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1987

Nonverbal encoding and decoding of emotion in children :: data and theories.

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NONVERBAL ENCODING AND DECODING OF EMOTION

IN CHILDREN: DATA AND THEORIES

A Thesis Presented

By

Pierre Rene PHILIPPOT

Submitted to the Graduate School of the
University of Massachusetts in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE

September 1987

Psychology
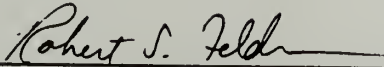
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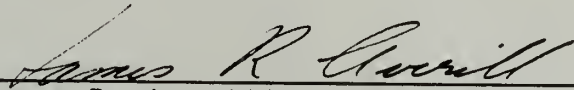
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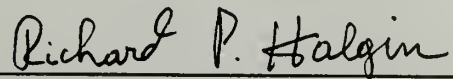
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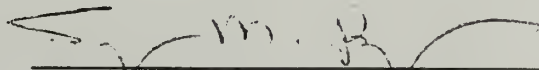
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Introduction

The study of facial expression of emotion integrates two areas of theory and research, emotion and nonverbal behavior. In the last 15 years, a revival of interest and research activity has boosted the development of these two areas in both of which facial expression is one of the very fertile fields of work. Moreover, the rediscovery of facial expression a century after the pioneering work of Darwin (1872) is often considered to have catalyzed the renewed interest in emotion. Indeed, elaborating on Tomkins' original idea of the central role of facial expression in emotion, Ekman's and Izard's transcultural studies of facial expression spurred a new line in the development of emotion models (Ekman, 1984).

To begin of the study of emotional facial expression development, fundamental questions which underlie this whole field of research must to be introduced: Can we define emotion? What constitutes nonverbal facial behavior? What is the relationship of nonverbal facial behavior to emotion?

Emotion

Many authors have sought, but no one has found an acceptable definition for the concept of emotion. These repeated failures raise the question of whether such a definition is possible. It is now commonly accepted that no definition of emotion can be established, at least in the classical sense of individually necessary and jointly sufficient attributes (Averill, 1982; Fehr & Russell, 1984). Emotion is then currently defined as an organized set of events, none of which is either necessary or sufficient. For example, Fehr and Russell (1984) have approached the definition of emotion from a prototypic perspective. In their view, for emotion (as well as for the prototypic categories described by Rosch and Mervis, 1975), membership is a matter of degree rather than an all or nothing situation, and no sharp boundaries separate members from nonmembers. Similarily, Averill (1982) defines the concept of emotion through an analogy to the concept of syndrome. As a syndrome, an emotion has a distinctive internal structure and can be identified, but is rarely defined by a set of necessary and sufficient attributes. Numerous other authors similarly espouse a composite definition of emotion (Izard, 1977; Scherer, 1984; Plutchik, 1980; Leventhal, 1979).

Thus, based on an emergent consensus of many theorists, the concept of emotion, as used in this thesis, refers to an entire syndrome of different "symptoms" including neurophysiological, motor-expressive, and phenomenological components (Izard, 1977). The phenomenological component is defined as the subjective experience of emotion that is motivating or that has immediate meaning for the individual. The motor-

expressive component consists primarily of patterned facial movements and secondarily of postural and vocal responses. Finally, the neurophysiological component includes electrochemical activities and autonomous nervous system changes occurring during emotion. As stated above, none of these components is singly necessary or sufficient unto itself in establishing emotion.

Once emotion has been defined, different perspectives can be taken for its study. Roughly, three main perspectives or level of analysis are reported in the literature. According to the theorist's inclination, any emotional event can be analyzed from a biological, psychological, or social perspective.

The biological system of analysis mainly refers to the laws of evolution and to the information encoded in the genetic material. For example, facial expressions of emotion can be analyzed from the perspective of their meaning for the evolution and survival of the species. The psychological system of analysis considers the cognitive schemas acquired during the idiosyncratic history of the individual through learning and as a function of experience. The concept of cognitive schema, as used in this context, must be understood in the broad sense of systems of internal representation by the individual about emotion. The psychological system of analysis investigates how an event makes sense in the individual's history. Finally, the social system of analysis uses the rationale of the sociological analysis, employing the central concepts of cultural rules, norms, roles, and regulative social mechanisms. The meaning of emotion is considered from the perspective of its social function. For example, grief can be analyzed as a set of

behaviors regulated by the social norms of mourning, a behavior which has a specific social function and assigns a determined social role to the individual.

Within each of these three perspectives, the object of analysis can vary in generality, ranging from the most inclusive to the most specific unit. For example, studying facial expression from a biological perspective, one can focus on the adaptive value of a given facial display for the species (inclusive unit), or on some fixed, reflex-like, facial actions pattern in response to a specific stimulus (specific unit). The different levels of generality of the object of analysis can be ordered in a hierarchy. The distinctions between these different perspectives and objects of analysis will be used to compare and contrast the different theories of facial expression development.

In sum, emotion has been tentatively defined as a composite concept articulating neuro-physiological, motor-expressive, and phenomenological components. Historically, three different perspectives have been used to analyze emotion; the biological, psychological, and social perspective. Finally, within each perspective the specificity of the object of analysis can vary.

Facial expression of emotion

In considering the concept of facial expression of emotion, two of its facets must be discussed: the nature of facial expression as a nonverbal behavior and its relationship to emotion.

Facial expression as a nonverbal behavior

Being the center of visual attention in most interaction, the face is the most visible aspect of nonverbal behavior. As any nonverbal behavior, facial activity has been described as expressive by some or as communicative by others (Buck, 1984). The choice between these two alternatives depends in fact, on the importance that one attributes to intentionality in the definition of communication. More specifically, the issue of intentionality generates the distinction between spontaneous and voluntary expression. Buck (1984), defining communication broadly as any behavior of an individual influencing the behavior of another individual, distinguishes between spontaneous and symbolic communication. Spontaneous communication non-intentionally transmits biologically shared signs, while symbolic communication voluntarily transmits a specific message contained in socially defined symbols. Thus, if one admits that intentionality is not a defining attribute of communication, any facial behavior is potentially communicative.

Facial expression and emotion

With a practically infinite number of combinations of several dozen different muscle movements, facial expression is the most differentiated element of the motor-expressive component of emotion. Because of this potentiality, facial expression has been investigated in a wealth of studies, while other elements of emotional expression like voice or posture have received little attention from researchers. As a consequence, facial expression is often equated incorrectly with the expressive component of emotion.

