement categories (coded appearance changes) within each facial region (eyebrows/forehead, eyes/nose/cheeks, and mouth). Several coding techniques are now available for use, each slightly different in

designating what facial action patterns (movements) determine which emotion is recorded. All of these coding systems were anatomically based upon what the facial muscles allowed the face to do and how these movements were related to affective expression. The goal of this kind of systematic observation was to insure objectivity and accuracy in recording facial expression. As such, only when the observed movements met a criteria for a given emotion, was it determined that a discrete emotion (or blend thereof) had been observed.

The Maximally Discriminative Facial Movement Coding System (MAX), was developed by Izard (1983, R 1987) and designed specifically for use with infants. The first step in the development of MAX, was to determine the movements involved in each of the facial expressions designated as the fundamental emotions in the Differential Emotions Theory (Izard 1977; Tomkins, 1962, 1963). Examination of cross culturally standardized expressions of discrete categories of emotion and the ascertainment of what facial muscles were involved in the movements constituting these expressions were part of Izard's strategy in developing the MAX system. In addition, the corroborative efforts of several psychologists, biologists, and anatomists lent additional information on facial muscle activity and its relationship to emotion expressivity. Anatomically related movements were grouped and others were eliminated if not essential to

the identification of the affect expressions in Discrete
Emotions Theory (interest, joy, surprise, sadness, anger,
disgust, contempt, fear, distress/pain and shame/shyness).
Verbal and pictorial descriptions of the facial expressions
were also developed. Finally, strong reliability of the
system was obtained using a variety of stimulus materials
(video segments of infant expressions illustrating the
appearance changes identified in MAX). The Maximally
Discriminative Facial Movement Coding System (MAX) was
chosen as the coding system utilized in the present
investigation to record the infant's facial expressions.

The face, as described by Ekman (1972), is "probably
the most commanding, complicated and confusing of all
nonverbal behaviors." Appreciating this complexity,
investigators have attempted to address whether or not
observers could agree on a subject's display of emotion and
could distinguish between facial behaviors exhibited under
different emotional states. The judgment study is the most
common approach utilized in designing nonverbal behavioral
research. Individual differences in judges' ability to rate
facial expressions (i.e., depressed mothers versus
nondepressed mothers) as well as individual differences in
the facial expressions of various groups of subjects (i.e.,
full-term versus preterm infants) has provided a wealth of
valuable information. In general, the focus of these
studies has been to measure the judgments about a particular

nonverbal message. Judges make inferences about the
emotional response underlying an observed behavior pattern.
The response format utilized by researchers has typically
been a rating scale of 2 types: categorical or dimensional.
The categorical rating scale presents the observer (judge)
with two or more response alternatives of which one is to be
selected (i.e., one category for each example of facial
behavior). The dimensional rating scale offers greater
precision in rating as the observer chooses a numerical
value to identify his/her judgement. In an attempt to
ascertain the effect of the infant's gestational age on
adult perception of infant facial expression, Holmes, Reich,
and Lauesen (1986) analyzed judgment ratings of smiling
versus neutral infant expressions in a group of fullterm and
preterm infants. Judges were found to rate smiling infants
more positively than infants whose expressions were neutral.
Interestingly, the positive effect of smiling was
significantly larger for the fullterm infants as compared to
infants born prior to term. This suggested that the smile
of the preterm infant was somehow less effective in
eliciting positive response. Clearly the judgment study has
provided a powerful contribution to our understanding of
observer response to emotion signals.

An alternative approach in the design of nonverbal
behavioral research focuses on measuring the physical
characteristics of the behavior observed. Though less

popular, the "component" study has recently received greater attention by researchers as new methodologies and techniques for analysis have been developed. Until recently the emotions of human experience captured by the researcher remained the creature of specific frames of time, contexts and instruments. As described earlier, the advanced technologies for the analysis of organized patterns of facial movements signalling emotion expressions have now become available for use (Izard, 1979/1981; Oster, 1977/1978). By measuring the actions produced by the facial musculature (expressions) it becomes possible to determine exactly what differs in the faces of two groups of subjects - a possible avenue for establishing to what observers respond when making their judgements. Undoubtedly, the expanded utilization of the component study can provide valuable information sorely needed to strengthen the empirical foundation in the study of emotion.

Neither the judgment study nor the component study attempts at observing nonverbal behavior should be thought of as more valid than the other. Rather, each design type complements the other by describing observed behavior at two different levels of analysis. The kind of information suggested by the judgment study targets molar units in that judges are asked to rate the "smile" in photographs of infants (suggesting macroanalytic analysis). Conversely, the component study focuses on molecular structures in an

observed behavior stream usually observed over very short intervals (suggesting microanalytic analysis). Observing behavior is a complex task. Two current misconceptions prevail here. The first criticizes the macroanalytic focus in observational data as inherently "too molar", too complex for precise antecedent-consequent patterns to be extracted. Similarly, investigators choosing to focus their endeavors at a more microanalytic level are charged with destroying the inherent integrity and organization of the behavior to be explained. With the advent of the video recorder, some argue (Yarrow, 1979) that investigators seeking to capture ongoing behavior streams become "trapped" by equipment that allows the analysis of the minutia of behavior. Cairns (1933) suggests that we need not assume that the method must capture at the first level of analysis the "wholeness" of the phenomenon under study. He argues that the general lesson is that there is not necessarily a direct relationship between the level of analysis employed and the nature of the phenomenon to be explained. Fundamentally, the challenge remains to match research design with one's research aims. Ultimately, fitting microanalytic data into a molar framework is likely to lead to a richer understanding of the behavior observed. For the purposes of the current study, the microanalytic design has been employed in order to examine developmental and context variation in infants' displays of emotional expression.

CHAPTER VI

THE STUDY: EXAMINING THE MICROSTRUCTURE OF INFANT FACIAL EXPRESSIVITY

The present investigation explores emotional expression in early infancy. That infant appearance in general is a powerful elicitor of response from the environment has been the conclusion of diverse research efforts (Boukydis, 1981; Butterfield, 1986; Maier et al, 1984; Ritter, 1986). Facial expression has been shown to have survival value (Darwin, 1879), prove adaptive in the life of the infant as he engages and organizes environmental stimuli with a growing understanding of self and others (Campos, Sorce & Emde, 1983; Klinnert, 1984; Sameroff & Waters, 1976) and evidence developmental change in its temporal pattern (Charlesworth, 1982; Field, 1984; Tronick, 1982). The role that expressive behavior plays in the initiation and modulation of social contact in face-to-face interactions has been clearly demonstrated (Malatesta & Ritter, 1986; Stern, 1986). A fundamental component in the language of infancy is the emotion signalling system. How "good" the infant is at getting and maintaining attention and eliciting positive response from those around him will impinge upon the course of developmental sequelae in cognitive, perceptual, social and motor areas. While this is a strong statement, attempts have been made throughout

the present discussion to highlight the pinnacle importance
of the infant's facial expression as it relates to other
areas of development. A study by Demos and Kaplan (1987)
clearly illustrates how the young infant is capable of
eliciting response from the environment, and how this
behavior comes to bear upon development in other areas.
While this was not the central objective of their study, the
illustrations provide a poignant description of how this
influence (the infant's eliciting behavior) might be
expected to translate to subsequent developmental outcome.
Demos and Kaplan observed and videotaped 2 infant girls in
their homes every 2 weeks during the first year. Both
girls, Cathy and Donna, were born to professional parents
who had looked forward to their arrivals.

As described by Demos and Kaplan, two behaviors were
exhibited by Cathy's mother that became central behavioral
components in her interactions with Cathy over the course of
the first year. Whenever Cathy would gaze into her mother's
face without smiling (remaining quiet and interested),
Cathy's mother would interpret this facial expression as
"boredom". She would subsequently substitute her face with
a jiggling toy that quickly failed to maintain Cathy's
attention. In addition, Cathy had an older brother whom
mother would attend to, often at the "expense" of her
interactions with Cathy. Demos suggested that Cathy had
"learned" several things from these early interactions with

mother; that her own states of interest and joy didn't last long, that she had little control in initiating or prolonging these experiences, and that ultimately she was not the source of interesting or enjoyable events. Central to the present discussion is the subsequent observation of Cathy's development throughout the first year. Cathy remained relatively immobile well into her seventh month. Her exploration was dominated by sucking behavior, a reduced capacity to sustain her interest in people and toys and diminished acquisition of other exploratory and instrumental behaviors in her transactions with the environment.

In comparison, Donna's states of interest and joy were continually prolonged and intensified during the course of interactions with her mother throughout the first year. Donna's mother continually remained responsive to Donna's "interest" in en face interaction by imitating and exaggerating her own facial expressions as well as "pulling back" when Donna was no longer attentive. Similarly, Demos suggested that Donna had "learned" several things from these early interactional patterns: that her own states of interest could be prolonged and intensified; that she was an active agent in bringing this about (contingency/effectence); and finally that she was indeed the source of interesting and enjoyable events. Again, what remains a most salient feature of these observations to the

present course of inquiry is the illustration of Cathy and Donna's subsequent development. "Because of Donna's greater sense of agency and her greater embodiment or ownership of rewarding experiences, many more objects and events were interesting and enjoyable for Donna than for Cathy. Donna's experience of these positive affects was more varied, more intense, and more prolonged than was Cathy's, and Donna developed a larger repertoire of behaviors and more elaborate strategies than did Cathy for prolonging and creating interesting, enjoyable experiences ... Thus Donna was continually able to expand her experience of herself as competent and effective in prolonging rewarding experiences and in developing instrumental skills." (Demos, 1988).

Clearly, the developmental course of these two infants assumed different trajectories. While the aim of the present investigation recorded the infant's facial expressions within the context of mother infant interaction, (allowing the suggestion that such displays inherently elicit caretaker response), it is not suggested that other salient characteristics of these infants and their families (e.g., mother's interactional style) did not provide an equally compelling source of influence on the course of development. As an interactionist, the dynamic character of the infant's transactions with her environment is vigorously assumed. However, if we can clearly articulate the nature of emotional expressivity in infancy, we might

better understand how affective signals are perceived and in so doing provide a richer taxonomy for describing the infant's affective repertoire.

The present report examined the microstructure of infant facial expression in a group of fullterm and preterm infants. Infant facial expressions were recorded using the Maximally Discriminative Facial Movement Coding System (Izard 1977, R/1983) as the infant interacted with his mother in a structured interaction sequence. Three Events comprised the mother-infant interaction sequence: (1) The mother faces infant with an impassive face (still-face); (2) The mother is instructed to maintain her infant's attention; and (3) The mother imitates her infant. The Differential Emotions Theory suggests a discrete number of fundamental emotions emerge during infancy and can be recorded using the MAX. Based upon past research three general hypotheses were addressed in the research to be described here.

The first hypothesis predicts that infants will display an identifiable pattern of facial expression (interest, joy, surprise, sadness, anger, contempt, fear, and distress/pain) under different environmental conditions (still-face, get attention, imitation). The interactive paradigm presently utilized, provided the ideal situation to elicit behavior across a range of environmental constraints and contingencies (Events). Research has demonstrated the importance of contextual cues in eliciting certain emotions.

Several investigators have probed the interactive dynamics of the "still-face" situation. As was discussed earlier, when the interactive adult partner (e.g., mother) was instructed to assume a still-face during the course of interaction (sit silently and expressionless facing the infant), the affective tone and organization of the infant's behavior was altered. It is expected that the use of the still-face procedure (Event 1) will produce a loosely organized pattern of negative affects as compared to the smooth cycling of positive affects in the more "typical" interactional events (mom tries to get her infant's attention and mom imitates her infant). It will be interesting to find if the infant's response to mother's impassive face will produce the typical infant response (loss of visual regard and positive affect) as the procedure is somewhat altered in the present design. First, the still-face event (as it is presently utilized) is the first interactional event in the structured interaction sequence. Tronick (1989) has suggested that this results in a diminished "still-face reaction" on the part of the infant relative to the typical procedure where the still-face follows a course from spontaneous interaction to "still-face" back to spontaneous interaction. In this design, the alteration in the infant's facial expressivity may be less intense and/or variable than past research would predict.

It has been established that external demands on

attention and processing affect infant behavior. The infant has to developmentally come to grips with internal arousal being controlled to some extent by external forces (Fogel, 1982). Clearly, the structured interaction sequence will reflect fluctuations in the level of arousal produced by each event. Specifically, each event provided the infant a different set of cues from mother that varied in intensity, activity and discrepancy from typical interactional patterns. When mother's behavior remains most clearly "interactional", (her behavior constrained by cues she perceives from her infant with the dialogue mutually regulated by both partners), it is expected that the infant will respond more positively (recording more positive expressive displays) in comparison to the interactive events assuming a less playful or typical affective tone (Brazelton et al, 1974; Campos, Emde & Hiatt, 1979; Cohen & Tronick, 1987; Gusella, Muir & Tronick, 1989). The aim of the present investigation was to map coherences between the pattern of emotional expression identified for the sample of young infants (e.g., joy, interest, distress, etc.) in response to the changing eliciting conditions presented them.

