MOTIONS, PERSONALITY, AND PSYCHOTHERAPY

eries Editors:
arroll E. Izard, *University of Delaware, Newark, Delaware*
nd
rome L. Singer, *Yale University, New Haven, Connecticut*

urrent volumes in the series

HE COGNITIVE FOUNDATIONS OF PERSONALITY TRAITS
Shulamith Kreitler and Hans Kreitler

NDING MEANING IN DREAMS: A Quantitative Approach
G. William Domhoff

ROM MEMORIES TO MENTAL ILLNESS: A Conceptual Journey
William M. Hall

MAGERY AND VISUAL EXPRESSION IN THERAPY
Vija Bergs Lusebrink

HE PSYCHOLOGY OF EMOTIONS
Carroll E. Izard

UANTIFYING CONSCIOUSNESS: An Empirical Approach
Ronald J. Pekala

HE ROLE OF EMOTIONS IN SOCIAL AND PERSONALITY
EVELOPMENT: History, Theory, and Research
Carol Magai and Susan H. McFadden

AMPLING INNER EXPERIENCE IN DISTURBED AFFECT
Russell T. Hurlburt

AMPLING NORMAL AND SCHIZOPHRENIC INNER EXPERIENCE
Russell T. Hurlburt

/HAT DEVELOPS IN EMOTIONAL DEVELOPMENT?
Edited by Michael F. Mascolo and Sharon Griffin

What Develops in Emotional Development?

Edited by

Michael F. Mascolo
Merrimack College
North Andover, Massachusetts

and

Sharon Griffin
Clark University
Worcester, Massachusetts

Plenum Press • New York and London
1998

10

The Development of Emotion from a Social Process View

K. Laurie Dickson, Alan Fogel, and Daniel Messinger

This chapter examines the definition of emotion and how emotions develop. Although many researchers speak of the development of emotion, there is neither consensus about what emotions are nor what it means to say that they develop. These issues have been the focus of an ongoing debate between differential (Izard, 1994; Izard & Malatesta, 1987), cognitive (Frijda, 1993; Lazarus, 1991; Lewis & Brooks-Gunn, 1979; Ortony, Clore, & Collins, 1988; Sroufe, 1979, 1984), and functional approaches to emotion (Barrett, 1993; Campos, 1994; Fischer, Shaver, & Carnochan, 1990). We examine these issues from the perspective of the social process view of emotion (Fogel et al., 1992).

First, we briefly describe current definitions of emotion and various conceptualizations of emotional development. Our review is by no means exhaustive; rather, it provides a sampling of the major theories in order to illustrate unique aspects of each perspective. Second, we present the social process theory regarding the definition and development of emotion. Third, in order to illustrate social process theory's propositions, data from two

K. Laurie Dickson • Northern Arizona University, Department of Psychology, Flagstaff, Arizona 86011. **Alan Fogel** • University of Utah, Department of Psychology, Salt Lake City, Utah 84112. **Daniel Messinger** • Departments of Pediatrics and Psychology, University of Miami, Miami, Florida 33101.

What Develops in Emotional Development? edited by Michael F. Mascolo and Sharon Griffin. Plenum Press, New York, 1998.

separate research projects are discussed. In conclusion, we attempt to describe the functions of emotional change for the psychological and social life of the child.

DEFINITIONS OF EMOTION

Differential emotion theorists (Ackerman, Abe, & Izard, Chapter 4, this volume; Izard, 1977, 1991; Izard & Malatesta, 1987) link facial expressions to proposed discrete emotion categories via a relatively unidirectional relationship between internal states and facial expressions. Emotions are "a particular set of neural processes that lead to a specific expression and a corresponding specific feeling" (Izard & Malatesta, 1987, p. 496). The development of emotion is accounted for by an innate core set of emotions that emerge primarily as a function of biological change, that is, central nervous system (CNS) maturation (Izard, 1990; Izard & Malatesta, 1987; Tomkins, 1962, 1981). A "fairly predictable" maturational timetable dictates the emergence of structured whole emotions, for example, sadness, anger, and fear (Izard & Malatesta, 1987). Izard (1994) believes that emotion experience is invariant. Thus, "the task of development becomes one of learning to control state fluctuations and modulate expressivity" (Izard, 1991, p. 13). Development involves the changing connection between invariant emotions and cognition. Although the emotion per se does not change, Izard believes that environmental influences and cognitive development play a role in how emotions are displayed and appraised.

Cognitive theorists focus on the evaluative element of emotion (Frijda, 1993; Lazarus, 1991; Lewis & Brooks-Gunn, 1979; Ortony et al., 1988; Sroufe, 1979, 1984). According to cognitive emotion theorists, cognitive development mediates emotional development. These theorists differ in their definition of emotion; however, they all assume that cognitions play a primary role in emotion. Although they assume that newborns are equipped with innate reflexive expressions triggered by physiological processes, they propose that emotions require cognitions that develop over the first year of life; that is, particular developmental milestones are required for the infant to appraise the innate physiological response (Lewis & Brooks-Gunn, 1979; Sroufe, 1979). For example, infants are unable to experience anger until about 7 months due to immature cognitive functioning (Sroufe, 1984). It can be inferred that young infants are incapable of certain emotions as a result of inadequate cognitive development. However, Cicchetti and Sroufe (1976) define the relationship between emotion and cognition as interdependent rather than causal.

Rather than placing primary emphasis on either CNS maturation or cognitive development, functionalists focus on the relationship between the organism and the environment. Emotions are viewed as "processes of establishing, maintaining, or disrupting the relations between the person and the internal or external environment, when such relations are significant to the individual" (Campos, Campos, & Barrett, 1989, p. 395). Functional theorists (Barrett, 1993, Chapter 5, this volume; Barrett & Campos, 1987; Campos & Barrett, 1984) emphasize the functional implications of "emotion" movements. Emotions exist to perform specific functions that are required due to the individual–environment interface, including social, internal, and behavioral regulation. They are not tied to specific neural programs as discrete emotions; rather, emotions comprise "emotion families." Emotion processes that comprise an emotion family involve similar person–environment relationships and serve similar regulatory functions. Physiological, facial, and vocal patterns are characteristic of certain emotion families (see Barrett, 1995; Barrett & Campos, 1987).