However, a good deal of controversy persists about the exact nature of facial expression and its relationship to emotion. Indeed for some theorists, facial expression holds a central place in emotional processes. For others, facial expression is just a peripheral phenomenon. In the last decade, the debate about the role of facial expressive behaviors in emotion has been centered on the facial feedback hypothesis. In its most general formulation this hypothesis holds that the subjective experience of emotion is derived from facial expressions. Various authors have proposed different types of feedback; feedback from the efferent muscular nerves (Izard, 1977), or from differences in the vascular irrigation of the brain resulting from the constriction of blood vessels by the facial muscles (Zajonc, 1984). The reality of facial feedback is still debated on empirical and experimental grounds, although the weight of the evidence favors the proponents of the facial feedback hypothesis (Laird, 1984; Tourangeau & Ellsworth, 1979).

Similarily, controversy persists about the constancy of the relationship between facial expression and underlying internal states. While some authors stress the relative indepedence of facial expression from internal states (Lewis & Michalson, 1983), others emphasize a consistent correspondance between facial expressions and internal states (Ekman, 1984). Also, from a developmental perspective, some authors report changes over time in the coordination between expressive behavior and affective states (e.g., Zivin, 1986a). Depending on the stage of development, a specific internal state may be expressed by different facial expressions.

Facial expression also plays an important role in the debate about the concept of "fundamental emotion". This concept refers to basic pan-human emotions inherited from the phylogenetic history of the species. The experience and expression of fundamental emotions are independent from the culture and do not require any type of learning; they constitute a biological given. Authors like Izard (1977) or Ekman (1984) have defended the existence of at least seven fundamental emotions: happiness, sadness, fear, anger, surprise, disgust, and contempt. Their principal evidence rests on findings of universally expressed and recognized facial expressions in specific emotional situations. The issue of the fundamental emotion raises the question of the extent to which facial expression of emotion is the product of innate biological forces or is learned and relative to a specific culture. As one would expect, there is a consensus maintaining the interaction of both factors in producing facial expression. However, large differences persist among theorists in terms of the weight they attribute to each factor.

Conclusion

This introduction addresses numerous questions and issues which underlie the field of facial expression of emotion. All of these issues, as well as the definitional problems of emotion, will be debated in the six theories of the development of facial expression of emotion reviewed in the next section. In presenting each theory, special attention will be given to determining how emotion and facial expression are defined and related to one another, and which perspective is used to analyze them. More specifically, the issue of nature versus nurture, spontaneous versus

voluntary expression, and the function of facial expression in the emotional system will be discussed.

Six Theories of the Development of Facial Expression

Historically, two general models of the development of facial expression of emotion have been proposed. In the first model, which will be named the "differentiation model", the ontogenesis of facial expression is depicted as a gradual evolution and differentiation of facial displays over time. As presented by Bridges (1930), this scheme maintains that the infant at birth displays only general excitement. Within a short period of time however, this behavior differentiates into clear signs of distress and delight. After some months fear, disgust, and anger displays develop out of distress, and elation and affect displays out of delight. From these, other more complex displays are differentiated. In the second model, which will be referred to as "discrete onset model", facial expressions are genetically pre-wired and appear full-blown at specific points of development during the process of maturation. This model, originated by Tomkins (1962), implicates the universality of facial expression.

This section presents the six major contemporary models of the ontogenesis of facial expression of emotion which elaborate upon the two prototypic models just introduced. The first three models, developed by Buck, Izard, and Ekman, commonly emphasize a biological system of analysis and employ a discrete onset model, but each of them has its specific perspective. Buck develops the neurological and cerebral

aspects of the development of facial expression. Izard situates facial expression within an extensive theory of emotion. Ekman, introducing the concept of cultural display rules, makes a link between the biological and social perspectives.

The fourth model, of Emde, and the fifth, of Sroufe, present the alternative of a psychological system of analysis. While Emde presents a psychoanalytic point of view of the ontogenesis of facial expression still rooted in biological basis, Sroufe elaborates on the original differentiation model of Bridges (1930). Finally, in the sixth model, Lewis develops a social analysis of the development of facial expression of emotion.

The same rationale as that developed in the introduction is used to present each model. The model's definition of emotion will first be presented. Then, the relationship between emotion and facial expression will be clarified, and finally, the model's scheme for the development of facial expression will be exposed in detail.

Buck: an evolutionary model

Buck's main areas of interest are nonverbal communication, human motivation, and emotion. He recently published an integrative theory of emotion (Buck, 1985) and a handbook on the communication of emotion (Buck, 1984). In his work he encompasses concerns of social and developmental psychology and ethology of communication.

What is emotion?

According to Buck (1985), primary motivational/emotional systems or "primes" underly emotions. Primes have evolved through the entire phylogenetic history of the human species as systems of behaviors that respond to challenging stimuli in ways that are adaptive. First, they emerged to serve the basic functions of bodily adaptation and maintenance of homeostasis. Later, primes developed to assure an efficient communication and behavior coordination with other conspecifics, mechanisms necessary for social regulation and sexual reproduction (Buck, 1984).

Each prime serves a specific function for the species (Buck, 1985). They are based on innate mechanisms organized within identifiable subcortical and paleocortical regions of the brain. (Buck (1984, p. 78-87) describes the specific cerebral localizations of the primes). Primes require some particular internal or external stimulation to become activated. Relevant learning can influence or modify the way primes operate.

Emotion and motivation are two aspects of the primes. Motivation is the potential for behavior inherent in the neurochemical structures of the primes, and emotion involves the means by which that potential is realized, or readout, when activated by a challenging stimulus. Thus, to each emotion corresponds an analogous motivation. Buck (1985) clarifies this distinction with the analogy of the relation between matter and energy in physics: Just as energy is the potential that manifests itself in matter, motivation is a potential that manifests itself in emotion.

Primes exist at different levels of organization, ranging from simple reflexes to more elaborate primary affects. The latter includes happiness, fear, anger, sadness, surprise, and disgust. The capacity to experience these affects is innate and unlearned. Each primary affect is associated with a specific facial expression.

Emotions have evolved as readout mechanisms carrying information about the states of the primes. Three readout mechanisms can be identified: Emotion I, Emotion II, and Emotion III. Each is associated with a specific type of emotional response (Buck, 1983, 1985).