In the second hypothesis to be tested, it is predicted that the infant's identifiable facial expression (Hypothesis 1) will be altered by birth condition (fullterm versus preterm).

The basic neuromuscular equipment necessary for the reception of emotional stimulation and performance of emotional responses include perceptual, motor, and central components. We might assume then, that a particular event will lead to different emotion expressions depending on development in perceptual, cognitive, emotional, and motor systems. The preterm infant may deviate from his fullterm counterpart in just those areas suggested to be involved in the expression of emotion (behavioral organization, the capacity to respond appropriately to environmental stimulation, the speed of information processing). In addition, as has been demonstrated, the premature infant often looks different, behaves differently, and is responded to differently by the social surround in comparison to fullterm infants. Undoubtedly, we expected these salient characteristics of the infant born prior to term to impinge upon the facial expressions presently recorded.

As Field (1977, 1982) and others have suggested, the premature infant embraces a narrower threshold of stimulation to which he responds positively. Therefore, the preterm infant's optimal threshold for stimulation assumes a narrower range, resulting in external stimulation falling above or below appropriate levels. Field (1977) observed 3 groups of infants (premature, postmature, fullterm) as they interacted with their mothers in a structured interactional sequence of events (spontaneous,

mother tries to get her infant's attention, mother imitates her infant). She found differences in the infants' response to emerge as a function of eliciting event. Specifically, Field found the premature infant to be particularly engaged by the imitation event and discussed this finding in terms of the premature infant's competency to respond positively when interaction was established within a more optimal range. The imitation event allows the infant to take charge (lead) of the interactional dialogue, forcing mother to remain sensitive to cues from her infant. In the present investigation, we might expect then, more negative affect expressed for the "still-face" and "get attention" episodes, with a more positive response to mother's imitation where she is especially tuned into directives from her infant.

According to Soloman (1974), mother is a highly arousing unconditioned stimulus and, primarily due to her sensitivity in managing this, the infant develops increasing affective tolerance for high arousal. While similar to habituation (effective tuning out of stimulation), affective tolerance allows the infant to maintain moderate levels of internal arousal while remaining engaged with the stimulus. The young infant is learning how to control his behavior in relation to his mother and learning to tolerate the intensity of the arousal that she presents. Infants develop increased tolerance for affective arousal and begin to display self-regulated modulation of arousal about an

optimum level. The premature infant has been described as less tolerant of arousal, embracing a narrower threshold for stimulation evidencing a positive response. It may be the underlying dimension of arousal (that varies in intensity in the 3 interactional events) that will impact upon differential responding on the part of the premature infant. For example, when mother faces her infant impassively and when she tries to get her infant's attention, her behavior is more arousing to the young infant than when she imitates him/her. Therefore, we anticipated the premature infant to respond more negatively to those events than when mother's behavior was less arousing.

Finally, Demos (1988) suggests that one can draw direct comparisons between the infant's state organization and the infant's affective states (as described in the literature). For example, the wakeful state of "alert inactivity" (face relaxed, eyes open/bright/focussed) describes the categorical emotion of "interest" (eyes widened and focussed, mouth relaxed or slightly open). While Demos contends that difficulty arises given the global and imprecise measurement of infant state, compared to the very precise coding of infant facial expression, her arguments are indeed worthy of further attention. Given that behavioral state observations in the infant born prior to term is often described as disorganized and labile, we similarly expected affective patterning to reflect facial

expressions loosely organized, labile and more variable than those displayed by the fullterm infant. As such, data from the present report could lend empirical support for drawing parallels between the infant's state organization and affective repertoire.

In sum, given these considerations, the identification of the infant's expressive repertoire will be examined for differential patterning based upon the infant's birth condition (fullterm/preterm).

The last hypothesis to be tested is that the infant's identifiable facial expression will change over time (2, 4 and 6 months of age).

Current research has concluded there are discrete patterns of facial expression that represent universal response categories (Ekman, 1972). We have as yet to determine the developmental course these categories assume, and still lack an ontogeny of emotions in human development. As has been discussed, theories tend to suggest either a biological or socialization underpinning in the development of affect. The study of the infant's emotion expressions provides the ideal subject population to examine these dual developmental forces in the ontogenesis of emotion.

Most theorists allow that there is little capacity in early infancy to experience all the basic emotions or perform the fully differentiated facial expressions as observed in the adult. Izard suggests that a discrete number

of fundamental emotions are evidenced in infancy, emerging ontogenetically as they become adaptive in the life of the infant (interest, pleasure, disgust and startle are present early with surprise, anger and fear appearing in the second half of the first year). We expect the older infant to use a greater variety of affective expressions, with these expressions reflecting longer durations and more organized patterning than those displayed by the younger infants.

As one of the first theorists to describe the infant's affective experience (feeling) independent of learning or cognitive processing, Tomkins (1962, 1963) describes two distinct concepts: the affect per se and affect related information. In the first sense, the primary affects are conceptualized as biologically inherited programs. Each affect describes a correlated set of responses including facial muscle, Autonomic Nervous System bloodflow, respiratory and vocal components. Conversely, affect related information includes salient characteristics of the stimulus event (activator) and the response to the event (such as the recollection of past experiences, motor and cognitive processes). According to Tomkins, the affect per se and affect related information may or may not be "coassembled" at any given moment. That is, development consists of the gradual construction (coassembly) of affective complexes that will provide learning opportunities to organize and guide subsequent behavior. Given these

considerations, appreciating the increasing involvement of cognitive activity (increasingly active discrimination and appraisal of the stimuli), we would expect differences in expressive displays to emerge across age (2, 4 and 6 months) in the present sample of infants in response to the structured interactional sequence of events. For example, while the young infant might find mother's impassive face interesting, the older infant may reveal a different facial expression. Perhaps an increased frequency of negative expressions will be recorded (to get mother to stop) or more positive expressions will be recorded as the infant attempts to engage mother in more appropriate behavior.

In sum, the literature is replete with suggestions that infant affectivity (specifically facial expression) changes with development. Clearly, the expectation is that development allows further articulation and more varied use of the response categories (facial expressions) available to the young infant. As the subsystems of personality become integrated, the infant embraces an infinitely varied affective repertoire to cope with the emotions (Izard, 1977). Given that the window of observation in the present design is narrow (11 seconds of coded expressions per event), this richness in the infant's affective capabilities may not be revealed by recording more facial expressions per se, but fewer expressions of longer duration indicating greater organization (subject less to quick change and

random patterning). The present report recorded infant

expressive patterning, while searching for developmental

trends in the use of specific categories of emotion.

METHOD

SUBJECTS

Parents were recruited at the time of their infant's birth for a longitudinal study that included various assessments (social, emotional, developmental and cognitive) spanning the child's first 10 years (Appendix 4). As part of this larger study, an investigation probing the interactional patterns of mothers and their infants was conducted at 2, 4 and 6 months of age. The aim of the present study was to code and analyze the facial expressions displayed by the infant partners in the interactional paradigm.

All infants were from middle-class, intact families, had appropriate prenatal care, were without known damage to the central nervous system and were born at the Evanston Hospital, Evanston, Illinois from 1979-1980. There were a total of 24 mother-infant pairs in the sample used in this study. The mother-infant pairs were chosen on the basis of available videotaped interactional data at the infant ages of 2, 4 and 6 months. A varied subset of these 24 mother-infant pairs participated in the study at 2, 4 and 6 months of age. As the trained observer remained blind to subject identification throughout the course of investigation, it was not until the infants were identified that it was determined that every subject did not participate at each

age period. Table 1 describes the breakdown of the sample used in the present study. All infants were Caucasian and first born. Infants were of appropriate weight for their gestational age (gestational age as determined by Dubowitz, 1970 but varied in health, maturity, and length of hospitalization as described by the following two groups:

Short gestation infants. These infants were less than 37 weeks gestation (range = 29-36 weeks; mean = 33.7 weeks). All had some degree of postnatal medical problems secondary to prematurity, and all were hospitalized in the intensive care nursery for a minimum of 6 days (range = 6-78 days; mean = 23.0 days). There were 12 infants in this group (5 female and 7 male).

Healthy fullterm infants. These infants were fullterm with a gestational age of at least 39 weeks (range = 39-42 weeks; mean = 40.4 weeks). All were healthy at the time of birth and discharged from the normal newborn nursery within 7 days (range = 2-7 days; mean = 4.1 days). There were 12 infants in this group (5 female and 7 male).

Table 1

Sample used in Study

Total Sample	Preterm N=12	Fullterm N=12
AGE		
2	N=10 (male=6, female=4)	N=9 (male=5, female=4)
4	N=9 (male=4, female=5)	N=8 (male=4, female=4)
6	N=9 (male=5, female=4)	N=8 (male=5, female=3)

PROCEDURE

Data for this study were obtained from evaluations of the infants at 2, 4, and 6 months (corrected for gestational age at birth). Although a number of measures were obtained on the infants at these evaluations, only the data on infant facial expression obtained from the face-to-face mother-infant interactions will be reported here.

Mother-infant interactions were videotaped in a laboratory setting which was furnished much like a playroom. The infant was positioned in an upright infant seat stationed on a table, while mother sat in a chair in an en face position toward her infant. The infant's face and body, and the mother's face were recorded in continuous real time for the duration of the interaction sequence.

Each of the mother-infant dyads was videotaped in a 6-minute structured interaction sequence at each age. To maximize control of the interaction sequence, the interaction was divided into 11 different structured events. From these 11 events 3 were selected for inclusion in the present study: (1) Mom faces infant with an impassive face; (2) Mom is instructed to maintain her infant's attention; and (3) Mom imitates her infant (See Figure 1).

These particular events were selected based upon prior research suggesting behavioral and theoretical relevance to the objectives of the present investigation. Earlier it was demonstrated how the still-face procedure has been widely used in observational research with infants and has

Figure 1

Sequence of Events

Event 1:   Mother Faces Infant with an Impassive Face

Event 2:   Mother Attempts to Maintain Attention

Event 3:   Mother Imitates Her Infant

evidenced a typical response on the part of the infant to mother's altered behavior (infants display loss of visual regard and positive affect in response to mother's stillface). The still-face event was therefore included in the present course of inquiry to determine whether or not the infant's facial expression (as coded in the present design) would support the more global measures of the infant's response (e.g., gaze) to his still-face mother.

In addition, the present investigation sought to expose the infant to a broad enough range of environmental constraint and contingency that one could attempt to build coherence between the eliciting event and the infant's subsequent facial expression. Therefore, the eliciting conditions had to be different enough from one another to examine differential facial response patterns as they were displayed and recorded for the infant. Once it is accepted that mother-infant interaction is a mutually regulated system (Brazelton et al, 1990), then, each of the interactional events can be seen as possessing a different affective quality. That is, each event varied in the presence of these salient behavioral dimensions that are believed to characterize infant-mother transaction: reciprocity, sensitivity, and discrepancy. For example, while Event 1 (mother is instructed to assume a still-face) and Event 2 (mother is instructed to get her infant's attention) were fundamentally "mother driven" (mother

assumes "lead" in the interactional dialogue), these events were opposed in terms of mother's maintenance of mutuality and reciprocity/sensitivity. In the first instance, where mother is instructed to assume a still-face, her behavior is totally noninteractive: her behavior is neither altered or affected by behavior she observes in her infant. In the second instance, to achieve the "goal" of "maintain the infant's attention", mother must be especially attuned to cues she perceives from her infant. Clearly, this is a more "typical" interactional pattern shared between mother and infant, and certainly some mothers are better than others in responding appropriately to cues from their infants. Further, the imitation event allowed the infant to "take charge" of the interactional dialogue and was included to determine if differences in the infant's facial expressivity might emerge as a function of interaction that remained "infant driven" as opposed to "mother driven". In addition, recall the suggestion by Field (1982) that the preterm infant may be particularly engaged by this kind of interactional attempt. Similarly, it was anticipated to map this favorable response on the part of the preterm infant by recording more positive facial expressions in the infants response to this interactional pattern.

Finally, given the microanalytic nature of the present design, it was necessary to make design choices to reduce the data into a form amenable to analysis. Thus, the 3

interactional events examined (still-face, get attention, imitate) met the criteria to achieve the fundamental objectives of the present investigation. (See Figure 2.)