"Development does not cause emotions, as entities, to emerge at particular ages; rather, the developmental abilities of the organism influence which particular member of an emotion family will be displayed" (Barrett, 1993, p. 163). Barrett does not view emotions as entities; therefore, they cannot be present at birth as whole entities or emerge as whole entities at particular points in development. Emotions are processes that are affected by the situation, the person's competencies, abilities, personal attributes, and the person's previous relevant experiences, and so forth. The development of emotion involves multiple factors that influence the emotion process, including cognitive development, socialization, and motor development. Barrett has used the emotion family of sadness to illustrate her point. Sadness may exist at very young ages, though the form of sadness varies with development. Thus, sadness for an infant does not exist in all of the same forms that it will at later ages. The type of person–environment interactions that could initiate sadness during early infancy are very limited, given the cognitive and motor capabilities of the young baby and the baby's limited socialization experiences. If an infant does not display the expected emotion in a specific context, it is critical not to assume that the infant is incapable of that particular emotion. The complexity of the emotion process increases logarithmically as the person develops (K. C. Barrett, personal communication, January 24, 1996). According to this view, development involves changing functions of emotion families with respect to the environment.

In summary, for differential emotion theorists, the primary determinant of emotional development is biological maturation. For cognitive theorists, the primary element of early emotional development is cognitive development. The infant requires specific cognitive milestones to appraise innate physiological responses (Lewis & Brooks-Gunn, 1979; Sroufe, 1979). For functionalists, the primary focus is on the relationship between the organism and the environment. Thus, development involves the changing functions that emotions play due to person–environment interaction.

SOCIAL PROCESS THEORY OF EMOTION

The social process theory of emotion proposes that emotions are not states but self-organizing dynamic processes created by an individual's activity in a context. A large number of constituents are involved in emotion, including patterns of CNS activation, autonomic nervous system (ANS) arousal, actions of the face, body and voice, psychological processes (such as feelings, drives, motivations and evaluations), and processes related to the transaction between individual and environment. Emotions are not discrete entities encased in the individual, but are socially constructed, dynamically created out of the constituents' interaction (Fogel et al., 1992).

What makes a behavior an emotion constituent? Behaviors are emotional when they are related to other behaviors that reflect change and maintenance of significant ongoing relationships between an organism and its environment. There are several constituents that are traditionally viewed as emotional (smiles, laughs, racing heart), but the degree to which a behavior is emotional has to do with its role in maintaining and changing organism–environment relationships. Behaviors that are not typically viewed as part of emotion by other theories may be conceptualized as an emotion constituent according to the social process view. For example, a father's tickle may be emotional because of its relationship to the emerging smile, and the smile may be emotional because of its relationship with the anticipation of the tickle and the child's gaze behavior. Also, the tickle to both the father and infant is emotionally meaningful; the tickle means fun, stimulation, physical engagement, and so forth, and therefore must be considered a constituent. How heavy the individual is breathing and the degree of physiological activation may be emotional because of their relationship to other emotion constituents. Behaviors are not emotional because of what they are; rather, it is how they occur, organize, and are organized by other components that makes phenomena emotional. This dynamic interaction constitutes the emotion process.

Given that emotion is viewed as a continuous process, what makes the emotion process different from what we call cognitive processes or motivational processes, and so on? The primary distinguishing feature is that emotion is related to that which is significant or meaningful for the individual. One of the goals of our research is to interpret how the patterns we observe are organized into a pattern of significance. Examples from Dickson (1994) illustrate this point. Evidence suggests that the infant opens his or her mouth wide during tickling episodes. The significance could be interpreted as an approach–avoidance process; being tickled is exciting and maybe even surprising, but it also causes some cringing and withdrawal from the physical stimulation and intensity of the tickling, as illustrated by the physical struggling to remove the tickling. The significance of the process (the enjoyment of it) comes from the balance of the approach and withdrawal, wanting to be tickled and not

wanting to be tickled. The dynamics and intensity can lead to an enjoyable process, a boring one, or an unpleasant one. Another example involves the significance of a surprise emotion pattern. The surprise pattern appears in various situations, including book reading, when the parent suddenly makes an animal sound or an exaggerated facial expression, or during a tickling episode, when the parent sneaks up on the child with a quick tickle to the infant's stomach. Both of these episodes can produce a favorable or enjoyable process if the balance between anticipation, startle, and security is maintained. Once again, the dynamics of timing and intensity, and the organization of the constituents influences the significance of the organism–environment relationship or the emotion process. Rather than deciding *a priori* which parts of a continuous stream of action are more salient or significant than others, "it makes more sense to talk about sequentially related phases in an emotional process, differences in intensity, variations in motivational attitude between the self and the environment, all from the perspective of how each of these variations makes a transition from one pattern to another" (Fogel et al., 1992, p. 133).

The social process theory of emotion employs dynamic systems tenets in its explanation of emotion and the development of emotion. The principle *self-organization* will be emphasized. The focus will be on the emergence of stable patterns of constituents that develop from the dynamic interplay of the constituents. Self-organization occurs as the contributing elements act together to constrain the multiple possible actions of other constituents so that the complex system organizes into recognizable patterns (Fogel & Thelen, 1987; Haken, 1977; Kugler, Kelso & Turvey, 1982). The coordinated patterns of preferred states are viewed as resulting solely from the interaction between contextual variables and component synergies, without the benefit of a central executive control agent (for a discussion see Camras, 1992; Fogel & Thelen, 1987). From the many forms of organization that are possible given a particular set of constituents, only a relatively small number of patterns emerge (Michel, Camras, & Sullivan, 1992; Thelen, Kelso, & Fogel, 1987) and result in organized and repeated emotion patterns.