Emotion I involves the systems directly responsible for bodily adaptation and the maintenance of the homeostasis. Emotion I is responsible for the visceral reactions of emotion.

Emotion II is an external readout which reflects the states of the primes in overt expressive behavior. Emotion II organizes the facial proprioceptive feedback.

Emotion III is a direct cognitive readout of the primes into consciousness. It involves syncretic as opposed to analytic cognition. Syncretic cognition is associated with the right hemisphere and refers to a holistic conceptualization in which sensory and cognitive elements are fused or synthesized into a global experience (Werner, 1957, cited in Buck, 1984). Emotion III constitutes an unmediated subjective experience of the emotional states. Evidence for a direct readout into consciousness are offered by brain stimulation studies that have produced integrated emotional states in subjects.

The subjective experience resulting from emotion III can be appraised and labeled by the cognitive system (analytic cognition). None

of these readouts is either sufficient or necessary to produce emotional experience. Their relative contribution to the emotional process depends on the individual, the situation, and the primes involved.

The status of facial expression in emotion

Facial expression is a product of emotion II. Although it does not constitute a necessary or sufficient element, facial expression contributes to the emotional experience (Buck, 1985). This external readout of the primes is based on innate neural programs based in the upper brain stem. Facial expressions can, however, be modified by display rules which are the social codes that control the facial displays. Buck (1984) refers to displays as behavioral patterns that have evolved as signals in the service of social coordination. In sum, a given facial expression has two potential determinents: The innate biological programs and the social rules governing nonverbal expression.

Thus, as described in the introduction, Buck (1984) distinguishes between spontaneous and symbolic communication. Spontaneous communication is biologically shared as part of the phylogenetic heritage of the species. It occurs automatically, without voluntary control. Symbolic communication is socially shared and voluntary: The sender intends to send a specific message via a symbolic code. Symbolic communication influence increases through the phylogenetic and ontogenetic scale.

Hence, there are two sources of facial expression: a spontaneous source which is a readout of the emotional state itself, and a symbolic source which is the state that the subject intends to convey and which is

controlled by the display rules. The neural pathways controlling the facial musculature are different whether the expression is spontaneous or symbolic. The former is controlled by the pyramidal motor system, and the latter by the non pyramidal motor system (Buck, 1984).

Buck (1984) proposes parallel mechanisms for decoding facial expression. For spontaneous facial expression, the decoding mechanisms are direct built-in processes with evolutionary roots analogous to the roots of the sending processes. Spontaneous facial expression acts like an ethological releaser. For the symbolic aspects of facial expression, the decoding processes are mediated by decoding rules, guided by cultural norms.

Model of the facial expression process

As shown in figure 1, the motor control of facial expression is monitored in the lower brain stem (1). This center can be activated by two mechanisms:

(a) Voluntary expression mechanisms are initiated in the precentral motor cortex, more precisely in the facial area (4). They operate via corticobulbar fibers (dashed lines).

(b) Hard wired facial expression mechanisms are based in the upper brain stem (2). These mechanisms can be activated either by emotional systems in the hypothalamic/limbic system (cross-hatched area) for spontaneous expression, or by a system of voluntary facial expression initiation. Buck (1984) suggests that this voluntary initiation mechanism is associated with the cingulate cortex and/or the supplemental motor area above the cingulate gyrus (3).

FIGURE   1

Neural Pathways of Emotional Expression
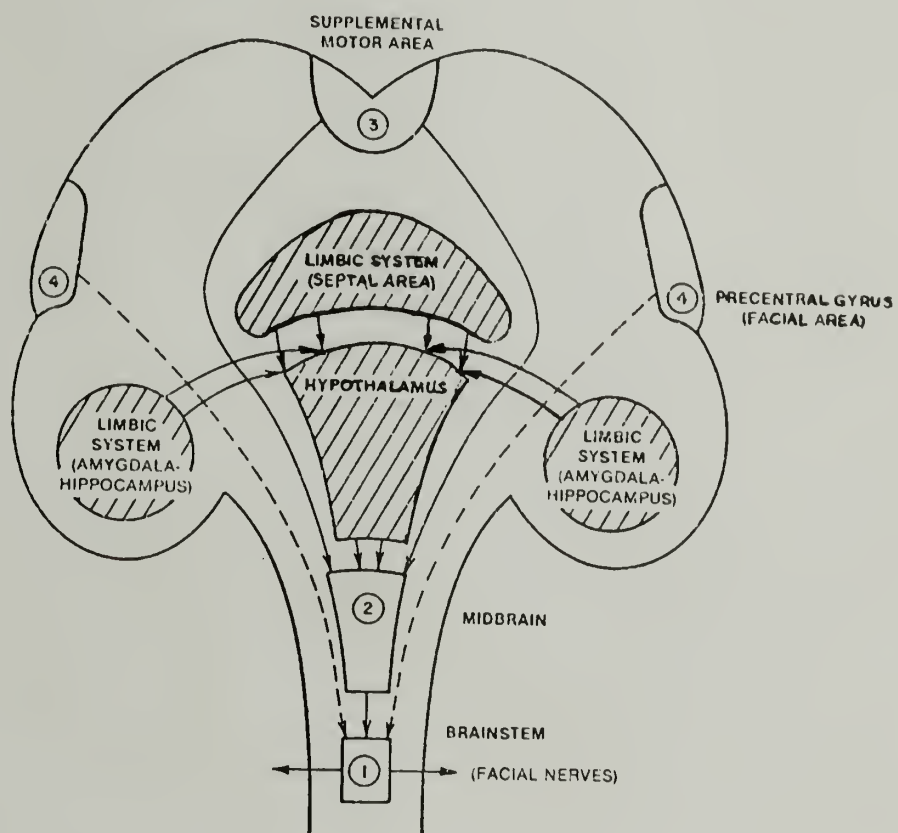
(From Buck, 1984, p. 99)

Hence, innate and universal patterns of facial expressions can be activated by two mechanisms: The automatic readout of emotion II and a voluntary initiation. Thus people can pose universally recognized facial expressions or use these hard wired expressions in the flow of symbolic communication.

Buck does not propose a parallel model for the decoding of facial expressions. However, he reports evidence, from studies of brain-damaged patients, of the importance of the right hemisphere for facial expression recognition (Buck, 1984).