CODING

The continuous stream of behavior observed in our infant subjects was coded using the Maximally Discriminative Facial Movement Coding System (MAX) (Izard, R/1983). MAX is an attempt to provide an efficient, reliable and valid system for identifying emotion expressions in infants. Ten fundamental emotion expressions (interest, joy, surprise, sadness, anger, disgust, contempt, fear, distress/pain and shame/shyness) as well as blends of these expressions can be identified using the MAX coding system. Coded appearance changes in 3 regions of the face: the forehead/eyebrow/nasal root; eye/nose/cheek; and mouth/lips/chin constitute the MAX coding system. (See Figure 3.) The MAX manual and video training tape illustrates each appearance change and presents a code number to identify the movements observed. In total, there are 29 appearance change codes identified in the MAX system corresponding to the 3 regions of the face; forehead/eyebrow/nasal root (6 codes), eye/nose/cheek (9 codes), mouth/lips/chin (14 codes). (See Figure 4.) In addition, the MAX requires that each video segment of observed behavior be scored independently for each region of the face. In other words, only 1 facial region is coded at a time. In this first phase of analyzing facial behaviors,

Figure 2

Hypotheses of Present Study

1.   Infants will display an identifiable pattern of facial
      expression (interest, joy, sadness, anger, contempt,
      fear, distress/pain or blend thereof) under different
      environmental conditions (Event: 1, 2, 3).

2.   The infant's identifiable facial expression will be
      altered by birth condition (Group: Fullterm/Preterm).

3.   The infant's identifiable facial expression will change
      over time (2, 4, & 6 months of age).

Figure 3

Face Detailing 3 Regions Coded
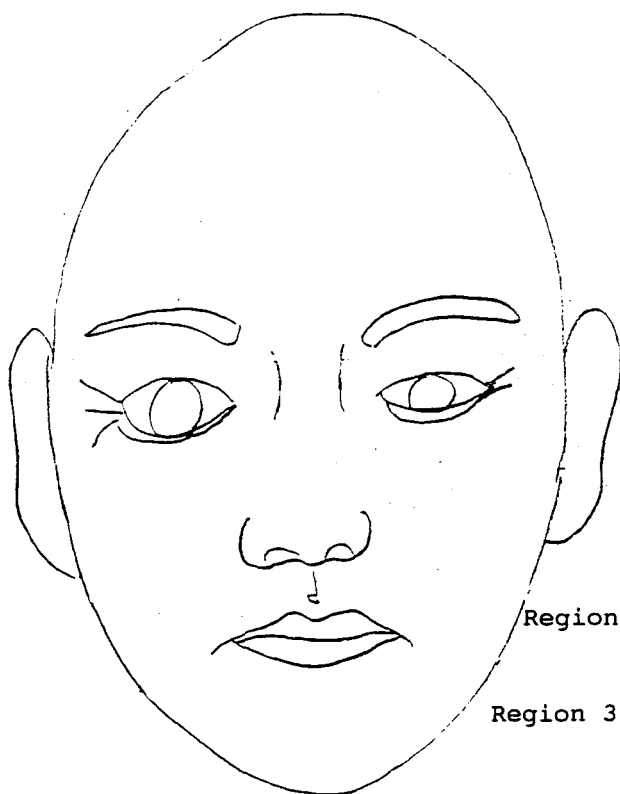
Region 1: Forehead/eyebrow
Nasal Root (6 codes)

Region 2: Eye/Nose/Cheek (9 codes)

Region 3: Mouth/Lips/Chin (14 codes)

Figure 4

MAX Appearance Change Codes and Definitions

```
20 = brow raise producing enlarged, roundish appearance of
     eye region
21 = unilateral brow raise
22 = brows raised and together
23 = inner corner brows raised and together
24 = brows together and (possibly) slightly down
25 = brows sharply down and together
31 = widening of eye fissure and increased exposure of
     sclera due to raise of upper lid
33 = narrowing of eye fissure, squinting; involves tensing
     and raising of skin immediately below the eye; may
     crinkle tissue at eye corner
34 = tensing, tightening of lower lid without cheek movement
35 = visual scanning (to be used only in absence of any
     codable signal other than 51)
37 = eye fissure squeezed tightly closed
42 = nasal bridge furrowed and thickened, nose wrinkle
50 = mouth open and roundish, oval
51 = relaxed open mouth
52 = mouth corners pulled back and up
53 = mouth corners stretched laterally; strong activity may
     recruit neck tightening
54 = squarish, angular mouth
55 = mouth stretched open with tight, tense, taut lips
56 = mouth corners pulled down (horse shoe mouth); may also
     involve tightening of chin boss and lower lip being
     pushed up and out
57 = mouth corner compressed against the teeth on one side
     of the mouth causing the lower cheek to bulge; may
     produce dimpling
58 = mouth corners compressed against the teeth on both
     sides of the mouth causing the lower cheeks to bulge;
     may produce dimpling
59A= mouth open and relaxed with tongue beyong gum line
59B= squarish, angular mouth with tongue beyond gum line
61 = upper lip raised on one side
62 = compressed lips: the lips are tightly pressed against
     each other (by action of the orbiculris oris; the
     mentalis may, or may not, participate)
63 = lower lip depressed exposing lower teeth or gum
64 = lower lip or both lips rolled inward
65 = lips pursed or puckered
66 = tongue extruded beyond gums or teeth
 0 = no movement within a facial region
OBS/NC = obscured/noncodeable
```

Note: (Izard R/1983)
trained observers (80% agreement with the MAX master code on

Training Tape 1) make judgements regarding the presence or absence of clearly defined facial movements (appearance changes). Coders begin by concentrating on the brow region only. The segment number is recorded and observed in real time. The coder slowly proceeds through the segment watching the brow area for any muscle activity or appearance change described in the MAX codes. When a movement is observed, the code that best describes it is recorded. Onset and offset times are recorded to the nearest 0.1 second. This procedure is then repeated for the eye/nose/cheek and lips/mouth/chin regions of the face. At this point the coder does not make any judgement of the emotion displayed (e.g., joy).

In phase 2 of the coding, the discrete emotion expression (or combinations thereof) are identified. An emotion expression is predicted if all 3 regions of the face show the appropriate changes or if 2 of the regions of the face show appropriate movements with the third region not showing a movement characteristic of another emotion. If the third region does show such a codeable movement, it is necessary to score a blend. (See Figure 5.) This 2-step process enables the MAX coding system to be described as an "objective" system for identifying infant emotion expressions. In the present investigation, the coder was trained on the MAX coding system in 6 months. Reliability

Figure 5

The MAX Coding Process: Phase 1/Phase 2

Phase 1

1.   Coder trained on MAX System.

2.   Viewing each region of the face separately, code best
      describing appearance change is recorded.

3.   Codes for each region of the face are transcribed for
      entire segment. Each second of coded material now has
      appearance change codes identified for the
      forehead/eyebrow/nasal root; eyes/nose/cheek;
      mouth/lips/chin.

Phase 2

1.   Each EVENT for each subject is standardized in
      duration. Middle eleven seconds of each interactional
      event is determined.

2.   Eleven seconds of coded material translated to emotion
      category identification.

Figure 6

Reliability

1.   Randomly chose a subject and recoded entire video segment.

2. $Subject_1$ = original coding

     $Subject_2$ = reliability recoding

3. $Subject_1$ and $Subject_2$ were matched to determine reliability or % agreement:

$$\frac{\text{agreements}}{\text{agreements \& disagreements}}$$

4.   The % agreement in the MAX coding by region of the face:

           Brows = 96%
           Eyes = 94%
           Mouth = 90%

5. $\bar{X}$ reliability = 93%

estimates for all subjects was excellent (range = 90%-96%;
mean = 93%). (See Figure 6 for a complete description of how
Reliability was determined.)

Each interactional event was coded in its entirety.
In an attempt to standardize the duration of each event
(some mothers spent a slightly shorter or longer time in
each event in disregard of instructions), it was decided
that the most reliable index of the behavior observed in our
infant subjects, during a given event, would be the middle
11 seconds of the event. If, for example, Event 1 for a
given subject lasted 22 seconds (while the entire event was
coded) only the middle 11 seconds were translated into
expression categories (phase 2 coding) and used in the
present analysis. In sum, the final data set for each
subject was then 11 seconds of coded infant expressions
(using the MAX coding system) for each of 3 events
(impassive face, maintain attention, and imitate) at 2, 4,
and 6 months of age. (See Figure 7.)

Finally, the frequencies of specific categories of
emotion were ascertained, providing a descriptive record of
the expressive behavior displayed. At this point, those
categories of emotion never displayed were dropped from
further analysis. (See Table 2.) In addition, because data
were missing within subjects (mothers deleted a given event
in disregard of instructions or the infant cried and the
interaction was discontinued) as well as across age (data

Table 2

Frequency Totals of Identified Expression Category for each Event/Age

EVENT

	1			2			3		
AGE	2	4	6	2	4	6	2	4	6
ENJOYMENT (EJ)		4	3	3	11	2			3
INTEREST (IE)	80	79	73	34	55	46	44	57	79
SURPRISE (SA)	3			1			1	2	
DISTRESS/PAIN (DP)	11			6					
ANGER (AR)				1			1	6	
POSITIVE BLEND (PB)	63	22	33	94	75	82	52	44	26
NEGATIVE BLEND (NEGB)	22	8	6	4	21	10	3	14	20
MIXED BLEND (MB)	7	6	4	13	30	2	9	5	12
NEUTRAL BLEND (NB)	2	5					11	3	11

*The frequency total was computed across all participating subjects at a given age and event. Each subject contributed 11 seconds (11 identified expressions) during a recorded event. Recorded here are only those expressions and categories yeilding some frequency.

Figure 7

Standardizing the Interactional Event

---

0 1 2 3 4 5 [6 7 8 9 10 11 12 13 14 15 16] 17 18 19 20 21 22

   *Hypethetical duration of an interactional sequence
      (Secs.)

   *Entire 22 seconds coded according to MAX procedure

   *Middle 11 seconds translated into emotion identifications
      (Phase 2 Coding)

were not available at each age period for each subject), the age variable will be described in terms of its covariation.

RESULTS

The major variables dividing our sample are: Group (between-subjects: preterm and fullterm; Age (within-subjects: 2, 4 and 6 months); and Event (within-subjects: 1, 2, 3). Each subject's facial expressions were coded using the Maximally Discriminative Facial Movement Coding System (Izard, R/1983). The infant's expressive displays were coded while they were engaged in 3 separate structured interactional events with their mothers. In sum, the present data set consisted of 11 seconds of coded expression for each interactional event (1, 2, 3) at 2, 4 and 6 months of age for each subject.

Frequency totals of the identified expression categories can be seen in Table 2. Any coded expression (no matter how infrequent) was included in the present investigation. Those categories of emotion were: (1) Enjoyment (EJ); (2) Interest (IE); (3) Surprise (SA); (4) Distress/Pain (DP); (5) Anger (AR); (6) Positive Blend (PB); (7) Negative Blend (NEGB); (8) Mixed Blend (MB); and (9) Neutral Blend (NB). As very young infants rarely display "pure" categories of emotion (as described by the MAX identification procedures) it was also necessary to code "blends." Recall that in order to identify a certain emotion, each region of the face (brows, eyes and mouth) must show the appropriate appearance changes corresponding

to that identification. If the facial regions did not correspond (e.g., Eyes = surprise and Mouth = interest), it became necessary to score a "blend". (See Appendix 3.)