The principle of self-organization applies to both real-time dynamics and ontological-time dynamics (Fogel & Thelen, 1987; Thelen, 1989); that is, emotion components arrange into coherent patterns during moment-to-moment interaction (real time) and over developmental time, as illustrated in the following examples. Emotion components, such as facial and body movements, motivation, and so on, create patterns of emotion that are unique to that dyad. The father and infant's behaviors are not controlled by an executive program; rather, their behaviors dynamically interact and organize into recognizable patterns. An example from Dickson (1994) illustrates a pattern in real time. As the infant rolls onto her back, the father lowers his head into her stomach saying, "I'm gonna get you." Her jaw drops while she is smiling as

his face touches her stomach and she begins to laugh. Her vocalizations fluctuate at the same speed at which he is tickling her stomach with his face in a side-to-side fashion. Her laugh evens out in pitch as he lifts his head before tickling her with his fingers. The vocalizations' speed and fluctuation increase as the father speeds up his tickling. Her jaw closes into a basic smile as the father withdraws his physical stimulation. This emotion pattern is repeated several times, though it is not dictated by an executive control. The behaviors of the partners dynamically interact to create the emotion patterns' timing and intensity.

Related to ontological development, the dynamic systems perspective proposes that emotions need not emerge as structured wholes according to a maturational timetable. Emotion constituents, such as cognitive appraisal capabilities, action capabilities, self-regulation capabilities, and facial movements may develop heterochronically and over time be organized into emotion patterns. The social process theory assumes that when behavior develops, it is attributable to some change or alteration in the dynamic process by which the constituents interact. Development is conceptualized as changes in how a system's constituents influence each other. The resulting stable patterns are a product of all of the mutually constraining constituents, rather than implying the emergence of new executive controls (Fogel & Thelen, 1987; Thelen, 1989). In dynamic systems terminology (Fogel & Thelen, 1987; Kelso & Scholz, 1986), a control parameter is a component that catalyses a reorganization of the system. Reorganization of constituent patterns occurs when the control parameter reaches a critical value. The system may shift from one major coordination pattern to another because of a single critical component. Although a particular component may catalyze the change, it is no more important than any other component because the change is uniquely determined by all the constituents acting together. Development is too complex to afford one component sole responsibility for the change.

Another real-time example and an ontological example are presented to illustrate the control parameter concept. A horse's gait shifts from a trot to a gallop when the speed of locomotion increases past a critical threshold. The speed of locomotion functions as the control parameter that stimulates the reorganization of the system from a trot to a gallop; that is, the shift in patterns result from the dynamic interactions among the lower-level constituents rather than a command from a central program (Camras, 1991). Concentrating on ontological development, Thelen (1989) illustrates the potential value of the dynamic systems perspective in her analysis of the development of walking. Traditionally, similar to the development of emotion, walking was assumed to appear by autonomous changes within the organism reflecting a phylogenetic blueprint. Thelen found that walking occurs when the fat–muscle ratio in the leg changes so that the infant can lift its leg against gravity while in the upright position. The fat–muscle ratio catalyzes the reorganization of the system's components and a new developmental structure emerges; that is, when the ratio reaches a critical threshold, the constituents reorganize and walking emerges.

Similarly, the emotion process changes or develops as one emotion constituent (the control parameter) reaches a critical level. The reaching of a critical threshold by an obvious or noncentral constituent, for example, motor abilities or cognitive appraisal capabilities, may spur a reorganization of the emotion system resulting in a novel emotion pattern for that individual. Understanding the process of developmental change involves examining the continual interplay of newly formed constituents and their relationship to the ongoing history of the emotion system. Development is conceptualized as a reorganization of behaviors that results in a novel, stable pattern and reflects a change in the significance in the organism–environment relationship. It is not merely any change in behavior. Development may be the result of various changes within the system, such as the relative influences between constituents or alterations in one or more of the constituents themselves, for example, maturation of physical structures, neuromotor processes, and additions or deletions of the social context. It is unlikely that the same mutual influences are at work in the patterning of all emotions, or at all points in development.

Camras (1991) provides excellent examples of the developmental path for several emotion patterns. The surprise-expression pattern involved a distinct pattern of nonfacial behavior (i.e., soft panting and limb waving, suggesting arousal and excited attention) at 9 weeks of age. Developmentally, the nonfacial components appeared to change in conjunction with motor development. For example, when directed reaching developed in the first 3 months, the surprise configuration was often observed during this activity. The context in which the surprise configuration was observed changed by 5 months; the surprise configuration often occurred during a reaching, grabbing, and mouthing of the object sequence. By the second year, the surprise pattern was not regularly observed during this context. A more frequent context at this age involved the infant imitating the adult's emblematic usage of the surprise expression. One interpretation is that motor development appears to function as a control parameter at about 3 months, with the development of directed reaching, and catalyzes the emotion constituents into a novel pattern, whereas the child's developing ability to imitate the adult's emblematic use of the surprise expression shifted the emotion pattern by the second year.

The social process theory makes no assumptions regarding the relative importance of any single constituent in influencing development. The social process theory of emotion affords no single emotion constituent primary responsibility. Given the focus on the dynamic relationship between emotion constituents, the emotion constituent that functions as the control parameter will vary depending on the relationship between the constituents involved. Each component that other perspectives afford primacy may take the role of

control parameter at some point in development. For example, cognitive milestones, such as object concept, intentionality, and causality, may function as a control parameter for the development of the emotion pattern for anger at approximately 7 months, as Sroufe (1984) suggests. However, the emergence of other novel emotion patterns, such as sadness, may be due to other factors, including cognitive realization of the significance of the event, the person's motor-response repertoire, or the social context in which the infant is embedded. It is premature to say that one emotion component warrants credit for the development of emotion. This remains an empirical question.