The ontogenesis of facial expression

Maturation and development of emotion ii. To explain the development of emotion, Buck (1983, 1984) borrows concepts from two authors, Harlow and Piaget. As Piaget's concepts are mainly used to provide an account of the ontogenesis of the subjective experience of emotion, they will not be developed here.

In his ontogenetic analysis of emotional expression, Buck refers to Harlow's studies on the social development of rhesus monkeys (Harlow, 1971). Harlow (1971) proposes that the emotional system develops in a fixed sequence determined by the biological maturation of the neurochemical structures underlying emotion. However, the infant has to deal with emotion and its communication through social experience which are normally coordinated with the maturational sequence. Indeed, heredity transmits only elementary forms of communication which require learning to function effectively.

In his "affectional system" theory, Harlow (1971) proposes three stages in the social and affective development of the rhesus monkey. Each stage is constituted by a critical period where social experience and maturational sequence are coordinated and facial expressions appear at the stage where they are functionally adaptive. According to Buck (1983, 1984), these stages can also be observed in the human infant.

During the first stage, the infant develops the "maternal affectional system". Warm contacts with the mother establish a fundamental trust and attachment which constitute the basis for the infant's exploration behavior and progressive independence from the mother. At this stage, the infant expresses pain and curiosity. During the second stage, the "peer affectional system" period, the infant is confronted with social relations with peers or strangers. Fear and aggression appear. In Rhesus monkeys, a third stage can be observed: The "heterosexual affectional system" period. However, in human development, this stage has no parallel because of the emergence of language and because of the long period of maturation before puberty.

Drawing on Piaget, Buck (1984) reports similar key concepts of an ontogenesis unfolding through a sequence of stages, where the integration of particular social experiences is a pre-requisite.

Once established, these primary emotion systems and their corresponding spontaneous facial patterns do not undergo any further change. However, under the effect of socialization the symbolic aspects of facial expression continue to develop. The respective influence of spontaneous and symbolic communication in facial expression during the

ontogenesis is illustrated by figure 2. This pattern retraces as well the phylogenetic pattern of nonverbal communication.

Social learning. Buck (1984) suggests that the kind of socialization that can affect a behavior is determined by its accessibility. The accessibility of a behavior is the degree to which this behavior is available via sensory channels to others and to the individual who performs it. The spontaneous expressive tendencies and the symbolic communication aspect of facial expression differ in accessibility and thus they undergo different socialization processes.

Intentional facial expression (symbolic communication) can be trained via imitation and social reinforcement. Buck (1983, 1984) also emphasizes the importance of language as a new system of behavior control which is functionally independent from the biological system upon which it is based. Language allows expressive behavior to come in conformity with culture, and to be under the control of the principles of logic and reasoning.

To the extent that facial expression is spontaneous, it simply reflects the actual states of the primes. By definition, the senders have no control over spontaneous expression, and, furthermore, they are often unaware of their facial expression. But accessibility is also susceptible to learning, and individuals can and do learn impression management techniques to control their spontaneous expressions.

In sum, while the ontogenesis of facial expression is mainly determined by maturational factors, symbolic facial expression evolves in parallel as a function of social experience, cognitive development, and language acquisition.

FIGURE   2

The Relationship between Symbolic and Spontaneous
Communication during Ontogeny

Extent of Influence

Symbolic Communication

Spontaneous Communication

Age
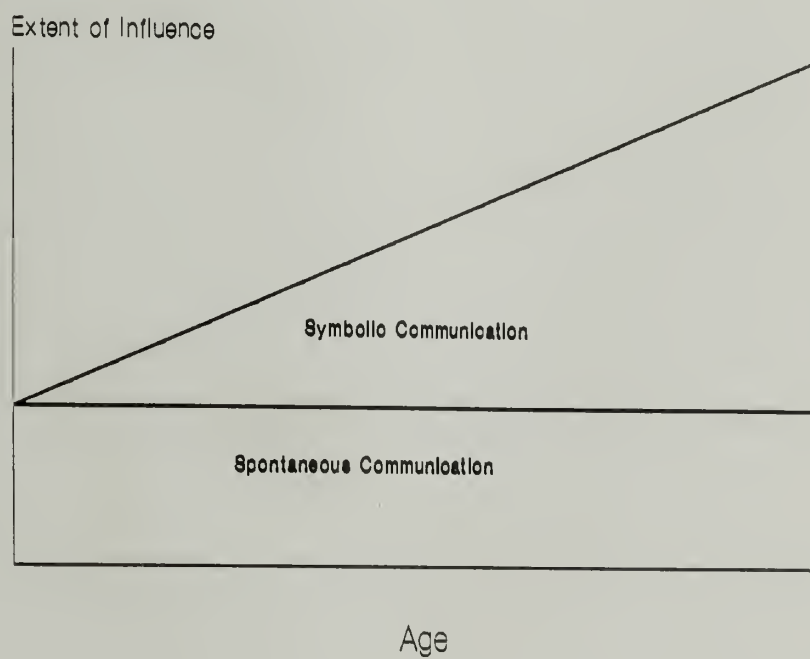
Buck (1984) does not elaborate upon the development of decoding abilities. However, he does point out that nonverbal sensitivity increasingly improves with age, in part because children acquire the cultural rules and expectations about the interpretation of emotional displays. They also learn to rely more heavily on leakier, less controllable nonverbal channels in cases in which discrepancies are perceived in the nonverbal message.

Conclusions

Buck definitively considers emotion and the development of facial expression from a biological perspective. The mechanisms and functions of both of these concepts are inherited from the phylogenetic history. Specific facial expressions have been selected for their adaptive value of communicating internal states to other conspecifics. Yet, facial expression is not a necessary component of emotion.

In Buck's theoretical construct, spontaneous facial expression of emotion appears early in life, in a discrete sequence controlled by the maturation of the subcortex. However, to be functional, this biological basis must be activated by specific social interactions. Later, through the processes of socialization, children learn to control their facial expressions.

Nesting development of facial expression of emotion within his global theory of emotion, Buck offers a very comprehensive perspective. His model integrates concerns from theories of emotion and motivation, nonverbal behavior, ethology of communication, and ethology. He nicely distinguishes between spontaneous and voluntary facial expression, and

their neurological basis. His is the only developmental model of facial expression to consider both encoding and decoding and to clearly differentiate their ontogenesis, although he develops the encoding aspects of facial expression more than the decoding aspects.