To examine the effects of eliciting condition (Events 1, 2, and 3) on the infant's expressive display, and to determine how this display varied with birth condition (PT/FT), a two-way analysis of variance with age as a covariate was conducted for each expression category. It was necessary to discuss subject age variable in terms of its covariation because of missing data at each age period. Specifically, 19 infant subjects participated at 2 months, while 17 subjects participated at 4 months and at 6 months. Nine infants had available data for each age period (2, 4, and 6 months). The other subjects either participated at only one age period or two age periods. (See Table 1 for a complete description of missing data.) Thus, eleven 2-way ANOVAS were examined. The results of these analyses are presented in Tables 3 and 4. As can be seen, the effects of eliciting condition on the infant's expressive display yielded 3 of the 4 significant main effects. Specifically, the expressive categories of interest (IE), positive blend (PB), and neutral blend (NB) revealed significant main effects for eliciting condition (Event). There were no significant differences in the frequency of emotion expression as a function of birth condition nor did birth condition interact significantly with event. Finally, a

Table 3

Mean Frequency for each Expression by Event

- Those categories of expression yielding a significant main effect for event.
* $P < .05$ for comparison of x_1 with x_2
- $P < .05$ for comparison of x_1 with x_3
▲ $P < .05$ for comparison of x_2 with x_3
♦ $P < .05$ for comparison of x_1 with x_2
‼ $P < .05$ for comparison of x_2 with x_3
0 $P < .05$ for comparison of x_1 with x_2
◉ $P < .05$ for comparison of x_2 with x_3

EVENT

EXPRESSION	STILL-FACE X_1	GET ATTENTION X_2	IMITATE X_3
ENJOYMENT	.08	.34	.12
•INTEREST	*4.46	2.46	3.60
SURPRISE	.06	.02	.06
DISTRESS/PAIN	.21	.12	0
ANGER	0	.02	.15
•POSITIVE BLEND	♦2.31	‼4.76	2.60
MIXED BLEND	.40	.90	.55
NEGATIVE BLEND	.65	.56	.79
•NEUTRAL BLEND	- .14	▲ 0	.53
•NEUTRAL PROPORTION	0 .45	◉ .33	.45

Table 4

ANOVA Tables: 2-way Analysis of Variance with Age as a Covariate

Neutral Face Proportion (DV_2)   N: 145   Multiple R: 0.245 Squared R: 0.060

Source	Sum-of Squares	DF	Mean-Square	F-Ratio	P
Group	0.136	1	0.136	0.996	0.320
*Event	1.025	2	0.513	3.761	0.026
Group*Event	0.083	2	0.041	0.303	0.739
Error	18.944	139			

Enjoymment (EJ)   N:149   Multiple R: 0.251   Squared Multiple R: 0.063

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
Group	0.021	1	0.021	0.053	0.818
Event	2.034	2	1.017	2.592	0.078
Group*Event	0.085	2	0.042	0.108	0.898
*Age	1.557	1	1.557	3.970	0.048
Error	55.705	142	0.392		

Interest (IE)   N:149 Multiple R: 0.279   Squared Multiple R: 0.0

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
Group	30.852	1	30.852	2.505	0.0
*Event	104.228	2	52.114	4.231	0.0
Group*Event	1.249	2	0.624	0.051	0.95
Age	9.774	1	9.774	0.793	0.3
Error	1749.115	142	12.318		

Positive Blend (PB)   N:149   Multiple R: 0.343   Squared Multiple R: 0.11

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
Group	0.164	1	0.164	0.014	0.90
*Event	184.020	2	92.010	7.752	0.00
Group*Event	3.075	2	1.537	0.130	0.879
Age	39.711	1	39.711	3.346	0.06
Error	1685.325	142	11.868		

Neutral Blend (NB)   N:149 Multiple R: 0.266   Squared Multiple R:

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
Group	0.064	1	0.064	0.088	0.76
*Event	7.060	2	3.530	4.856	0.009
Group*Event	0.359	2	0.179	0.247	0.782
Age	0.084	1	0.084	0.115	0.73
Error	103.240	142			

significant difference did emerge in the frequency of enjoyment across age.

The interest expression (IE) yielded a significant main effect for Event, $F(2, 142) = 4.23$, $P = .02$. Post hoc comparisons (see Table 3) revealed that more interest expressions were coded when the infants were responding to their mothers' impassive face (Event 1) than when mother was trying to get her infant's attention (Event 2). The amount of interest exhibited to the imitation task fell between that for the other two conditions but did not differ significantly from them.

Similarly, the positive blend (PB) expression category yielded a significant main effect for Event, $F(2, 142) = 7.75$, $p = .001$. Post hoc comparisons revealed that Event 2 (where mother is asked to maintain her infant's attention) differed significantly from both Event 1 (mother faces infant with an impassive face) and Event 3 (mother imitates her infant). Subjects displayed more positive blend expressions in response to Event 2 than either Event 1 or Event 3 (mean = 4.76 as compared to mean = 2.31 and 2.60 respectively). Looking at the neutral blend (NB) expression category, there was a significant main effect for Event, $F(2, 142) = 4.86$, $p = .009$. Simple effect analysis determined that the infant's facial expression was most often coded as a neutral blend (NB) in response to mother's imitation of her infant's behavior. Mean response patterns

for these events can be found in Table 3.

Finally, 2 additional dependent measures were computed and analyzed by way of a 2-way analysis of variance model. Recognizing the increased frequency of the "interest" expression in the present sample, it was decided that further attempts to identify its frequency might prove heuristic in articulating more clearly the young infants' use of this expressive display. Based upon the correlations among the discrete emotion categories of interest, neutral blend and mixed blend, the categories were collapsed to compute 2 additional dependent measures: (1) Dependent variable 1 = Neutral Face = interest + neutral blend + mixed blend; and (2) Dependent variable 2 = Neutral Proportion = interest + neutral blend + mixed blend/11 - obstructions. These analyses allowed examination of the infant's "neutral face" in terms of its frequency and duration. Results from these analyses are described in Table 3. While no significant differences emerged for Neutral Face, the Neutral Proprotion produced a significant main effect for Event, $F_{(2, 139)} = 3.76$, $p = .02$. Results obtained from the post hoc comparison procedures revealed that infants display a "neutral face" expression more often when responding to their mother's impassive face (Event 1) and to their mothers' imitation of them (Event 3) as compared to the event where mother attempts to maintain her infant's attention (Event 2).

The MAX Codes (11 dependent variables) used provided a descriptive record of the categories of emotion displayed by the infant subjects. In addition, a segment of the data were organized into meaningful units identifying the duration of the affects expressed, the affect index (affectograms). Organizing the data in this manner facilitated the search for recurrent patterns of emotion expressions between our groups of infants, across events and over time. The affect index ranges in value from 0-1 and is the proportion of time that a particular affect or pattern of affects is expressed during a given episode: The Affect Index = total time the affect was expressed during episode divided by the total time in the episode that the face was codeable (Izard, R/1983).

The discrete categories of positive blend, interest, and neutral face were each converted into an affect index. A MANOVA was conducted for each affect index with Group (between-subjects: preterm and fullterm, Age (within-subjects: 2, 4 and 6 months) and Event (within-subjects: 1, 2, 3) dividing the sample. Results of these analyses are found in Table 5.

As can be seen, the positive blend (PB) affect index revealed a significant main effect for Event, $F(2, 142) = 6.94$, $p = .001$. Post hoc comparisons revealed that the duration of the infant's positive display was greatest when responding to mother's attempt at maintaining attention

Table 5

ANOVA Tables: MANOVA

Neutral Face   N:149 Multiple R: 0.264   Squared Multiple R: 0.069

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
*Group	0.502	1	0.502	4.519	0.035
*Event	0.645	2	0.322	2.903	0.058
Group*Event	0.014	2	0.007	0.062	0.940
Age	0.017	1	0.017	0.156	0.693
Error	15.765	142	0.111		

Interest   N:149   Multiple R: 0.0279   Squared Multiple R: 0.078

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
Group	0.255	1	0.255	2.505	0.116
*Event	0.861	2	0.431	4.231	0.016
Group*Event	0.010	2	0.005	0.051	0.951
Age	0.081	1	0.081	0.793	0.375
Error	14.455	142	0.102		

Positive Blend (PB)   N:149 Multiple R: 0.332   Squared Multiple R: 0.011

Source	Sum-of-Squares	DF	Mean-Square	F-Ratio	P
Group	0.042	1	0.042	0.373	0.542
*Event	1.549	2	0.774	6.943	0.001
Group*Event	0.009	2	0.004	0.039	0.962
Age	0.372	1	0.372	3.337	0.070
Error	15.835	142	0.112		

(Event 2), mean = .53. This display differed significantly from both Event 1 and Event 3 (mean = .30 and mean = .34, respectively). In addition, the positive response of the infant when mother assumed a still face or imitated her infant did not differ significantly from one another.

Similarly, the interest (IE) affect index yielded a significant main effect for Event, F (2, 142) = 4.23, p = .016. Post hoc analyses revealed that the proportion of time the infant exhibited an interest expression was increased when mother assumed a still face (mean = .41) and differed significantly in comparison to mother's attempt to maintain her infant's attention (mean = .22). Again, the infant's response of interest to mother's imitation fell between that for the other two events but did not differ significantly from them.

Finally, the neutral face affect index revealed a significant main effect for Group, F(1, 142) = 4.52, p = .04. Simple effect analyses revealed the preterm infants displayed a neutral face significantly more often (mean = .46) than fullterm comparisons (mean = .34) across all eliciting events. (See Table 6.)

Table 6

The Neutral Face Affect Index by Group/Event

	EVENT		
	Still Face	Attention	Imitate
GROUP			
PT	.51	.36	.51
FT	.41	.25	.36

Table 7

Mean Proportion for each Affect Index by Event

* $P < .05$ for comparison of x_2 with x_1 and x_3

♦ $P < .05$ for comparison of x_1 with x_2

EVENT

	Still-Face x_1	Get Attention x_2	Imitate x_3
AFFECT INDEX			
Positive Blend	.30	* .53	.34
Interest	● .41	.22	.33
Neutral Face	.46	.31	.43

DISCUSSION

Contributing to a richer understanding of basic
processes in emotional development, emotion expressions are
themselves worthy of study in their own merit. Examination
of the microstructure of infant facial expression in a
sample of fullterm and preterm infants allows an empirical
description of the expressive repertoire displayed by the
young infant. While no one questions the social signal
value of infant facial expressions (Darwin, 1872; Holmes,
Reich & Lauesen, 1986; Izard et al, 1990; Lewis and
Michaelson, 1983) and some have found them to be good
indicators of specific cognitive attainments (Sroufe, 1978),
forces remain that impede progress made in the study of
emotion. The concern with behavioristic learning theories,
perceptual and cognitive processes have perpetuated the
attitude that the emotions cannot be studied objectively or
systematically. The development of anatomically based,
objective and precise methods for measuring emotion
expressions has undoubtedly contributed to the success of
research efforts in this area. Using an objective system
for coding the facial expressions in young infants the
present inquiry sought to more clearly define the young
infant's expressive capabilities, providing a richer
taxonomy to understanding the nonverbal world within which
the infant grows and develops.

In the introduction to this dissertation the idea of

emotion comprising four central components (physiological, overt behavior, subjective experience and social function) was presented. The present report focussed upon the overt behavioral component, specifically emotion expression. Attempts have been made throughout the present report to understand facial expression as it relates to the other components of emotion (physiological, experiential, social). Researchers must consider the complex, multi-faceted ways in which behavioral, organismic and environmental factors interact to affect development.

Determination of the frequency of the categories of expression allowed us to record how often the infant subjects displayed various expressions over the course of interaction with their mothers. There is general consensus as to the order in which various emotional expressions emerge during infancy. Briefly, pleasure, rage, disgust, interest, distress, and startle are present in the first few months of life; surprise, anger, and fear appear around 6-12 months with shame, shyness, and guilt following in the 2nd year. (Izard, 1977; Kagan, 1978; Tomkins, 1962). The data presently described reveal the interest expression (also the neutral expression) as a frequently recorded display for the present sample of infants. As such, the data are consistent with Izard's suggested developmental timetable for the emergence of various expressions during infancy. The interest expression appears within the first few months of

life (as recorded in the present investigation), with the frequency of the display dependent upon environmental constraint and contingency. In addition to finding few "pure" categories of emotion expression (as described earlier) this sample of infants demonstrated a very narrow range of expressive behavior in that a very limited number of different expression categories were recorded at all.

Several possibilities might account for this "flattened" response pattern. First, the young age of the infant participants (2, 4, and 6 months of age) may have contributed to this pattern. Although argument remains about the "meaning" of the infant's expressive displays, most theorists agree that the young infant is not capable of the fully differentiated emotion signalling system present in the adult. Regardless of the precise mechanism, such differentiation awaits advances and integration in perceptual, cognitive, and motor areas of development. Therefore, we did not expect our subjects to use the entire range of categorical emotions (Izard, 1982). Further, with so many blended expressive displays recorded (each region of the face did not correspond to a single emotion identification), it was necessary to cluster these "blends" into larger expression units (PB, MB, NB and NEGB) amenable to analysis. Undoubtedly this procedural requirement may have diminished some of the variability recorded for our subjects. The finding of more blended expressive displays

is however consistent with the literature describing the young infant's expressive behavior to be less organized than that of the older infant and child (Campos, Emde & Hiatt, 1979; Izard, 1982; Izard et al, 1980; Izard, Kagan & Zajonc, 1984). Clearly, for example, when the eyes are expressing one emotion and the mouth another (necessitating the scoring of a blended expression according to MAX procedure) the expression appears less cogent to the social surround and may be described as "disorganized". Finally, the nature of the interactional sequence did not lend itself to the elicitation of certain emotion categories. The present intent was not to expose the infant to noxious, painful or fearful stimuli. Others have recorded these earlier developing negative expressions in "taste" investigations and observations of infant inoculation (Ganchrow, Steiner & Daker, 1983; Izard et al, 1983; Stenberg, Campos & Emde, 1983). The aim of the present investigation was to record the frequency of the infant's emotion expressions under specific environmental conditions within the context of mother-infant interaction. To this end, our study strongly suggests the young infant's emotional response patterns are indeed affected by eliciting condition. Four of the five significant main effects revealed significant differences in the infant's response to mother's impassive face, mother's attempt to maintain attention and mother's imitation of her infant.