According to the social process theory, emotion is the process that emerges from the interaction of emotion constituents that relate meaningfully to the organism–environment relationship. Constituents of interactive or behavior processes are emotional to the degree that they are involved in a process that is affecting and/or stemming from the ongoing significant relationship of an organism and its environment. This emotion process changes over time. The variability of patterning of emotion constituent or the social context specificity of various emotion constituents illustrates this change. Evidence for this position derives from research on infant emotion that illustrates the changing relationships among constituents over time (Demos, 1982; Dickson, Nwokah, Fogel, & Nelson, 1997; Dickson, Walker, Fogel, 1997; Holt, 1984, 1990; Jones & Raag, 1989; Messinger, 1994).

INFANT EMOTION EVIDENCE

In this section, we discuss two empirical studies that help illustrate some of the points discussed thus far. As dynamic systems developmentalists, we seek patterns in sequences of action in a context, in both real-time and developmental-time scales. In the first study, we (Dickson, Walker, et al., 1997) studied the context specificity of different smile types during infant–parent play, real-time interactions. In the second study, we (Dickson, Nwokah, et al., 1997) examined the relationship between different types of smiles and different types of laughter over the first year of life to illustrate the complex transformation of facial and vocal features of positive emotion, developmental time. Although the two studies we have chosen to discuss do not provide a critical test between theories, they illustrate the heuristic value of the social process view of emotions.

The Relationship between Smile Type and Play Type

Given the social process view of emotion, it is important to look for changing patterns in the relationship between emotion constituents, in this case, the relationship between different types of smiles and the social context.

Research suggests that there are several distinct types of smiles, and that these different types of smiles are context specific (Dedo, 1991; Dickson, 1994; Ekman, Davidson, & Freisen, 1990; Fox & Davidson, 1988; Holt, 1990; Messinger, Dickson, & Fogel, 1992a, 1992b). The different types of smiles that have been identified include basic, play, and Duchenne smiles (Dedo, 1991; Ekman et al., 1990; Fox & Davidson, 1988; Holt, 1990; Messinger et al., 1992a, 1992b). Facial expressions are coded according to action units (AU) that describe the specific muscle groups that are responsible for changing the facial features (Facial Action Coding System—FACS; Ekman & Friesen, 1978). A basic smile involves lip corner raises caused by a contraction of the zygomatic muscle (AU12). In play smiles, the jaw drops open and the lip corners are raised (AU12 and AU26/AU27). With a Duchenne smile, in addition to lip corner raises, the orbicularis oculi contracts and raises the cheeks and, in adults, crinkles the eye corners (AU12 and AU6).

Duchenne smiles are more often associated with pleasant stimuli and self-reports of pleasure in adults than are basic smiles (Ekman et al., 1990). In 10-month-old infants, Duchenne smiles are associated with mother approach, whereas basic smiles are associated with stranger approach. Infant Duchenne smiles are also differentially associated with left-hemisphere activation, as assessed by electroencephalogram recording (Fox & Davidson, 1988). Blurton-Jones (1972) reported a reliable association between three mouth positions and social context. During social exchanges, children most often displayed smiles with lips parted and teeth showing. Play-face smiles were associated with conditions of high excitement. Smiles with lips together tended to occur during solitary activities. Jones, Raag, and Collins (1990) also found with 17-month-old infants that different smile types were distributed differently between social and nonsocial targets. Bared-teeth smiles were more often directed toward the mother than an object; thus, they were more likely to occur in social versus nonsocial contexts.

Given the proposition that patterns emerge from the interaction of the emotion constituents, the goal of this study (Dickson, Walker, et al., 1997) was to identify regularities or patterns of emotion constituents in the play interaction. Although this study does not examine emotion development per se, it addresses the issue of how facial expressions, one constituent of emotion, dynamically interact with the social context, another emotion constituent. The focus is on the interaction of emotion constituents and how noncentral constituents of the system may alter the emotion process. This illustrates the utility of viewing emotion from a dynamic systems perspective.

This study explored the interactional process between parents and their infants by examining infant smiles during parent–infant play. The subjects consisted of 36 Caucasian families, with 17 female and 19 male 12-month-old infants. Each parent–infant dyad was videotaped playing at their home for 10 minutes. The videotaped sessions were coded continuously for smile type

and play type. A coder certified in Ekman and Friesen's (1978) FACS and trained on the infant version, Baby FACS (Oster & Rosenstein, in press), coded infant smiles (basic, Duchenne, and play smiles) from videotapes that focused on the infant's face. The parent–infant interactions were categorized into play type (object play, physical play, vocal play, and book reading).

Loglinear analysis revealed that different types of smiles occurred during different types of play. This discussion focuses on several of the significant associations for co-occurring behaviors that were more likely to occur than expected by chance. Basic smiles were more likely to occur than expected by chance during book reading, whereas play smiles occurred during physical play more often than expected by chance (see Table 1).

Qualitative analyses were used to interpret the loglinear findings and to preserve the continuous nature of the communication process. The significant effects from the three-way association (Smile × Play × Parent Gender) in the loglinear model were elaborated by creating descriptive narratives of select play sequences. The associations that were more likely to occur than expected by chance for the three-way interaction guided the selection of the play sequences. Prior to examining the specific effects within the three-way association (e.g., the finding that Duchenne smiles were more likely to occur during vocal play for mother–infant dyads), the play sequences were selected on the basis of the following criteria in order to enhance the objectivity of the selection: To be selected for description, the infant's face was required to be in view of the camera for the entire sequence (between 15 and 20 seconds), and the infant had to smile at some point during the sequence, regardless of specific smile type. The six play sequences were chosen randomly from the 45 episodes that fit the criteria. The selected sequences included a play sequence from both mother–infant and father–infant dyads for physical play, object play, and book reading.