Unfortunately, the developmental processes are presented in a very broad manner and only general outlines are given. Also, the concept of spontaneous versus voluntary expression appears very dichotomous. It is not clearly delineated how both aspects interact to produce observed real-life facial expressions.

In sum, certain characteristics of the eliciting situation and the pattern of the corresponding facial expression are biologically given. In the course of development, voluntary expression is learned through specific socialization processes as a parallel system.

Izard: a neuro-motor model

The work of Izard has influenced the last 20 years of theory and research in the fields of emotion and facial expression. Izard has developed Tomkins's (1962) notion that facial expression originates the subjective experience of emotion. Similar to, yet independent of Ekman, Izard established the existence of pan-human emotions. His more recent work concentrates on the development of facial expressions, specially in young infants.

What is emotion?

In Izard's theoretical framework, the concept of emotion is placed within a broader system: personality. Izard (1978a, 1979a, 1984) conceives of personality as a complex organization of six interrelated subsystems: the homeostatic, drive, motor, perceptual, cognitive, and emotion subsystems. Although they have different functions, most of the time these subsystems operate in interaction. Hence, the emotion subsystem cannot be studied in isolation (Izard, 1984).

All personality subsystems comprise a minimal set of genetically encoded programs. This set constitutes the basis of the further elaboration and development of personality. Still, the subsystems are not present equally developped at birth, and each of them has its own rate of development. In Izard's view, the emotion subsystem is the primary motivational system for human beings, and therefore is the major determinant of the personality functions (Izard & Buechler, 1980).

Izard (1977, 1978a) defines the emotion subsystem as a complex process with neurophysiological, neuromuscular and phenomenological components. The phenomenological component is essentially the emotional subjective experience that is motivating or that has immediate meaning or significance for the person. The neuromuscular level consists primarily of patterned facial activity and secondarily by postural-gestural, visceral-glandular and vocal responses. Finally, the neurophysiological component includes (a) patterned electrochemical activity in the nervous system, particulary in the cortex, the hypothalamus, and the limbic system (b) the neural structures involved in the facial feedback and (c) the autonomic nervous system changes occurring during emotion.

None of these components alone is sufficient to produce emotion; all three components must be activated (Izard & Buechler, 1980). The processes whereby these interactions are regulated have been selected for and developed through our phylogenetic history (Izard, 1977).

Izard (1977, 1978b) identifies ten fundamental emotions: interest, joy, surprise, anger, distress, disgust, contempt, fear, shame/shyness, and guilt. The "fundamental" character of these emotions is defined by a set of properties. Fundamental emotions have innately determined neural mechanisms for their expression and experience. Thus, a specific fundamental emotion has a characteristic facial expression and a distinctive subjective quality. The neural mechanisms for the perception of fundamental emotions are also innate. Finally, the ontogenesis of fundamental emotion is primarily a function of maturational processes.

Izard (1977) differentiates emotion from reflex. Emotion involves a motivational state in addition to the motor action. Moreover, while reflexes are fixed and do not have any social value, the expression of emotion is modifiable and communicates social information.

But communication of the expressor states is not the only mediating function of the emotional system. Emotion also provides a basis for certain inferences about the environment and fosters social interaction that can facilitate the development of interpersonal relations (Izard, 1984). At the individual level, an emotion provides motivation, action tendency, and behaviorial alternatives that enhance personal adaptation (Izard, 1984). By providing direction, focus, and integration to the processes of sensation, perception, and cognition, emotion is the

principal organizer of the development of consciousness (Izard, 1978a, Izard and Buechler, 1980).

In sum, emotions are adaptive mechanisms selected for during our evolutionary history. They serve several functions at different levels: individual regulation, interindividual relations, and individual-environment relations. Emotions are complex phenomena involving neurophysiological, expressive, and phenomenological components. Fundamental emotions are genetically pre-wired and have characteristic facial expressions and subjective qualities.

Differential emotion model

Izard's model of emotion follows essentially a neurological sequence: the emotion phenomenon is constituted by a succession of motor and neurological events that end in the subjective experience of emotion.

The elicitor event. Izard (1977) mentions two broad classes of events that elicit emotion: perception by the individual of some characteristics of the environment, and intra-individual processes such as imaging, memory activity, imaginative and anticipatory thinking, proprioceptive impulses from motor activity, and autonomic nervous system activity. Certain cues are innate releasers of emotion (Izard, 1977): We inherit from our evolutionary history a set of relations between releaser events and emotions. Each emotion is prepared to respond to a limited set of incentive events, without requiring any form of learning or conditioning (Izard, 1984).

The neural activation. The elicitor, processed by the appropriate sensory receptors, changes the gradient of neural stimulation and the

pattern of activity in the limbic and sensory cortex (Izard, 1977). Izard refers here to Tomkins's (1962) neural activation theory. Tomkins (1962) defines neural activation as the product of intensity times the number of neural firings per unit of time. In Tomkins's theory, each emotion is triggered by a specific pattern of neural activation change over time. Izard (1977) subscribes to Tomkins' model, but adds to it some innate neural mechanisms programed to be selectively sensitive to certain inputs.

Emotion differentiation. At this stage, a first differentiation of emotion occurs. Changes in neural activation are transmitted to the hypothalamus. From the different patterns of neural activation, the hypothalamus determines the appropriate emotion and its associated facial expression and physiological pattern.

Expression of emotion. From the hypothalamus, the impulses go the motor cortex which organizes the neural message for facial expression. This information is transmitted to the muscles of the face via the facial nerve (the VIIth cranial).

Facial feedback. The trigeminal (Vth cranial) nerve conducts the proprioceptive feedback from the muscles of the face to the sensory cortex. The integration of the facial feedback by the cortex generates the subjective experience of emotion. This experience is the direct derivative of neurochemical sensory processes, which does not require any cognitive representation or transformation (Izard, 1984).

According to Izard (1977), the function of the autonomic nervous system is secondary. The cardio-vascular, hormonal, and respiratory systems have some importance in amplifying and sustaining emotion (Izard,

1977). They also mobilize energy for the behavioral outcome of emotion (Izard, 1978a). But given its poor differentiation, and the presence of visceral activity without emotion, the autonomic nervous system cannot possibly play a determining role in the emotion process.