As expected, more positive expressive behavior (PB) was found in response to mother's attempt to maintain her infant's attention as compared to the other interactive events. In addition, this pattern was supported when the positive blend affect index was analyzed. While mother's behavior was constrained, to some extent each mother's interpretation of each event was uniquely her own. Undoubtedly, this event paralleled more closely typical maternal behavior patterns. At this age mothers are heavily involved in getting to know their young infants. What better way to recognize and be recognized than through attempts at maintaining attention? Examining the temporal structure of face-to-face communication between mothers and infants 2-6 months of age, Kaye and Fogel (1980) found that mothers spend nearly 100% of their time watching their babies directly. Assessing maternal activity and infant gaze in two structured face-to-face interaction sequences (mother asked to get the infant's attention and mother imitates her infant), Field (1977) found more maternal activity and less infant gaze during the attention-getting event and less maternal activity with increased infant gaze during the imitation event. The present investigation demonstrated a similar pattern of results. We observed an increase in the interest expression (gaze is a fundamental component of IE) in response to mom's imitation of her infant and impassive face in comparison to her attention-

getting behavior. This finding was further supported when we looked at the proportion of time the infant spent in a neutral face, finding once again infants to respond with an interest expression significantly more often when mom imitated and attended impassively to her infant. Finding the affect index of interest to yield a similar pattern further evidences the young infant's use of this display as producing a robust effect in response to mother's varied interactional attempts.

The central question became: what is it about our sequence of events that differentially impacted expressive behavior in the present sample of young infants? Each event differed in intensity, activity level, and discrepancy from more typical interaction patterns. Kagan (1983) has argued that one function for the classification of affective phenomena is to relate classes of incentive events to internal changes. He has suggested that some incentive events fall into developmental sequelae. Early on, the infant is drawn to objects because of their physical properties. By 2 months of age the infant has produced a number of "schemata" for various common objects in his/her environment and attention is then determined by how closely the objects correspond to the child's existing schemata. Among the first incentives for state change in the infant are discrepant events. Further, as schema formation becomes increasingly important in the elicitation of affect, it is

no longer the stimulus per se that produces the affective response but the baby's effort in processing the stimulus content. Together, these two issues (discrepancy and increased information processing demands as stimuli are "matched" to existing schemata) seem relevant to our obtained results. The impassive face event exposes the infant to a case of moderate discrepancy with the resulting affective pattern described as brief negative affect, maximum attention with sustained positive affect. Given our narrow window of observation (11 seconds), finding maximum attention (interest) lends support to Kagan's hypothesis.

As a natural consequence of the infant's engaging the environment, it has been demonstrated that early stages of face-to-face interaction creates an intense state of excitement (tension/arousal) in the young infant (Sroufe & Waters, 1976; Tomkins, 1962). Arousal is a valuable heuristic in organizing second by second changes in the demands placed on the infants cognitive apparatus (Ewy, 1988). The infant's arousal levels fluctuate regularly with the build up and release of affective tension. Tension increases seem to be associated with attentive behavior while release of tension is typically followed by smiling behavior observed in the infant. Again, our recorded patterns of infant expressive displays support the value in appreciating the arousal variable in organizing affective stimuli. Our findings suggest mother's impassive face to be

highly arousing for the infant. The impassive face event elicited maximum attention from the infant (tension build-up) and resulted in more positive expressive displays (tension release) as mother's behavior became more playful (Field, 1977).

In regard to addressing the question of how birth condition (FT/PT) impacted the infant's affective display we were surprised to find no significant group differences in our sample of young infants. To some extent, methodological constraints may have accounted for this. The relatively small sample size, missing data, and the need to cluster certain expressive categories contributed to weakening the power of our analytic capabilities. In addition, while the MAX has proven a reliable and valid technique for coding facial expressions in the young infant, it is not capable of discerning fine discriminations within the identified categorical emotion. For example, a "52" appearance change code is defined as "mouth corners pulled back and up" (slight or pronounced). Translated in Phase II of the coding procedure, this behavior is identified as "joy". How slight or pronounced the smile appears is not systematically codeable. One might speculate that these gradations in the "appearance" of the smile may be recognized differentially by the social surround.

Organizing the data into meaningful units across time and over events (affectograms) suggested differential

responding in the groups of fullterm and preterm infants.
Specifically, preterm infants showed an increased frequency
of the neutral face expression across all eliciting
conditions. If we assume the neutral expression (of which
interest is a large component) reflects higher information
processing demands, we might argue that the preterm infant
is consuming more of his energies to organize stimulation
and attempt to maintain it within optimal thresholds,
leaving less residual time to respond with other expressive
displays (Field at al, 1979; Kagan, 1978). It has been
evidenced that both preterm and fullterm infants process
visual information in a similar manner, but preterms of
comparable post conceptional age do so more slowly (Rose,
1980). To more clearly articulate this finding we wondered
if indeed this response "flattened" the preterm infant
response pattern in regard to utilizing other expression
categories. Further analyses revealed that it did not.
However, one might argue that the neutral expression emits a
less clear signal to the social surround. Various studies
have found the preterm infant to be rated less positively on
measures of behavioral organization and "readability"
(Brazelton, Koslowski & Main, 1974; Field, 1977; Field et
al, 1979). It is interesting to note here the finding by
Holmes et al (1986) that smiling infants are rated more
positively than those infants displaying a neutral face.
The literature suggests problematic interaction patterns

and differential misinterpretation by the caretaking surround in response to infants born prior to term. While the present report focussed upon infant expressive behaviors, we know affective behavior in early infancy is a system of communication between mother and infant, communication before verbal language. Not only is it important then to systematically look at what mothers bring to the interactional dialogue but also their interpretation of behavior they identify within their own infant. Russell (1987) suggests mother dominant patterns of interaction decrease with age as infant dominance increases. It is at later ages we might expect to find the majority of differences among the groups of mother-infant pairs. New areas of difference may evolve as the infant matures and embraces more complex forms of behavior (Holmes, Reich & Pasternak, 1984).

Finally, if one accepts the theoretical position that facial expressivity is essentially "hard-wired" at birth (stemming from the universality of facial expression) findings here indicate that differences between our groups of preterm and fullterm infants do not lie in this early structure of affective life. Only the involuntary (spontaneous) expression system can be assumed to be operative in early infancy. Comparatively, voluntary expressions are learned behaviors controlled by neural pathways that are different from the preprogrammed and

interconnected systems that mediate involuntary emotion expressions. Consistent with LeDoux's (1987) concept of a subcortical emotion activation system, the central program operative in spontaneous expression need not involve the neocortex. Specifically, there is more involvement of the limbic and extrapyramidal circuits in involuntary expression, whereas, motor cortex and the pyramidal tract are relatively more involved in voluntary expression. Basch (1976) concluded that neurophysiological studies have corroborated that early affective behavior is autonomic and under direct control of subcortical structures. We are born then with the basic requirement for a complex social existence. As indexed by the second to second changes in facial musculature, this early affective system appears intact in our sample of preterm and fullterm infants. Research efforts with groups of older infants must clarify how the developing expression system is impacted by cognitive, motoric, and experiential changes as biological determination loosens its control as the infant matures.

CONCLUSION

        In conclusion, there are two important and related

themes, one substantive the other methodological, to be

drawn from the present study. It has been demonstrated that

infant facial expression is sensitive to eliciting event

(contextual cues). Examined within the context of mother-

infant interaction, the infant's use of the expression

categories varied in response to mother's interactional

attempts. Significant findings were consistent with

expectation. The infants' facial patterning varied in the

expected direction in response to the changing eliciting

conditions presented them. When mother's behavior was

playful and interactive there was an increased frequency of

coding a positive facial display for the infant, in

comparison to when mother's behavior was atypical and/or

noninteractive.

        The researcher can now fit this kind of precise

information about the infant's affective repertoire as it

relates to a host of important developmental issues. To

illustrate the value of a study of this type, recall the

suggestion that the interest expression (assumed related to

a state of processing in the young infant) plays a

significant role in cognitive development. Specifically,

the perception of novel events activates interest, interest

motivates exploration, exploration leads to surprise,

surprise and interest interact to heighten attention and
further exploration (Charlesworth, 1969). In other words, a
particular emotion experience (interest, surprise, etc.)
allows for concomitant cognitive processing, thereby
increasing the infants ability to act appropriately and cope
with situational demands. While it is not suggested that
the present investigation has offered any specific
description of the infant's cognitive development (as it
relates to discrete patterns of emotional response), what
has been shown is that the window of opportunity is open to
learn more about the role of discrete emotions in individual
development (cognitive, social, experiential). If
expressive behavior causes or contributes to the activation
of emotion feeling (the facial feedback hypothesis) then the
examination of the infant's expressive repertoire has an
even wider relevance. Precise information about the
infant's displays of emotion could prove valuable to ongoing
research efforts attempting to construct theoretical models
of affective meaning for the infant (Mahler, 1975; Stern,
1990).

It was surprising to find so little difference in the
facial patterns displayed by the present sample of preterm
and fullterm infants. Perhaps the early structure of the
infant's affective system is intact within these groups,
with new areas of difference to emerge as the infant
matures. For this reason, it is important to study groups

of older infants as they embrace more complex forms of
behavior. In addition, the level of prematurity as
identified in the present investigation may not have been
severe enough to produce differences in facial expression,
underscoring the need to investigate facial expressivity
in groups of other atypical infants and children. Finally,
possibly coding the frequency of the discrete categories of
emotion will not produce differential responding.
Differences might be expected to emerge in the sequential
patterning or timing of the infant's facial displays. Such
information was unable to be determined within the context
of the present analysis.

While the coding instrument utilized in the present
investigation has proven sensitive to environmental
constraint, it would be helpful to systematically code
intensities (gradations) of the muscle activity involved in
the display of the discrete categories of emotion.
Extending the present technologies for coding facial
expression to include more fine grain descriptions would
lend valuable information to emotion identification.
Clearly, one might argue that such information is inherently
involved in the perception of the infant's affective
capabilities (i.e., "readability"). Central to the
perception of the infant is the dynamics of the social
surround as it relates to infant affectivity. The mother-
infant dyad has been established as the model context within

which to explore salient issues involved in the process of
development. Exciting possibilities for future research
endeavors exist in examining the dyad in terms of each of
the component levels of emotion (physiological, behavioral,
experiential). For example, in determining the facial
patterns of emotion observed in mothers and their infants,
research can extend our current understanding of infant
affectivity by enriching the base to explore future
emotional experience as it is observed within the dyad.

The work on infant facial expressivity has brought new
sophistication and precision in handling affective phenomena
with implications for assessment of the emotions much
earlier in infancy. Taken together, data from a wide
variety of sources suggest the empirical base is
strengthening to take infant affect seriously. When an
infant displays an identical pattern of facial expression as
that observed in an older child or adult, we must be
increasingly willing to describe the pattern as "affective".
For example, when the brows are drawn together and sharply
lowered, the eyes squinted, and the mouth square and open,
the discrete category of emotion displayed is anger. It is
not a huge inferential leap to suggest the infant is
experiencing something at this moment (as in this example
something inherently aversive or punishing). The present
report has evidenced the adaptive importance of the
affective system, with the infant entering the world well

equipped to process affective stimulation and to begin to communicate his/her own emotional states. In regard to the emotions then, "acknowledging the infant's full biological heritage is an attempt to allow the human infant full membership into the human species" (Demos, 1990).