The descriptive narratives facilitated the interpretation of the finding that basic smiles occur during book reading. Basic smiles may occur during book reading because of the primary focus on visual attention. In the mother–infant book-reading sequence, the infant has a basic smile on his face while studying

Table 1. Percentages for Smile Type by Play Interaction Type from Loglinear Analysis

	Play			
Smile	Object	Physical	Vocal	Book reading
Basic	35.0	28.2	15.6	63.0
Duchenne	35.5	26.7	66.7	31.5
Play	29.5	45.1	17.8	5.6

the pictures. Also, in the father–infant book-reading sequence, the infant has a Duchenne smile as she raises her head to look at the camera. Her cheeks lower into a basic smile as she looks back at the pictures. Basic smiles were more likely to occur when the infant was studying the pictures, yet both Duchenne and play smiles were more likely to occur when the infant was gazing away from the book. Duchenne smiles, which involve cheek raises, may obscure the infant's vision and interfere with the activity; thus, Duchenne smiles may be more likely to occur when the infant is not focusing visual attention on the book. Visual attention on the task may function as a control parameter, thus playing a key role in the occurrence of basic smiles during parent–infant object play. Basic smiles may occur during book reading in which the communicative function of the smile is enjoyment of the activity, yet the infant can continue to attend and concentrate on the book.

The significance of visual attention and smile type could be implied in a Fox and Davidson study (1988). A study using 10-month-old infants found that Duchenne smiles occurred more often during mother approach, whereas non-Duchenne smiles occurred more often during stranger approach. One interpretation is that more visual attention may be required when an unfamiliar person approaches than when the familiar mother approaches, therefore, visual attention may be functioning as a control parameter in the creation of non-Duchenne smiles.

Two interpretations of the finding that play smiles were found to occur during physical play emerged from the descriptive narratives. First, infants may open their mouths into play smiles in order to increase their air intake during a physically stimulating activity. In the mother–infant physical play sequence, the infant's jaw drops into a play smile and a giggle erupts each time the mother shakes his body. As the movements become more vigorous, the infant's shoulders heave up and down as he breathes heavily. It appears that the infant's jaw drops simultaneously as the infant is inhaling deeply or breathing heavily, which may help explain the occurrence of play smiles during physical play.

Second, there is evidence that tactile stimulation may help create play smiles. In the father–infant physical play sequence, the infant's jaw drops into a play smile as the father's face touches her stomach. She begins to laugh as he tickles her stomach with his face in a side-to-side motion. Her vocalizations fluctuate at the same speed as his tickling. Her jaw closes into a basic smile as the father withdraws his physical stimulation. Depending on how the emotion constituents organize, either tickling or inhaling deeply may function as a control parameter at 1 year of age during parent–infant play.

An example from the mother–infant object play sequence may help illustrate the idea that tactile stimulation alone does not cause play smiles in a linear manner. The mother and infant lean toward each other with basic smiles on their faces as the mother lies on the floor. The infant watches as the

mother lowers her head. The infant's cheeks raise into a Duchenne smile as the mother makes rumbling sounds. Then, the infant's jaw drops into a play smile just as the mother shakes her head against the infant's stomach. The infant pats the mother's head with her hand a couple times. The infant's face changes to a neutral expression just as the mother raises her head away from the infant's stomach. The infant looks past the mother. Then, the mother leans into the infant's face and neck, and pretends to bite the infant's neck while making chomping noises. Before the mother pulls back, the infant looks at a toy that is beside her. The mother quickly buries her face into the infant's stomach as she did moments before, yet the infant does not smile. The mother attempts again to stimulate the infant's stomach, though the infant's attention remains focused on the block that she is now holding. The mother then pulls back and watches the infant play with the block.

Close examination reveals that various components must be present in order for the interaction to include a smile. The pattern that organizes depends on the components involved in the interaction. It appears that tactile stimulation functions as the control parameter in the creation of the play smile at the beginning of this narrative; however, when the components are organized differently, tactile stimulation does not function as a control parameter for this pattern. Other components in the system, such as the infant's increased desire to engage with the block, overstimulation from the tactile component, the mother's facial expressions, the timing or intensity of the tickle, and so forth, may play a key role in the interactions that did not result in a play smile. Given that tactile stimulation does not cause or elicit play smiles, regardless of other components, affords credence to the notion that other components in the system must interact to create the smile types. The principle of self-organization can be used as a heuristic to better understand this phenomenon. There does not appear to be a linear relationship between the environment and the facial expression, via an innate emotion program. The dynamic constituents involved in the emotion process interact to create the facial expression that is part of the emotion process. Thus, smiles emerge from the interaction of all the communicative components rather than being elicited or caused by a specific behavior.

This study examined the interaction of emotion constituents in real time to illustrate the utility of the social process perspective. The findings suggest that emotion constituents, in this case, different types of smiles, are created by the interaction of the different emotion constituents, including visual attention, tactile stimulation, vocalizations, and so forth. Recall that behaviors are considered emotion constituents when they are related to other behaviors that reflect change and maintenance of significant ongoing relationships between an organism and its environment. Smile types do not appear to be dictated by one specific component, such as feeling states, tactile stimulation, or cognition. There is no evidence that emotions or facial expressions are the result of a

sole determinant. A more plausible explanation lies in the principle of self-organization. Different smile types may partially be determined by the reaching of a critical point by a control parameter, such as tactile stimulation and the formation of play smiles. However, a particular configuration of the other constituents of the system is also necessary. Next, we examine the principle of self-organization with respect to developmental time.

The Relationship between Laughter Types and Smile Types

This exploratory study (Dickson, Nwokah, et al., 1997) examined the changing relationship between smile type and laughter type (emotion constituents) over the first 2 years of life. Different types of smiles and laughs are not emotions; they are motor and vocal constituents of the emotion system. Recall that no one behavior is considered an "emotion." Related behaviors that organize into coherent patterns relative to the organism–environment relationship constitute the emotion process. According to the social process theory, the development of emotion can be described as the systematic change in the relationship between emotion constituents. Attention was paid to nonobvious emotion constituents that may be functioning as control parameters in the changing relationship between these emotion constituents.