The status of facial expression in emotion

In Izard's model, facial expression is a necessary component of naturally occurring emotion (Izard, 1978b). Nevertheless, during the emotion process, all three components are interactive and interdependent. No single component alone constitutes emotion (Izard, 1977). As a heritage of our evolutionary past, facial expressions of fundamental emotions are innate and universal (Izard, 1978a). The neural substrate of facial patterns and their links to certain releasers and specific subjective states is genetically programed. The neural mechanism for the perception of facial expression is also innate (Izard, 1978a). Facial expressions and more generally, the expressive behavior components of emotion, are direct function of sensory processes that do not require, in the stricte sense, any cognitive mediation. However, information processing, in a more general sense, is of course involved at some level in this process (Izard, 1984). Based on the innateness and universality of facial expression, then, Izard (1984) postulates the universality of the mental representation and feeling component of emotion.

Facial expression serves three main functions. First the facial feedback provides the brain with data for the cortical integration that generates subjective experience of emotion. Thus, facial expression plays a determining role in the elaboration of the phenomenological

component of emotion (Izard, 1978a). Second, facial patterns communicate the state of the expressor and, under certain circumstances, the face can act as an innate stimulus releaser for the perceiver. This social signaling function is particulary important in the development of the infant-caregiver attachment (Izard, 1977). Third, being partly under voluntary control, the face acts as a stage for the emotion-cognition interaction. Emotion can be cognitively regulated via the voluntary control of facial expression (Izard, 1984).

The ontogenesis of facial expression of emotion

   Biological foundations. In his ontogenetic model, Izard (1979) postulates a set of ten discrete emotions that are inherited from our phylogenetic history. Izard (1979a) is hereby clearly rejecting the differentiation hypothesis (Sroufe, 1976), according to which all the separate emotions have progressively stemmed from a unique and undifferentiated state of arousal during the course of development.

   The organism is prepared to respond by emotion and associated facial expressions to a limited set of innate releaser events without any conditioning (Izard, 1984). Through evolution, we have inherited innate neural programs that generate the facial patterns of fundamental emotions. The coherence between subjective state and facial expression is also genetically programed. Although innate, fundamental emotions and their associated expressive patterns, are not all present at birth. Their emergence is determined by a preprogrammed biological clock.

   Specific emotions appear when they become adaptive in the infant's life. Adaptiveness must not be intended for the infant as an individual,

but for the infant-in-social-surround. Adaptation of the individual considered in isolation is here secondary to the adaptation of the individual in his or her interpersonal dimension. Indeed, because of their compelling and motivating strength for the perceiver, infant facial expressions play a determinant role in the infant-caregiver interaction.

Given its strong genetic determinism, the ontogenesis of facial expression is primarily a function of maturational processes and secondarily a function of learning and experience (Izard, 1978b). According to Izard (1984), the biological development for the basic expressions already occurs before birth. Several distinctive facial patterns are present in the neonate: distress, smile, disgust, and interest (Izard, 1978b). By the first half of the second year, all facial expressions of fundamental emotions have appeared. Their time of emergence is the function, on one hand, of the neural and motoric maturation, and on the other hand, of the maturation of the cognitive functions that subserve the motivational component of these emotions (Izard, 1984).

Izard (1978a) refers here to the concept of critical period. The critical period can be considered as a milestone in the infant development where different personality subsystems come to interact together and set the stage for a particular type of learning and development. For example, the emergence of shame/shyness marks the beginning of the infant discrimination between self and others. Also, at a critical period, a given stimulus can elicit a different emotion than the one elicited during the previous stage. For example, the face of a stranger will elicit interest up to six month but fear later. These

developmental changes primarily result from the unfolding of innate neural programs of biological maturation.

In sum, an infant comes to the world with elaborated genetic programs. These programs organize the innate sensitivity to certain releasers, the morphology of facial expression, and a timetable for the emergence of the different facial expressions. The infant is prepared to display a range of pure discrete expressions prior to conditioning. The purity of the young infant facial expression is itself adaptive: it provides very compelling signals to the caregiver. These facial patterns undergo changes as a consequence of biological maturation, changes which mainly affect which expression will be elicited by which releaser. As a general developmental trend, emotion will be elicited first by physiological stimuli (e.g. neonatal smile during REM sleep period) and later, by progressively more psychological stimuli (e.g. the social smile) (Malatesta, 1985).

Socialization. On the other hand, innate maturational programs are not the only factors of developmental change in facial expression of emotion. Soon after birth, a series of social processes start to transform facial expression.

Instrumental learning. One of the first socialization factors is the shaping of facial expression occurring during the infant-caregiver interactions (Hyson & Izard, 1985). Indeed, the caregiver can respond or not to child's facial expression. In general, expressions of positive emotion will be reinforced, while expressions of negative emotions will not, or will be punished --a process which is especially true for female infants (Malatesta & Izard, 1985). Caregivers also adopt slow-paced

facial displays so that infants can imitate their modeled expression (Malatesta, 1985). These different forms of conditioning and shaping decrease the lability and the range of the infant facial display. At 18 months, blended emotion expressions appear, partly as a function of adult's shaping, and partly as a function of the increasing capacity for memory and cognitive appraisal (Hyson & Izard, 1985).

Voluntary control of facial expression and integration of emotion. After six months, infants learn voluntary facial expressions through imitation and imaginative play (Izard, 1978a). In so doing they acquire their first technique of self-regulation. At the same time, the emotional experience becomes increasingly organized, as a consequence of the development of the perceptive and cognitive processes associated with a given emotion experience (Izard, 1978a). The integration of the emotional experience culminates with language development which permits thoughts and feelings to coexist simultaneously in consciousness (Izard, 1984).

Enculturation. Through all the above mentioned processes, the infant starts to learn display and feeling rules (Izard, 1977) which specify where and when it is appropriate to display or to feel which facial expression. The cultural shaping of facial expression may be tantamount to the cultural shaping of emotion experience.

Conclusions

As well as Buck, Izard analyzes the development of facial expression of emotion from a strictly biological perspective. A large part of the emotion system, including expression, subjective experience, and

physiological responses have been selected during the process of evolution and are genetically programed. Izard defends Tomkins's position that facial expression, initiated by innate releasers, originates a direct experience of emotion.

The ontogenesis and morphology of facial expression of fundamental emotion are largely a function of innate biological maturation. Facial expressions appear full-blown soon after birth and their external appearance undergoes very few changes. From early reflex-like prototypes, facial expressions are progressively integrated into more complex forms of adaptive behaviors.