Appendix 1

CODING SHEET WITH EXAMPLE SCORING

APPENDIX 1

S#	G	TC	Age	EV	CLOCK	BR	CLOCK		CLOCK	E/N/C	CLOCK		CLOCK	M	CLOCK

APPENDIX 1

S#	G	TC	Age	EV	CLOCK	BR	CLOCK		CLOCK	E/N/C	CLOCK		CLOCK	M	CLOCK
			2 Mo	1	11.21.11	0	11.21.38		11.21.11	0	11.21.39		11.21.11	0	11.21.19
					11.21.38	20	11.21.43		11.21.39	31	11.21.40		11.21.19	58	11.21.20
									11.21.40	0	11.21.43		11.21.20	52	11.21.21
													11.21.21	0	11.21.43
			2 Mo	2	11.23.54	0	11.24.14		11.23.54	0	11.24.26		11.23.54	51	11.24.03
					11.24.14	24	11.24.16						11.24.03	59A	11.24.09
					11.24.16	0	11.24.26						11.24.09	51	11.24.19
													11.24.19	0	11.24.20
													11.24.20	51	11.24.23
													11.24.23	57	11.24.24
													11.24.24	50	11.24.26
			2 Mo	3	11.24.30	0	11.24.43		11.24.30	0	11.25.04		11.24.30	58	11.24.31
					11.24.43	24	11.24.46						11.24.31	51	11.24.33
					11.24.46	0	11.25.04						11.24.33	59A	11.24.37
													11.24.37	0	11.24.39
													11.24.39	51	11.24.42
													11.24.42	NC/62	11.24.45
													11.24.45	0	11.24.51
													11.24.51	59A	11.24.53
													11.24.53	0	11.24.58
													11.24.58	50/66	11.25.00
													11.25.00	0	11.25.02
													11.25.02	51	11.25.04

Appendix 2

EXPRESSION TRANSLATION SHEET

APPENDIX 2

TAPE CODE

S	EXP.	S	EXP.	S	EXP.	S	EXP.
1		11		21		31	
2		12		22		32	
3		13		23		33	
4		14		24		34	
5		15		25		35	
6		16		26		36	
7		17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

S	EXP.	S	EXP.	S	EXP.	S	EXP.
1		11		21		31	
2		12		22		32	
3		13		23		33	
4		14		24		34	
5		15		25		35	
6		16		26		36	
7		17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

S	EXP.	S	EXP.	S	EXP.	S	EXP.
1		11		21		31	
2		12		22		32	
3		13		23		33	
4		14		24		34	
5		15		25		35	
6		16		26		36	
7		17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

APPENDIX 2

TAPE CODE

S		EXP.	S		EXP.	S		EXP.	S		EXP.
1	0 0 0		11	0 0 0	IEH	21	0 0 0	IEH	31	20 0 0	
2	0 0 0		12	0 0 0	IEH	22	0 0 0		32	20 0 0	
3	0 0 0		13	0 0 0		23	0 0 0		33		
4	0 0 0		14	0 0 0		24	0 0 0		34		
5	0 0 0		15	0 0 0		25	0 0 0		35		
6	0 0 0		16	0 0 0		26	0 0 0		36		
7	0 0 0		17	0 0 0		27	0 0 0		37		
8	0 0 0		18	0 0 0		28	20 0 0		38		
9	0 0 58		19	0 0 0		29	20 31 0		39		
10	0 0 52		20	0 0 0		30	20 0 0		40		

S		EXP.	S		EXP.	S		EXP.	S		EXP.
1	0 0 51		11	0 0 59A	P/IE	21	24 0 51	IE	31	0 0 0	
2	0 0 51		12	0 0 59A	P/IE	22	24 0 51		32	0 0 50	
3	0 0 51		13	0 0 59A	P/IE	23	0 0 51		33		
4	0 0 51		14	0 0 59A	P/IE	24	0 0 51		34		
5	0 0 51		15	0 0 59A	P/IE	25	O O 51		35		
6	0 0 51		16	0 0 51	IEH	26	0 0 0		36		
7	0 0 51		17	0 0 51		27	0 0 51		37		
8	0 0 51		18	0 0 51		28	0 0 51		38		
9	O O 51		19	0 0 51		29	0 0 51		39		
10	0 0 59A		20	0 0 51		30	0 0 57		40		

S		EXP.	S		EXP.	S		EXP.	S		EXP.
1	0 0 58		11	0 0 51		21	0 0 0	IEH	31	0 0 0	
2	0 0 51		12	0 0 51	IEH	22	0 0 59A	P/IE	32	0 0 0	
3	0 0 51		13	0 0 NC/62	P/CL	23	0 0 59A		33	0 0 51	
4	0 0 59A		14	24 0 NC/62	IE/CL	24	0 0 0		34	0 0 51	
5	0 0 59A		15	24 0 NC/62	IE/CL	25	0 0 0		35		
6	0 0 59A		16	24 0 0	IE/P	26	0 0 0		36		
7	0 0 59A		17	0 0 0	IEH	27	0 0 0		37		
8	0 0 0		18	0 0 0	IEH	28	0 0 0		38		
9	0 0 0		19	0 0 0	IEH	29	0 0 50/66		39		
10	0 0 51		20	0 0 0	IEH	30	0 0 50/66		40		

Appendix 3

EXPRESSION IDENTIFICATION: PHASE 2 CODING

APPENDIX 3

Expression Identification: Phase 2 Coding

1.   Numerical Codes recorded for the 3 regions of the
     face: BROW, EYES, MOUTH (See Figure 4).

2.   The numerical codes recorded for the 3 facial
     regions (brow, eyes, mouth) were transposed to
     display a single occurrence of facial expression
     for each second of coded   material. An example:

          0   /0   /20   =   interest (IE)
          BROW   EYES   MOUTH

3.   The rules for the expressions actually recorded in
     the present study are described here:

          ENJOYMENT   (EJ)

          INTEREST   (IE)

          SURPRISE   (SA)

          DISTRESS/PAIN   (DP)

          ANGER   (AR)

          POSITIVE BLEND   (PB)

          NEGATIVE BLEND   (NB)

          MIXED BLEND   (MB)

          NEUTRAL BLEND   (NB)

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<u>ENJOYMENT</u>

52

33 + 52 (without 20, 21, 22, 23, 24, 25, 31, 34)

<u>SURPRISE</u>

50

20 + 50

<u>DISTRESS/PAIN</u>

37

25 + 37

25 + 37 + 54

25 + 37 + 55

<u>ANGER</u>

54   (except in: 25 + 37 + 54; 42 + 54; 66 + 54)

55   (except in: 25 + 37 + 55)

25   (except in: 25 + 37; 25 + 59B; 25 + 42)

<u>INTEREST</u>

59A

65

0 + 0 + 0

0 + 0 + 51

20 + 34   (without 50)

20 + 51

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20 + 59A

20 + 65

24 + 42

34

35   (35 is coded only in the absence of any codeable

       facial signal other than 51. It may occur,

       therefore, only in the following combinations: 0

       + 35 + 0; 0 + 35 + 51; 0 + 35 + OBS; OBS + 35 + 0.

       The combination OBS + 35 + OBS is translated

       OBS.

24 + 51

34 + 51

0 + 35 + 51

51 + 66

* Izard makes distinctions between IEH (hypothesized

interest) and IEV (visual interest). These categorical

distinctions were not presently employed.

4.   Other descriptive notations:

CL =   compressed lips, not a discrete emotion

           category, but a descriptive label.

NC =   noncodeable movement

OBS =   obscured, unclear or distinct image

TN =   tongue protrusion, not a discrete emotion

           category, but a descriptive label.

/   =   a delimiter separating regions of the face

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P   =   partial expression (Blend), no codeable
expression occurs in this region of the face,
while at least one codeable expression does
occur in the other region. Because the
present sample produced so many blended
expressions, it was necessary to articulate
their occurrence in a systematic manner:

POSITIVE BLEND (PB)

1.   A partial expression was coded (P/ ___ or ___/P) as a
positive blend if codeable face was positive. EXAMPLE:
P/EJ 2. Positive Blend was coded when any 2 or more
positive expression codes were recorded. EXAMPLE:
SA/EJ

NEGATIVE BLEND (NEGB)

1.   A partial expression (P/ ___ ; ___ /P) was recorded as
a Negatove Blend if codeable face was negative.
EXAMPLE: P/DP

2.   A Negatove Blend was recorded if any 2 or more negative
expressions were coded. EXAMPLE: SD/DP

MIXED BLEND (MB)

1.   A Mixed Blend was recorded if any 2 or more NEG/POS;
NEG/NEUTRAL; POS/NEUTRAL blends occurred.

NEUTRAL BLEND (NB)

1.   If TN or CL was all that was coded with a partial.
Because Izard does not yet have expression

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determination for TN (tongue protrusion) or CL
(compressed lips), their presence was disregarded if a
full expression code had been scored, or if TN and CL
accompanied a positive or negative expression blend, I
counted only the positive or negative blend. If the TN
or CL was the only codeable movement (P/TN or P/CL)
then these were scored as Neutral Blends.

2.   The SH expression (shame) was identified as a Neutral
Blend when scored as a partial.

Appendix 4

PUBLICATIONS FROM THE INFANT DEVELOPMENT PROJECT

APPENDIX 4

The Infant Development Project conducted at Loyola University of Chicago was established by Dr. Deborah Holmes and Dr. Jill Reich. Studies published to date include:

Holmes, D.L., Reich, J.N. & Pasternak, J. (1984). The development of infants born at risk. Hillsdale, New Jersey: Lawrence Erlbaum and Associates.

Holmes, D.L., Reich, J.N. & Gyurke, J. (1989). The development of high risk infants in low risk families. In F.J. Morrison, C. Lord, & D.P. Keating (Eds.), Applied Developmental Psychology, (3). New York: Academic Press.

Holmes, D.L., Nagy, J.N., Slaymaker, F., Sosnowski, R.J., Prinz, S.M., & Pasternak, J.F. (1982). Early influences of prematurity, illness and prolonged hospitalization on infant behavior. Developmental Psychology, 18, 744-750.

Maier, R., Prinz, S., Nagy, J.N., Holmes, D.L., Slaymaker, F., & Pasternak, J.F. (1983). A note on the use of a priori cluster scores for the Brazelton Neonatal Behavior Assessment Scale. Infant Behavior and Development, 6, 299-303.

Maier, R., Holmes, D.L., Slaymaker, F., & Reich, J.N. (1984). The perceived attractiveness of preterm infants. Infant Behavior and Development, 7, 403-414.

APPENDIX 4

Holmes, D.L., Ruble, N., Kowalski, J., & Lauesen, B. (1984). Predicting quality of attachment at one year from neonatal characteristics. _Infant Behavior and Development_, _7_, 171 (abs.).

Reich, J.N., Holmes, D.L., Slaymaker, F., Lauesen, B., & Gyurke, J. (1984). Infant assessments as predictors of 3-year I.Q. _Infant Behavior and Development_, _7_, 171 (abs.).

Holmes, D.L., Reich, J.N., & Lauesen, B. (1986). Infant attractiveness and adult response. _Infant Behavior and Development_, _9_, 173 (abs.).

Holmes, D.L., Reich, J.N., & Rieff, M.L. (1988). Kindergarten achievement of children born at risk. _Canadian Journal of Psychology_, _42_, 189-200.

REFERENCES

Adamson, L. & Bakeman, R. (1982). Affectivity and reference: Concepts, methods, and techniques in the study of communication development of 6-18 month old infants. In T.M. Field & A. Fogel (Eds.), Emotion and early interaction. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Ainsworth, M.D.S., & Bell, S.M. (1970). Attachment, exploration, and separation: Illustrated by the behavior of one-year-olds in a strange situation, Child Development, 41, 49-67.

Ainsworth, M.D. & Wittig, B.A. (1969). Attachment and exploratory behaviors of one-year-olds in a strange situation. In B.M. Foss (Ed.), Determinants of infant behavior: Vol. 4. London: Methven.

Als, H., Tronick, E.Z., & Brazelton, T.B. (1979). Analyses of face-to-face interaction in infant-adult dyads. In M.E. Lamb, S.J. Suomi, & G. R. Stephenson (Eds.), Social interaction analysis: Methodological issues. Madison: University of Wisconsin Press.

Bakeman, R. & Brown, J. (1977). Perinatal risk, mother-infant interaction and early developmental outcome of preterm and fullterm infants. Paper presented at the Society for Research in Child Development.

Bakeman, R. & Brown, J. (1979). <u>Early interaction consequence for social and mental development at 3 years</u>. Paper presented at the biennial meeting of the Society for Research in Child Development, San Francisco. Calif.

Basch, M.F. (1976). The concept of affect: A reexamination. <u>Journal of the American Psychoanalytic Association</u>, <u>24</u> (4), 759-776.

Bayley, N. (1969). <u>Bayley scales of infant development: Birth to two years</u>. New York: Psychological Corporation.

Boukydis, Z. C. (1981). Adult perception of infant appearance: A review. <u>Child Psychiatry and Human Development</u>, <u>11</u> (4), 241-255.

Bower, G.H. (1981). Emotional mood and memory. <u>American Psychologist</u>, <u>36</u>, 129-148.

Bradshaw, D.L., Campos, J.J., & Klinnert, M.D. (1986). <u>Emotional expressions as determinants of infants' immediate and delayed responses to prohibitions</u>. Paper presented at the 5th international conference on Infant Studies, Los Angeles, Calif.

Brazelton, T.B. (1973). <u>Neonatal behavioral assessment scale</u>. Philadelphia: J.B. Lippincott Co.

Brazelton, T.B. & Bertrand, G.C. (1990). <u>The earliest relationship</u>. Reading, Mass.: Addison-Wesley Lawrence.

Brazelton, T.B., Koslowski, B., & Main, M. (1974). The origins of reciprocity: The early mother-infant interaction. In M. Lewis & L.A. Rosenblum (Eds.), <u>The effect of the infant on its caregiver</u>. New York: Wiley and Sons, Inc.

Brazelton, T.B., Tronick, E., Adamson, L., Als, H., & Wise, S. (1975). Early mother-infant reciprocity. In M.A. Hofer (Ed.), <u>The parent-infant relationship</u>. London: Ciba.