Via acoustic analysis, Nwokah, Hsu, Dobrowolska, Fonte, and Fogel (1990) have found that laughter can be categorized into eight distinct types, and these laughter types appear to be context specific in the first 2 years of life. Three laughter types were examined in this study. The comment laugh is characterized by a single vocal peak with an explosive and aspiration quality. Comment laughter tends to occur during play; the child may reference the mother visually or it may be in response to mother's vocalizations. Comment laughs are often breathy and occur during conversation. The chuckle has two vocal peaks. The chuckle laugh tends to occur following an accomplishment by the infant or in response to the mother's behavior. The rhythmical laugh is characterized as a multiple laugh sequence of varying intensity. Rhythmical laughter tends to occur when there is an element of teasing, such as the infant dropping a toy and looking at the mother to see her reaction.

Eleven infants, 6 males and 5 females, were videotaped weekly when they were between 1 and 12 months of age and bimonthly during the second year. Each time the infant laughed, it was classified according to laughter type generated by the acoustical analyses (see Nwokah, Davies, Islam, Hsu, & Fogel, 1993). Each time laughter occurred, the infant facial expression was coded (basic, Duchenne, and play smiles) using FACS, as discussed previously (Ekman & Freisen, 1978).

To examine whether there is a systematic relationship between these emotion constituents for each mother–infant dyad, configural frequency analysis with smile type and laughter type was used. One subject was omitted

due to low frequency of all types of laughter. Consistent with previous laughter research (Nwokah, Hsu, Dobrowolska, & Fogel, 1994), the data were aggregated into two time blocks (4–32 and 33–103 weeks) to assess developmental change. Nine months was employed as the boundary due to the reorganization of the babbling phonatory–articulatory–auditory mechanism.

The findings of this study illustrate a systematic relationship between smile type and laughter type and that this relationship changes over the first 2 years of life. Two major developmental trends emerged from the data. First, for 67% of the dyads before 9 months, play smiles were more likely to occur with comment laughter than expected by chance, whereas after 9 months, basic smiles were more likely to occur with comment laughter for 78% of the dyads. Second, for 33% of the dyads before 9 months, basic smiles were more likely to occur during rhythmical laughter, whereas after 9 months, Duchenne smiles were more likely to accompany rhythmical laughter for 56% for the dyads.

Speculations regarding potential control parameters are discussed for the changing developmental patterns of these emotion constituents. Although the factors we discuss have not been studied in relation to these variables, they may help explain the dynamic relationship between the constituents. In the first 6 months of life, the infant's tongue is still quite large, filling most of the mouth. The infant's epiglottis is in contact with the palate and restricts the range of vocalizations. Major anatomical changes during the first year allow air to flow in and out of the infant's mouth more effectively (Kent, 1981). In order to make a comment laugh before 6 months, the infant may need to drop the jaw in order to allow sufficient intake of air to create the explosive peak. As the physical structure of the infant's head and neck change, the relationship between the emotion constituents (i.e., gaze behavior, physiological reactions) may change, which allows the infant to create a comment laugh without the jaw drop. In other words, given that the infant has sufficient air intake without opening the mouth wide, the infant can create an explosive peak (comment laugh) without the jaw drop, which results in the comment laugh–basic smile pattern that appears after 9 months. Thus, the physical changes may function as a control parameter in the changing relationship between the emotion constituents.

Another possible interpretation involves the dyad's social interactions. Basic smiles occurring during comment laughter make intuitive sense, because the comment laugh is used as a conversational enhancer by adults and children (Nwokah et al., 1990; Provine, 1993). Informal observations indicate that adults in everyday conversations often make a comment laugh accompanied by a basic smile to acknowledge their ongoing interest in the conversation. The infant may be imitating the mother's use of a basic smile during comment laughter, and this pattern becomes more frequent after 9 months of face-to-face interaction. Recall that this aspect of the interaction was not

examined in this study; the discussion is speculative in nature. The mother–infant interaction may help create the emotion pattern of the comment laughter accompanying a basic smile, thus functioning as a control parameter.

Rhythmical laughter is a multiple-sequence laughter of varying intensity and has been categorized as "real laughter" in adults. Ekman et al. (1990) suggest that Duchenne smiles signal enjoyment in adults and infants (Fox & Davidson, 1988). Given that rhythmical laughter has been categorized as "real laughter" and Duchenne smiles have been linked to intense enjoyment, it is hypothesized that Duchenne smiles may be more likely to occur during rhythmical laughter. It may be through mother–infant interaction that the infant's emotion constituents form patterns that are similar to adult emotion patterns.

The main findings are that specific types of smiles occur during specific types of laughter, and that these relationships change developmentally. These findings suggest that there may be an increasing match between infant and adult organization of emotion constituents, even before the age of 2 years. Rather than assuming a hardwired relationship between emotion constituents, the social process theory looks for nonobvious factors of the emotion system, such as physical growth and social interaction, that may be influencing the development of emotion. Dynamical systems mechanisms provide a procedure for the systematic search for critical elements that help explain development and interaction. Although we only examined one relationship among the many interactive emotion elements, these findings lend support for the social process theory's proposal that changing relationships among emotion elements over time help explain the development of emotion. Future research will examine a wider range of emotion constituents and experimentally test the hypothesis that specific emotion constituents are functioning as control parameters in the development of emotion.

CONCLUSION

One concern of this volume is the functions of emotional change for the psychological and social life of the child. We have chosen to address this issue in two parts. First, do emotion processes have specific functions? Second, what function is served by emotional development?

According to the social process theory, there is no set or specified function for different emotions; rather, the function of the emotion process emerges from the dynamic interaction of the emotion constituents. For example, anger does not have the specific function of serving as a social motive, regardless of context. The function of anger may be to regulate one's own physiological reaction to a situation, or it may be to force others to change their behavior. The functionalist perspective (Barrett, 1993) proposes that functions mediate

the display of emotions. The adaptive functions that emotions serve include intrapersonal regulation, behavior regulation, and social regulation. The social process theory supports the notion that emotions serve these functions as well. However, we would argue that the function of the emotion acts as one of the many emotion constituents that interact with other constituents to determine which emotion pattern is created. The function of the emotion does not directly dictate the display of emotion. The emotion process that emerges from the interaction of the constituents determines the function of the emotion. The function of emotion emerges from the situation and the capabilities of the individuals involved.