The already complex biological basis of the emotion subsystem is elaborated upon by (a) instrumental learning through shaping and imitation, (b) acquisition of voluntary control and self-regulation of facial expression, and (c) cognitive integration of emotional experience. These processes are responsible for enculturation via the learning of display. However, the socialization action is always secondary to and dependent on some biological given.

Ekman: a neuro-cultural model

Ekman's contribution to the study of facial expression is in many ways similar to Izard's. Both authors refer to Tomkins as the inspiration for their work, and they both give a predominant role to facial expression in emotional processes. That the existence of universal facial expressions has been established owes a great deal to both authors. However, while Izard's main concern is to elaborate a

general theory of emotion, the work of Ekman focuses more on facial expression of emotion in itself. Also, Ekman does not share Izard's strong stand in favor the innateness of most emotional processes.

What is emotion?

Ekman (1977, 1984) studies emotion in a comprehensive model integrating biological and cultural determinisms. In this model, similarily to Buck's and Izard's models, emotion is defined by a distinctive pattern of changes in three inter-related and emotion-differentiated systems: the cognitive system, the facial-expressive system, and the autonomic nervous system. Again, no single characteristic is sufficient to establish emotion, but a set of characteristics, organized into a coherent pattern, is required. To give an account of the relation between systems, Ekman (1984) postulates a direct central connection between the neural pathways leading from the motor cortex, which directs facial muscle activity, to hypothalamic areas involved in directing the autonomic nervous system.

Within this framework, Ekman (1984) uses the concept of emotion in a very specific and restricted sense. Indeed, with a set of ten differentiating characteristics, he distinguishes emotion from reflex, mood, emotional trait, and emotional disorder.

One of the main differentiating characteristic is duration. While reflexes are very short, the duration of emotion is longer, although strictly limited to between .5 and 4 seconds. Moods, possibly the consequences of longer enduring autonomic changes, refer to longer time spans than emotion. The concept of emotional trait defines the situation

where a particular emotion or set of emotions chronically reappears. Lastly, emotional disorder occurs when overwhelming emotions interfer with fundamental life tasks and when the individual cannot modulate his or her emotional experience or expression.

Emotions are also characterized by pan-cultural commonalities in their distinctive facial expressions, eliciting stimuli, and patterns of change in the autonomic and central nervous system. Moreover, as opposed to a reflex, emotional expression can be totally inhibited or simulated. Emotion can also be graded in intensity, reflecting variations in the strength of felt experience.

With this very restrictive definition of emotion, Ekman and Friesen (1986) identify seven distinct "fundamental" emotions: happiness, surprise, fear, disgust, sadness, anger, and contempt. In response to mixed eliciting situations, these emotions can be blended.

The status of facial expression in emotion

Ekman's (1984) theoretical and experimental work particularly emphasizes the facial expression of emotion. However, he notes that expression is not the most important feature in characterizing any affective phenomenon. Cognitive and physiological activities, as well as social context and subjective experience are also important. Nevertheless, Ekman describes facial expression as most readily accessible for study. A distinctive pattern of facial expression is a necessary condition for emotion: There is no emotion without facial expression. Ekman recognizes that expression can be inhibited, but he insists that the efferent impulses for a patterned facial expression will

<u>always</u> be produced when an emotion is called for.   One should note that this apparently extreme statement on the necessity of facial expression for emotion reflects more a narrow definition of emotion rather than a strong theoretical stand on the facial feedback hypothesis.   Indeed, Ekman labels as "non-emotion" any affective states exceeding 4 seconds of duration and/or lacking specific pan-human facial pattern.   In contrast, other authors still name the same states "emotion" (e.g., the study of grief by Averill, 1968).

The neurocultural model of facial expression

Ekman (1973, 1977; Oster & Ekman, 1978) has developed a comprehensive neurocultural model for studying the facial expression of emotion.   The model delineates five different components and suggests how biology, experience, and socialization might differentially influence each aspect of the facial expressive system.

1. Emotion Elicitors.   Based on cross-cultural studies of Boucher and Brandt (1981) establishing commonalities in emotion antecedents across many cultures, Ekman proposes "universal, abstract, <u>prototypic</u> situations as the elicitors for each emotion" (Ekman, 1984, p. 338) (e.g., an unexpected event for surprise).   Experience and socialization simply fill in the details, elaborating the universal prototypic elicitors for each emotion.

2. Appraisal Mechanisms analyze and evaluate the internal and external environment for potential elicitors of emotional responses. These mechanisms can be rapid and automatic if the eliciting situation matches with one of the prototypes.   These automatic processes can be

determined genetically or through repeated experiences. But if the antecedent event is not clearly related to a prototypic situation, an extended appraisal, involving more ponderous and protracted cognitive processing, and thus more time is required.

In any case, these appraisal mechanisms determine which emotion to activate. This is done by engaging the corresponding affect program and by triggering memories, images, and cognitions associated with the chosen emotion.

3. The Central Affect Program is a preprogrammed neurological sequence that sets off changes in a number of emotional responses, including the subjective experience of emotion. This set of responses constitutes the emotional response system. The centrality of the affect program allows it to control and coordinate simultaneous activities in several response systems.

4. The Emotional Response System includes facial and vocal responses, verbal responses, skeletal motor responses (e.g., turning away), more fully elaborated coping behaviors (e.g., fighting), and autonomic and central nervous system changes. The emotional response system also comprises the subjective experience of emotion. This latter component includes the memories, images, labels, and expectations related to the specific emotion, as well as the awarness of all or some of the above mentioned changes.

5. The Display Rules are processes for managing or interfering with the emotional responses. A display rule specifies who can show what emotion to whom, when, where, and how. Each individual has a defined set of display rules learned through his/her idiosyncratic experience of

socialization within family and culture. The display rules can amplify, modulate, or feign an emotional response. They can also mask an emotional response by the appearance of another one.

The ontogenesis of facial expression of emotion

In a general way, Ekman (Oster & Ekman, 1978) suggests that facial expression of emotion evolves ontogenetically in a gradual transition from automatic and uncontrolled expressions of emotion to more modulated, subtle, and voluntary expressions of emotion. The well-defined neurocultural model has, in this respect, precise developmental implications.

The model states that the display rules and most of the eliciting properties of the situations are learned. Indeed, as developed above, the display rules are the results of socialization and most of the eliciting properties of the stimuli are learned by the appraisal mechanisms. Through experience, conditioning, and cognitive maturation, the appraisor develops more complex and differentiated representations of the primary prototypes.