Bretherton, I., Fritz, J., Zahn-Waxler, C. & Ridgeway, D. (1986). Learning to talk about emotions: A functionalist perspective. <u>Child Development</u>, <u>57</u>, 529-548.

Broussard, E.R., & Hartner, M.S. (1970). Maternal perception of the neonate as related to development. <u>Child Psychiatry and Human Development</u>, <u>1</u>, 16-25.

Butterfield, P.M. (1986). <u>Parental perception of infant emotions</u>. Paper presented at the International Conference on Infant Studies, Los Angeles, Calif.

Cairns, R.B. (1933). (Ed.) <u>The analysis of social interactions</u>. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Campos, J.J. & Barrett, K.C. (1984). Toward a new understanding of emotions and their development. In C.E. Izard, J. Kagan, & R.B. Zajonc (Eds.), <u>Emotions, cognitions and behavior</u>. Cambridge: Cambridge University Press.

Campos, J.J., Barrett, K., Lamb, M.E., Goldsmith, H.E. & Stenberg, C. (1983). Socioemotional development. In M.M. Harth & J.J. Campos (Eds.), P.H. Mussen (Series Ed.), Handbook of child psychology: Vol. 2, infancy and developmental psychology, 783-915. New York: Wiley and Sons, Inc.

Campos, J.J., Emde, R., & Hiatt, S. (1979). Social patterning and infant emotional expression: Happiness, surprise and fear. Child Development, 50, 1020-1035.

Cannon, W.P. (1927). The James-Lange theory of emotions: A critical examination and an alternative theory. American Journal of Psychology, 37, 106-124.

Caron, A.J., Caron, R.F., & Meyers, R.S. (1982). Do infants see emotional expressions in static faces? Child Development, 56, 1552-1560.

Caron, A.J., Caron, R.F., & Maclean, D.J. (1988). Infant discrimination of naturalistic expressions: The role of face and voice. Child Development, 59, 604-616.

Carpenter, G.C. (1974). Visual regard of moving and stationary faces in early infancy. Merrill-Palmer Quarterly, 20, 181-194.

Charlesworth, W.R. (1969). The role of surprise in cognitive development. In D. Elkind & J.H. Flavell (Eds.), Studies in cognitive development, New York: Oxford University Press.

Charlesworth, W.R. (1982). An ethological approach to research on facial expressions. In C.E. Izard (Ed.), <u>Measuring emotions in infants and children</u>. New York: Cambridge University Press.

Charlesworth, W.R. & Kreutzer, M.A. (1973). Facial expressions in infants and children. In P. Ekman (Ed.), <u>Darwin and facial expression: A century of research in review.</u> New York: Academic Press.

Cichetti, D. & Pogge-Hesse, P. (1981). The relation between emotion and cognition in infant development. In M.E. Lamb & L.R. Sherrod (Eds.), <u>Infant social cognition</u>. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Cichetti, D., & Sroufe, L.A. (1978). An organizational view of affect: Illustration from the study of down's syndrome infants. In M. Lewis & L.A. Rosenblum (Eds.), <u>The development of affect</u>. New York: Plenum Press.

Cohen, L.B., Izard, C.E., Simons, .(1986, October). <u>Facial and physiological indices of emotions in mother-infant interactions</u>. Paper presented at the Society for Psychophysiological Research, Montreal, Canada.

Cohen, L.B., & Salapatek, P. (1975). <u>Infant preception: From sensation to cognition.</u> New York: Academic Press.

Cohn, J.F., & Tronick, E.Z. (1983). Three-month old infants' reactions to simulated maternal depression. <u>Child Development</u>, <u>54</u>, 185-193.

Cohn, J.F., & Tronick, E.Z. (1987). Mother-infant face-to-face interaction: The sequence of dyadic states. Developmental Psychology, 23, 66-77.

Cole, P.M. (1986). Children's spontaneous control of facial expression. Child Development, 57, 1309-1321.

Darwin, C. (1872). The expression of the emotions in man and animals. London: Murray. (Reprinted: Philosophical Library, New York, 1955).

DeCasper, A.J., & Carstens, A.A. (1981). Contingencies of stimulation: Effects on learning and emotion in neonates. Infant Behavior and Development, 4, 19-35.

Demos, E.V. (1988). Affect and the development of the self: A new frontier. In A.G. Goldberg, (Ed.), Frontiers in self psychology: Progress in self psychology, Volume 3. Hillsdale, N.J.: Analytic Press.

Divitto, B., & Goldberg, S. (1979). The development of parent-infant interaction as a function of newborn medical status. In T. Field, A.M. Sostek, S. Goldberg, & H.H. Shuman (Eds.), Infants born at risk: Behavior and development. New York: SP Medical and Scientific Books.

Donohew, L., Sypher, H.E. & Higgens, T.E. (1988). Communication, social cognition, and affect. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Dubowitz, L., Dubowitz, V., & Goldberg, C. (1973). Clinical
    assessment of gestational age in the newborn infant.
    <u>Journal of Pediatrics</u>, <u>77</u>, 1-10.

Eible-Eibesfeldt, I. (1972). Similarities and differences
    in facial expression of emotion. In R. A. Hinde (Ed.),
    <u>Nonverbal communication</u>. Cambridge, Mass.: Cambridge
    University Press.

Eimas, P.D., Siqueland, E.R., Juszzk, P., & Vigouto, J.
    (1971). Speech perception in early infancy. <u>Science</u>,
    <u>17</u>, 303-306.

Eisenberg, R.B. (1976). <u>Auditory competence in early life</u>.
    Baltimore: University Park Press.

Ekman, P. (Ed.). (1972). <u>Darwin and facial expression: A
    century of research in review</u>. New York: Academic
    Press.

Ekman, P. (1972). Universal and cultural differences in
    facial expression of emotion. <u>Nebraska Symposium on
    Motivation</u>, <u>19</u>, 207-283.

Ekman, P., & Friesen, W.V. (1975). <u>Unmasking the face: A
    guide to recognizing emotions from facial cues</u>.
    Englewood Cliffs, N.J.: Prentice Hall.

Ekman, P., & Friesen, W.V. (1976). Measuring facial
    movement. <u>Environmental Psychology and Human Behavior</u>,
    <u>1</u>, 56-75.

Ekman, P., Friesen, W.V., & Ellsworth, P. (1972). <u>Emotion in
    the human face</u>. New York: Pergamon Press.

Ekman, P., Levenson, R.W., & Friesen, W.V. (1983).
Autonomic nervous system activity distinguishes among
emotions. Science, 221, 1208-1210.

Ekman, P., Sorenson, E.R., & Friesen, W.V. (1969). Pan-
cultural elements in facial displays of emotion.
Science, 164, 86-88.

Ellsworth, C., & Gusella, J. (1988, April). Maternal
perception and understanding of infants' emotional
signals. Paper presented at the 6th Biennial
International Conference on Infant Studies, Washington,
D.C.

Emde, R. (1980). Levels of meaning for infant emotions: A
biosocial review. In W.A. Collins (Ed.), Development
of cognition, affect, and social relations. The
Minnesota symposia on child psychology (Vol. 13).
Hillsdale, N.J.: Lawrence Erlbaum Associates.

Emde, R.N. (1980). Toward a psychoanalytic theory of
affect: II. Emerging models of emotional development in
infancy. In S.D. Greenspan & G. Pollock (Eds.), The
course of life: Psychoanalytic contributions toward
understanding personality development, Vol. 1: Infancy
and early childhood. Washington, D.C.: National
Institutes of Mental Health.

Emde, R.N. (1981). Changing models of infancy and the nature
of early development: Remodeling the foundation.
Jouranl of the American Psychoanalytic Association, 29
(1), 179-219.

Emde, R.N., Gaensbauer, T.J., & Harmon, R.J. (1970).
Emotional expression in infancy: A biobehavioral study.
Psychological Issues, Monograph Series, 10 (37).

Emde, R., & Harmon, R.J. (1982). The development of
attachment and affiliative systems. New York: Plenum
Press.

Ewy, R. (1988). Relationships between infant smiles and
infant vocalizations in normal mother-infant
interaction. Paper presented at the International
Conference on Infant Studies, Washington, D.C.

Fagan, J.F. (1979). The origins of facial pattern
recognition. In M.H. Bornstein & W. Kessen (Eds.),
Psychological development from infancy. Hillsdale,
N.J.: Lawrence Erlbalum Associates.

Fantz, R.L., Fagan, J.F., & Miranda, S.B. (1975). Early
visual selectivity: As a function of pattern variable,
previous exposure, age from birth and conception, and
expected cognitive deficit. In L.B Cohen & P.
Salapatek (Eds.), Infant perception: From sensation to
cognition, (1). New York: Academic Press.

Field, T.M. (1977). Effects of early separation, interactive deficits, and experimental manipulations on infant-mother face-to-face interaction. Child Development, 48, 763-771.

Field, T.M. (1979). Interaction patterns of preterm and term infants. In T.M. Field, A.M. Sostek, & H.H. Shuman (Eds.), Infants born at risk: Behavior and development. New York: SP Medical & Scientific Books.

Field, T.M. (1981). Gaze behavior of normal and high-risk infants during early enteractions. Journal of the American Academy of Child Psychiatry, 20, 308-317.

Field, T.M., & Fogel, A. (Eds.). (1982). Emotion and early interaction. Hillsdale, N.J.: Erlbaum.

Field, T.M., Healy, B., Goldstein, S., Perry, S., & Bendell, D. (1988). Infants of depressed mothers show "depressed" behavior with non-depressed adults. Paper presented at the International Conference on Infant Studies, Washington, D.C.

Field, T.M., Sostek, A.M., Goldberg, S. & Shuman, H.H. (Eds.). (1979). Infants born at risk: Behavior and development. New York: SP Medical and Scientific Books.

Field, T.M., Vega-Hahr, N., Scafadi, F., & Goldstein, S. (1986). Effects of maternal unavailability on mother-infant interaction. Infant Behavior and Development, 9, 473-480.

Field, T.M., Woodson, R., Cohen, R., Greenberg, R., Garcia, R. & Collins, K. (1983). Discrimination & imitation of facial expressions by term & preterm neonates. Infant Psychiatry & Development, 6, 485.

Fogel, A. (1982). Early adult-infant face-to-face interaction: Expectable sequences of behavior. Journal of Pediatric Psychology, 7, 1-22.

Fox, N., & Davidson, R. (1984). The psychobiology of affective development. In K. R. Scherer, & P. Ekman (Eds.), Approaches to emotion. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Freedman, D.G. (1964). Smiling in blind infants and the issue of innate vs. acquired. Journal of Psychology and Psychiatry, 5, 171-184.

Freud, S. (1915). Instincts and their visissitudes: Standard edition (vol. 4). London: Hogarth Press.

Frodi, A.M., Lamb, M.E., Leavitt, L.A., & Donovan, W.L. (1978). Fathers' and mothers' responses to infant smiles and cries. Infant Behavior and Development, 1, 187-198.

Ganchrow, J.R., Steiner, J.E., & Daker, M. (1983). Neonatal facial expressions in response to different qualities and intensities of gustatory stimuli. Infant Behavior and Development, 6, 473-484.

Goldberg, S. (1977). Social competence in infancy: A model of parent-infant interaction. <u>Merrill-Palmer Quarterly</u>, <u>23</u>, (3), 164-177.

Goldberg, S. (1979, March/April). Premature birth: Consequences for the parent-infant relationship. <u>American Scientist</u>, 68-74.

Gordon, R.M. (1987). The structure of emotions. Cambridge: Cambridge University Press.

Gunnary, M., & Thelen, E. (1989). Systems and development. The Minnesota Symposia on Child Psychology, Volume 22, Hillsdale, N.J.: Laurence Erlbaum Associates.

Gusella, J.L., Muir, D., & Tronick, E.L. (1988). The effects of manipulating maternal behavior during an interaction on 3 and 6 month old affect and attention. <u>Child Development</u>, <u>59</u>, 1111-1124.

Haaf, R.A. & Bell, R.Q. (1967). A facial dimension in visual discrimination by human infants. <u>Child Development</u>, <u>38</u>, 895-899.

Harth, M.M. (1966). The response of the human newborn to visual movement. <u>Journal of Experimental Child Psychology</u>, <u>3</u>, 235-243.

Haviland, J.M. & Lelwica, M. (1987). The induced affect response: 10-week-old infants' responses to 3 emotional expressions. <u>Developmental Psychology</u>, <u>23</u>, 97-104.

Hildebrandt, K., & Fitzgerald, J. (1979). Facial feature determinants of preceived infant attractiveness. Infant Behavior and Development, 2, 329-339.

Holmes, D.L., Reich, J.N., & Lauesen, B.F. (1986). Infant attractiveness and adult response. Paper presented at the International Conference on Infant Studies.