Although emotion processes do not have specific, nonvarying functions, various functions are served by emotion processes as dictated by the organization of the constituents. The emotion process also involves a communicative function. This function has been discussed previously by emotion theorists; however, we stress that the communicative function emerges from the interaction of constituents, including the social context, rather than solely as a by-product of the individual. The focus is the changing communicative function for the relationship and how the function influences further relationships among emotion constituents, not on how an emotion *within* an individual changes functions over time. Emotion patterns and the communicative function build upon the cumulative patterns of prior interactions. These patterns are simultaneously influenced by and contribute to the emergent emotion process that has a communicative function. The function of emotion could be thought of as either intentionally or unintentionally communicating the significance of the interaction whether it is pleasant, unpleasant, embarrassing, and so forth.

Another function of emotion processes involves a way to organize and interpret experiences. As emotional processes develop, the way in which we interpret and organize experiences changes. For example, the emotion process of flailing arms, furrowed brow, narrowed eyes, clinched fists, and shaking head ("anger" for a 12-month-old) may function as opposition or as a request for assistance in withdrawing from the precipitating agent of the anger, whereas the emotion process of attacking with flailing arms, clinched firsts, and wide-open mouth and eyes ("anger" for a 25-year-old) may function to eliminate or scare the precipitating agent of the anger. Thus, the function of the emotion reflects the organization of the available emotion constituents. The 12-month-old's emotion process involved more limited motor and cognitive abilities, and differing motivations. The 25-year-old's motivation may have been to conquer the precipitating agent and might have been partially created because of the older individual's physical ability to achieve that goal. As evidenced by this example, emotion processes involve individual differences that are influenced by the available constituents of the individual, whether that is dictated by development or individual variation in

situation and/or ability. The pattern of available constituents functions to organize and interpret experiences.

In conclusion, we discuss the relationship between function and the development of emotion. As discussed, emotional development is predicated by the development of various components, including cognitive and physical development, and interpersonal experience. As these components change and develop, their interactions organize into patterns of behavior. With these increasing competencies, the individual is able to interpret and organize experiences in more complex ways. For example, the development of an emotion process for anger involves the interaction of cognitive and physiological development. With this increased understanding of anger and increased ability to cope with anger, the significance of the experience is more complex. The primary functions of emotional change for the psychological and social life of the child involve the increased ability to organize and interpret experiences, and the increased ability to regulate intrapersonal, behavioral, and social interaction. These functions, as emotion constituents, are influenced by and influence the emotion process.

REFERENCES

Barrett, K. C. (1993). The development of nonverbal communication of emotion: A functionalist perspective. *Journal of Nonverbal Behavior, 17*(3), 145–169.

Barrett, K. C. (1995). A functionalist approach to shame and guilt development. In J. Tangney & K. Fischer (Eds.), *Self-conscious emotions: The psychology of shame, guilt, embarrassment, and pride* (pp. 25–63). New York: Guilford.

Barrett, K. C., & Campos, J. J. (1987). Perspectives on emotional development: II. A functionalist approach to emotions. In J. Osofsky (Ed.), *Handbook of infant development* (2nd ed., pp. 555–578). New York: Wiley.

Blurton-Jones, N. G. (1972). Non-verbal communication in children. In R. A. Hinde (Ed.), *Nonverbal communication* (pp. 271–296). Cambridge, UK: Cambridge University Press.

Campos, J. J. (1994, Spring). The new functionalism in emotion. *SRCD Newsletter*, pp. 1–14.

Campos, J. J., & Barrett, K. C. (1984). Toward a new understanding of emotions and their development. In C. Izard, J. Kagan, & R. Zajonc (Eds.), *Emotions, cognition and behavior* (pp. 229–263). New York: Cambridge University Press.

Campos, J. J., Campos, R. G., & Barrett, K. C. (1989). Emergent themes in the study of emotional development and emotional regulation. *Developmental Psychology, 25*, 394–402.

Camras, L. A. (1991). Conceptualizing early infant affect: View II and reply. In K. Strongman (Ed.), *International review of studies on emotion* (pp. 16–28, 33–36). New York: Wiley.

Camras, L. A. (1992). Expressive development and basic emotions. *Cognition and Emotion, 6*, 269–283.

Cicchetti, D., & Sroufe, A. (1976). The relationship between affective and cognitive development in down's syndrome infants. *Child Development, 47*, 920–929.

Dedo, J. Y. (1991). *Smiling during later infancy: Relationships among facial expressions, contexts and other communicative behaviors*. Doctoral dissertation, Purdue University, West Lafayette, IN

Demos, E. (1982). Facial expressions of infants and toddlers: A descriptive analysis. In T. Field & A. Fogel (Eds.), *Emotion and early interaction* (pp. 127–160). Hillsdale, NJ: Erlbaum.

Dickson, K. L. (1994). *The parent–infant communication system: Infant smiles in relation to play type and gaze direction.* Doctoral dissertation, University of Utah, Salt Lake City, UT.

Dickson, K. L., Nwokah, E., Fogel, A., & Nelson, C. (1997). *Developmental analysis of the relationship between laughter type, smile type, and social context.* Manuscript in preparation.

Dickson, K. L., Walker, H., & Fogel, A. (1997). The relationship between smile type and play type during parent–infant play. *Developmental Psychology, 33,* 925–933.

Ekman, P., Davidson, R. J., & Friesen, W. V. (1990). The Duchenne smile: Emotional expression and brain physiology II. *Journal of Personality and Social Psychology, 58,* 342–353.

Ekman, P., & Friesen, W. (1978). *The Facial Action Coding System.* Palo Alta, CA: Consulting Psychologists Press.

Fischer, K. W., Shaver, P. R., & Carnochan, P. (1990). How emotions develop and how they organize development. *Cognition and Emotion, 4,* 81–127.

Fogel, A., Nwokah, E., Dedo, J. Y., Messinger, D., Dickson, K. L., Matusov, E., & Holt, S. A. (1992). Social process theory of emotion: A dynamic systems approach. *Social Development, 1,* 122–142.

Fogel, A., & Thelen, E. (1987). Development of early expressive and communicative action: Reinterpreting the evidence from a dynamic systems perspective. *Developmental Psychology, 23,* 747–761.

Fox, N. A., & Davidson, R. J. (1988). Patterns of brain electrical activity during the expression of discrete emotions in ten-month-old infants. *Developmental Psychology, 24*(2), 230–236.

Frijda, N. H. (1993). The place of appraisal in emotion. *Cognition and Emotion, 7,* 3–4, 357–387.

Haken, H. (1977). Some aspects of synergetics. In H. Haken (Ed.), *Synergetics* (pp. 1–17). New York: Springer-Verlag.

Holt, S. A. (1984, September). *The morphology and social context of toddler smiles: An ethological study.* Paper presented at the British Psychological Society, Developmental Section Meeting, Lancaster, UK.

Holt, S. A. (1990, April). *Toddler smile characteristics: Type and context similarities, sex and age differences.* Poster presented at the International Conference on Infant Studies, Montreal, Canada.

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

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

Izard, C. E. (1991). *The psychology of emotions.* New York: Plenum Press.

Izard, C. E. (1994). Intersystem connections. In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 356–372). New York: Oxford University Press.

Izard, C. E., & Malatesta, C. Z. (1987). Perspectives on emotional development I: Differential emotions theory of early emotional development. In J. Osofsky (Ed.), *Handbook of infant development* (2nd ed., pp. 494–554). New York: Wiley.

Jones, S. S., & Raag, T. (1989). Smile production in older infants: The importance of a social recipient for the facial signal. *Child Development, 60,* 811–818.

Jones, S. S., Raag, T., & Collins, K. (1990). Smiling in older infants: Form and maternal response. *Infant Behavior and Development, 13,* 147–165.

Kelso, J. A. S., & Scholz, J. P. (1986). Cooperative phenomena in biological motion. In H. Haken (Ed.), *Synergetics of complex systems in physics, chemistry and biology* (pp. 124–149). New York: Springer.

Kent, R. D. (1981). Articulatory–acoustic perspectives on speech development. In R. Stark (Ed.), *Language development in infancy and early childhood* (pp. 105–106). New York: Elsevier.

Kugler, P. N., Keslo, J. A. S., & Turvey, M. T. (1982). On the control and coordination of naturally developing systems. In J. A. S. Keslo & J. E. Clark (Eds.), *The development of movement control and coordination* (pp. 5–78). New York: Wiley.

Lazarus, R. S. (1991). Progress on a cognitive–motivational–relational theory of emotion. *American Psychologist, 46,* 819–834.

Lewis, M., & Brooks-Gunn, J. (1979). *Social cognition and the acquisition of self.* New York: Plenum Press.

Michel, G. F., Camras, L. A., & Sullivan, G. (1992). Infant interest expressions as coordinative motor structures. *Infant Behavior and Development, 15,* 347–358.

Messinger, D. (1994). A dynamic systems perspective on the development of infant smiling. Doctoral dissertation, University of Utah, Salt Lake City, UT.

Messinger, D., Dickson, K. L., & Fogel, A. (1992a, March). *The development of infant Duchenne and play smiles.* Paper presented at the meeting of the Southwestern Society for Research in Human Development, Tempe, AZ.

Messinger, D., Dickson, K. L., & Fogel, A. (1992b, May). *Infant and mother interactive smiles. Morphological and temporal characteristics.* Paper presented at the International Conference on Infant Studies, Miami, FL.

Nwokah, E., Davies, P., Islam, A., Hsu, H. C., & Fogel, A. (1993). Vocal affect in three-year olds: A quantitative acoustic analysis of child laughter. *Acoustical Society of America, 94*(6), 3076–3090.

Nwokah, E., Hsu, H., Dobrowolska, O., & Fogel, A. (1994). The development of laughter in mother–infant in communication: Timing parameters and temporal sequences. *Infant Behavior and Development, 16,* 23–25.

Nwokah, E., Hsu, H., Dobrowolska, O., Davies, P., Fonte, P., & Fogel, A. (1990, April). *Variations in the acoustic and contextual features of infant laughter.* Paper presented at the International Conference on Infant Studies, Montreal, Quebec.

Ortony, A., Clore, G. L., & Collins, A. (1988). *The cognitive structure of emotions.* New York: Cambridge University Press.

Oster, H., & Rosenstein, D. (in press). *Baby FACS: Analyzing facial movement in infants.* Palo Alto, CA: Consulting Psychologists Press.

Provine, R. R. (1993). Laughter punctuates speech: Linguistic, social and gender contexts of laughter. *Ethology, 95,* 291–298.

Sroufe, A. (1979). Socioemotional development. In J. Osofsky (Ed.), *Handbook of infant development* (pp. 462–516). New York: Wiley.

Sroufe, L. A. (1984). The organization of emotional development. In K. Scherer & P. Ekman (Eds.), *Approaches to emotion* (pp. 109–128). Hillsdale, NJ: Erlbaum.

Thelen, E. (1989). Self-organization in developmental processes. Can systems approaches work? In M. Gunnar (Ed.), *Systems in development: The Minnesota Symposium in Child Psychology, 22,* Hillsdale, NJ: Erlbaum.

Thelen, E., Keslo, J. A. S., & Fogel, A. (1987). Self-organizing systems and infant motor development. *Developmental Review, 7,* 39–65.

Tomkins, S. (1962). *Affect, imagery and consciousness* (Vol. 1). New York: Springer.

Tomkins, S. (1981). The quest for primary motives: Biography and autobiography of an idea. *Journal of Personality and Social Psychology, 41,* 306–329.