Holmes, D., Reich, J., & Pasternak, J. (1984). The development of infants born at risk. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Hornick, R., Risenhoover, N., & Gunnar, M. (1987). The effects of maternal positive, neutral, and negative communications on infant responses to new toys. Child Development, 58, 937-944.

Hue, J.W., Dostrovsky, J.O., & Sersle, B.J. (1981). Functional properties of neurons in cat trigeminal subnucleus caudals (medullary dorsal horn). Responses to roal-facial noxious and nonnoxious stimuli and projections to thalamus and subnucleus oralis. Journal of Neurophysiology, 5, 173-192.

Izard, C.E. (1971). The face of emotion. New York: Appleton- Century Crofts.

Izard, C.E. (1972). Patterns of emotions: A new analysis of anxiety and depression. New York: Academic Press.

Izard, C.E. (1977). Human emotions. New York: Plenum Press.

Izard, C.E. (1979/R 1983). The maximally discriminative facial movement coding system (MAX). Neward, D.E.: Instructional Resources Center.

Izard, C.E. (1982). Measuring emotions in infants and young children. New York: Cambridge University Press.

Izard, C.E. (1990). Facial expressions and the regulation of emotions. Journal of Personality and Social Psychology, 58 (3), 487-498.

Izard, C.E., Hembree, E.A., Dougherty, L.M., & Spizzuri, C. (1983). Changes in 2-19 month old infants' responses to acute pain. Developmental Psychology, 6, 473-484.

Izard, C.E., Huebner, R., Riser, D., McGuiness, G., & Dougherty, L. (1980). The young infant's ability to produce discrete emotion expressions. Developmental Psychology, 16, 132-140.

Izard, C.E., Kagan, J., & Zajone, R. (Eds.). Emotions, cognitions and behavior. New York: Cambridge University Press.

James, W. (1890). Principles of psychology. New York: Dover.

Johnson, R.S., Trulsson, M., Olsson, K.A., & Abbs, J.H. (1988). Mechanoreceptor afferent activity in the infraorbital nerve in man during speed and chewing movements. Experimental Brain Research, 72, 209-214.

Kagan, J. (1978). On emotions and its development: A working paper. In M. Lewis & L.A. Rosenblum (Eds.), The development of affect. New York: Plenum Press.

Kagan, J. & Lewis, M. (1965). Studies of attention in the human infant. Merrill-Palmer Quarterly, 11, 95-127.

Karger, R.H. (1979). Synchrony in mother-infant interactions. Child Development, 50, 882-885.

Klinnert, M. (1984). The regulation of infant behavior by maternal facial expression. Infant Behavior and Development, 7, 447-465.

Langsdorf, P., Izard, C.E., Raycas, M., Hembree, E.a. (1983). Changes in facial expressions of 2-19 month-old infants following acute pain. Developmental Psychology, 19, 418-426.

Laszlo, E. (1972). Introduction to systems phylosophy. New York: Harper & Row.

Lanzedta, J.T., Cartwright-Smith, J.E., & Kleck, R.E. (1976). Effects of nonverbal dissimulation of emotional experience and autonomic arousal. Journal of Personality and Social Psychology, 33, 354-370.

LeDoux, J.E. (1987). Emotion. In F. Plum (Ed.), Handbook of physiology: The nervous system, Vol. 1.

Lewis, M., & Goldberg, S. (1969). Perceptual-cognitive development in infancy: A generalized expectancy model as a function of the mother-infant interaction. Merrill-Palmer Quarterly, 15, 81-100.

Lewis, M. & Michaelson, R. (1983). <u>Children's emotions and moods: Developmental theory and measurement</u>. New York: Plenum Press.

Lewis, M., & Rosenblum, L.A. (Eds.). (1977). <u>Interaction conversation and the development of language.</u> New York: John Wiley and sons.

Lewis, M., & Rosenblum, L.A. (1978). <u>The development of affect.</u> New York: Plenum Press.

Lewis, M., & Rosenblum, L.A. (Eds.). (1979). <u>The child and its family.</u> New York: Plenum Press.

Mahler, M., Pine, F., & Bergman, A. (1975). <u>The psychological birth of the human infant.</u> New York: Basic Books.

Maier, R., Holmes, D., Slaymaker, F., & Reich, J. (1984). The perceived attractiveness of preterm infants. <u>Infant Behavior and Development</u>, <u>6</u>, 299-303.

Malatesta, C.Z. (1985). Developmental course of emotion expression in the human infant. In G. Zivin (Ed.), <u>The development of affect</u>. New York: Plenum Press.

Malatesta, C.Z., & Haviland, J.M. (1986). Signals, Symbols, and socialization: The modification of emotional expression in human development. In M. Lewis & C. Saarni (Eds.), <u>The socialization of affect</u>. New York: Plenum Press.

Moss, H.A., & Robson, K.S. (1968). The role of protest behavior in the development of the mother-infant attachment. Paper presented at the meeting of the American Psychological Association, San Francisco.

Matsumo, D. (1987). The role of facial response in the experience of emotion. More methodological problems and a meta-analysis. Journal of Personality and Social Psychology, 52, 769-774.

Oster, H. (1977). The structure of infant facial behavior. Paper presented at the Biennial Meeting of the Society for Research in Child Development, New Orleans.

Oster, H. (1978). Facial expression and affect development. In M. Lewis & L. Rosenblum (Eds.), The development of affect. New York: Plenum Press.

Oster, H. (1978). Measuring facial movement in infants. In P. Ekman & W. V. Friesen (Eds.), Analyzing facial action. New York: Plenum Press.

Parmelee, A.H., & Haber, A. (1973). Who is the "risk infant"? Clinical Obstetrics and Gynecology, 167, 376-387.

Piaget, J. (1952). The origins of intelligence in children. New York: International Universities Press.

Piaget, J. (1954). The construction of reality in the child. New York: Basic Books.

Plutchik, R., & Kellerman, H. (Eds.). (1983). <u>Emotions in early development Vol. 2: The emotions</u>. New York: Academic Press.

Ritter, J.M., Langlois, J.H., & Rita, J.C. (1988). <u>Adults' responses to infants varying in appearance, of age and attractiveness</u>. Paper presented at the International Conference on Infant Studies.

Rusalova, M.N., Izard, C.E., & Simonov, P.V. (1975). Comparative analysis of mimical and autonomic components of man's emotional state. <u>Avaiation, Space and Environmental Medicine</u>, <u>46</u>, 1132-1134.

Salapatek, P., & Kessen, W. (1966). Visual scanning of triangles by the human newborn. <u>Journal of Experimental Child Psychology</u>, <u>3</u>, 155-167.

Sameroff, A.J., & Chandler, M. (1975). Reproductive risk and the continuum of caretaking casuality. In F. Horowitz (Ed.), <u>Review of child development research</u>. Chicago, University of Chicago Press.

Sameroff, A.J., & Emde, R.N. (Eds.). (1989). <u>Relationship disturbances in early childhood</u>. New York: Basic Books.

Schachter, S., & Singer, J.E. (1962). Cognitive, social, and psychological determinants of emotional state. <u>Psychological Review</u>, <u>69</u> (5), 379-398.

Schaffer, H.R. (Ed.) (1977). <u>Studies in mother-infant interaction</u>. London: Academic Press.

Scherer, R.R., & Ekman, P. (Eds.). (1984). Approaches to emotion. Hillsdale, N.J.: Erlbaum.

Schwartz, A., Campos, J., & Baisel, E. (1973). The visual cliff: Cardiac and behavioral correlates on the deep and shallow sides at 5 and 9 months of age. Journal of Experimental Psychology, 15, 86-99.

Shiller, V.M., Izard, C.E., & Hembree, E.A. (1986). Patterns of emotion expression during separation in the strange-situation procedure. Developmental Psychology, 22 (3), 378-382.

Stenberg, C., Campos, J.J., & Emde, R.N. (1983). The facial expression of anger in 7 month old infants. Child Development, 54, 178-184.

Stern, D. (1985). The interpersonal world of the infant. New York: Basic Books.

Stern, D. (1990). Diary of a baby. New York: Basic Books.

Stern, M., & Hildebrandt, K. (1984). A prematurity sterotype: The effects of labeling on adult perception of infants. Developmental Psychology, 20, 369-362.

Stern, M., & Karraker, K.H. (1988). The prematurity stereotype: Empirical evidence and implications for practice. Paper presented at the International Conference on Infant Studies.

Sorce, J.F., & Emde, R.N. (1982). The meaning of infant emotional expressions: Regularities in caregiving responses in normal and Down's syndrome infants. Journal of Child Psychology and Psychiatry, 23 (2), 145-158.

Sroufe, A. (1978). Emotional development. In J. Osofsky (Ed.), Handbook of infant development. New York: John Wiley and Sons.

Sroufe, A., & Waters, E. (1976). The ontogenesis of smiling and laughter. Psychological Review, 83 (3), 173-189.

Termine, N.T., & Izard, C.E. (1988). Infants' responses to their mothers' expressions of joy and sadness. Developmental Psychology, 24 (2), 223-229.

Thoman, E.B., Acebo, C., Dreyer, C.A., Becker, P.T., & Freese, M.P. (1979). Individuality in the interactive process. In E.B. Thoman (Ed.), Origins of the infant's social responsiveness. New York: John Wiley and Sons.

Thompson, R.A., (1989). Causal attributions and childrens' emotional understanding. In C. Saarni & P. L. Harris (Eds.), Childrens understanding of emotions. New York: Cambridge University Press.

Tomkins, S. (1962). Affect imagery, consciousness, Vol. I: The positive affects. New York: Springer

Tomkins, S. (1963). Affect, imagery, consciousness, Vol. II: The negative affect. New York: Springer.

Tomkins, S.S. (1982). <u>Affect and consciousness, Vol. III:</u> <u>Cognition and affect</u>. New York: Springer.

Trehub, S.E., & Rabinovitch, M.S. (1972). Auditory-linguistic sensitivity in early infancy. <u>Developmental Psychology</u>, <u>6</u>, 74-77.

Tronick, E. (Ed.) (1982). <u>Social interchange in infancy:</u> <u>Affect, cognition and communication</u>. Baltimore: University Park Press.

Tronick, E.Z., Ricks, M., & Cohn, J.F. (1982). Maternal and infant affective exchange: Patterns of adaptation. In T.M. Field & A. Fogel (Eds.), <u>Emotional early</u> <u>interaction</u>. Hillsdale, NJ: Lawrence Erlbaum Associates.

Von Bertalanoffy, L. (1968). <u>General systems theory</u>. New York: Braziller.

White, R.W. (1959). Motivation reconsidered: The concept of competence. <u>Psychological Review</u>, <u>66</u>, 297-333.

Yarrow, L.J., & Anewon, B.J. (1979). Procedures for studying parent-infant interaction: A critique. In E.B. Thoman (Ed.), <u>Origins of the infants' social</u> <u>responsiveness</u>. New York: John Wiley & Sons.

Zajonc, R.B. (1984). On the primacy of affect. <u>American</u> <u>Psychologist</u>, <u>39</u>, 102-103.

Zajonc, R.B., Murphy, S.T., & Inglehart, M. (1988). Feeling and facial efference: Implications of the vascular theory.

Zivin, G. (1985). <u>The development of expressive behavior</u>.

New York: Academic Press.

VITA

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Holmes, D.L., Reich, J.N., & Lauesen, B.F. (1986). <u>Infant</u> <u>attractiveness and adult response</u>. Paper presented at the International Conference on Infant Studies, Beverly Hills, CA.

Holmes, D.L., Ruble, N., Kowalski, J., & Lauesen, B.F. (1984). <u>Predicting quality of attachment at 1 year</u> <u>from neonatal characteristics</u>. Paper presented at the International Conference on Infant Studies, New York.

Lauesen, B.F. (1985). <u>The infant care volunteer program at</u> <u>children's memoral hospital</u>. Paper presented at the Illinois Association for Infant Mental Health, Chicago, Ill.

Lauesen, B.F., Holmes, D.L., Reich, J.N., & Gyurke, J. (1984). <u>Perinatal predictors of infant's looking</u> <u>behavior in a mother-child interaction sequence at 2, 4</u> <u>and 6 months of age.</u> Paper presented at the Midwestern Psychological Association Conference, Chicago, Ill.

Morrison, F.J., Schurr, J., Foster, B.J. (1981). <u>Learning</u> <u>of regular and irregular rules in normal and disabled</u> <u>readers</u>. Paper presented at the Annual Meeting of the Society for Research in Child Development, Boston, Mass.

Reich, J.N., Holmes, D.L., Slaymaker, F.L., Lauesen, B.F., & Gyurke, J. (1984). <u>Infant assessments as predictors of</u> <u>3 year I.Q.</u> Paper presented at the International Conference on Infant Studies, New York.

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given the final approval by the Committee with reference to content and form.

The dissertation is, therefore, accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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