The other components of the model are described either as "universal" or as "innate". This distintion between "universal" and "innate" is important. Indeed, Oster & Ekman (1978) insist on the fact that universaIity does not imply in any way innateness. They suggest a number of alternative paths by which particular muscles' actions leading to facial expressions could come to be associated with particular emotions in people of all cultures. These paths range from being innate to being acquired through learning that is universal within the species.

Thus, according to Ekman and Oster, and contrary to the recent interpretation of Zivin (1986a), the affect program responsible for the consistancies in the facial appearances of emotion does not need to be fixed at birth.

After making the distinction between universality and innateness, the neurocultural model states that the neurological paths underlying physiological, facial, and muscular features of emotion are innate. The affect program, and the prototypical core of the eliciting situations are reported as universal. More precisely, Ekman and Oster (1982) established in a review of the literature that the facial musculature is fully formed and functional at birth. Oster (Oster & Ekman, 1978) also demonstrated that the full potential for facial expression was present at birth. Indeed, pre-term as well as full-term infants perform all the action units displayed by adults, and combine them in a non-random way. Ekman and Oster (1982) also reviewed evidence that distinctive facial expressions ressembling certain adults' expressions are present in early infancy.

Conclusions

In his neurological model Ekman articultes biological and psychological systems of analysis. The laws of evolution are responsible for the neurological and motor substrata of facial expression and culture transmits the display rules used during social interaction. While this model allows some place for individual learning, it does not develop an analysis of facial expression at the psychological level. Ekman's biological analysis of the development of facial expression is directly

drawn from Tomkins's model and is very similar to Buck's and Izard's analysis. However, Ekman must be credited for the concept of display rules which links social and biological perspectives.

Thus, from a developmental point of view, this model postulates that the neurological substrate for the expressions of fundamental emotion are innate and appear in a very discrete sequence very early in life. Later, children learn to control their facial expressions to conform to social display rules.

The strength of this model is twofold: It clearly delineates five components in the production of facial expressions and it specifies to which extent each component is innate, universal, or acquired. This latter distinction, also to be credited to Ekman, offers an interesting alternative to the classic dichotomy between nature and nurture. It grants to learning a significant role in the determination of facial expression and, more specifically, it suggests the possibility of pan-human learning. Unfortunately, this possibility has not been explored by Ekman.

However, the neuro-cultural model is not primarily a developmental model. Its first function is to give account of facial expression in adults. Nevertheless, the model does have some interesting implications for the ontogenesis of facial expression, but this is a secondary concern for Ekman. For example, how display rules and their usage are learned is not specified.

Finally, Ekman uses the concept of emotion in a very restrictive sense. The neuro-cultural model only applies to the specific responses that fall under this narrow definition of emotion.

Emde: a psychoanalytic model

The experimental work of Emde, a student of Spitz, is rooted in a psychoanalytic framework and in Emde's own clinical practice. He especially addresses the development of affect in early infancy. Although Emde is developing a model of affect and has extensively studied facial expression, he has never proposed a model of the production of emotional facial expression. Thus, his contribution must be considered in a slightly different manner from that used for the other authors discussed in this chapter.

What is emotion?

Emde (1980a) grounds his theory of emotion in Freud's later conception of affect (Freud, 1916-1917; 1926), which Emde refers to as the "organizational model". This model regards affect as a highly composite structure including, in the first place, motor innervation and discharges, and secondly certain feelings. These feelings are the perceptions of the motor actions just mentioned, and the direct feelings of pleasure/displeasure. The core which holds this composite structure of affect together is rooted in the biological history of the species. As a composite state, affect can be conscious or unconscious, and it includes cognitive elements. Affect is an active agent (what Emde calls a "principle") located in the ego; it organizes mental activity, behavior, and symptoms. As such, affect is considered as a signal rather than as a discharge phenomenon.

Drawing from contemporary developments in psychoanalytic thought, Emde (1980a) elaborates on the Freudian organizational model. He stresses the adaptive and organizational values of affect (Emde, 1980a, 1984). He also notes that human social relatedness is impossible without affective participation. Affect, because of its communicative value for the caregiver, is particulary necessary for survival during infancy. Affects are continuous aspects of our life, present both in conflict and no-conflict spheres of the ego. Finally, Emde (1980a) also incorporates Ekman's and Izard's concept of fundamental discrete emotion.

Facial expression of emotion

Facial expression is an important part of the "motor innervations and discharges" that are a primary constituent of affect. Emde avoids the definition problems of emotion by studying facial expression of emotion as a response system in its own right, without specifying the nature of its links with the internal states that generate facial expression (Emde, Kligman, Reich, & Wade, 1978).

Emde (Emde et al., 1978) stresses two fundamental characteristics of emotion expressions. Both of these characteristcs can be discerned in the way emotion expressions are communicated.

- a. Three dimensions, hedonic tone, activation, and internality-externality, can be extracted from emotional experience. These dimensions reflect biologically meaningful messages, playing an important role in adaptation.

- b. A number of categories of emotion, each of which carries discrete information, can be identified in emotion expression. These categories

are universal. As such, they too constitute biologically meaningful messages. They are biologically organized, although they are not present at birth and appear according to an epigenetic sequence. They can be combined to form "blends".

These two characteristics are related to two different neurological structures in the brain (Emde, 1984). The neurological substrate of the dimension is located in the diencephalic and reticular core of the brain. The discrete emotion requires more complex feedback from the hypothalamus, the thalamus, the autonomous nervous system, and the forebrain (Emde, Gaensbauer, & Harman, 1976).

The ontogenesis of facial expression

The genetic field theory. Emde's theoretical framework restates the genetic field theory of Spitz (Spitz, 1959; Emde et al., 1976), and Emde's research is organized within this context. Applied to facial expression (Emde et al. 1978), the theory asserts that:

1. There are uneven rates of physiological and behavioral development in infancy. Times of rapid changes are marked by the subsequent emergence of a new level of organization and of new functions in the infant behavior. As in Freud's theory of psychosexual development, the development of facial expression of emotion proceeds by a series of qualitative changes. The ontogenesis of facial expression is thus discontinuous.

2. Affective behaviors, particularly facial expression, are prominent indicators of these periods of rapid changes.

3. The proportional influence factor on the development of affect expression shifts from maturation to experience. The latter progressively becomes the most determining factor at the end of the first year.

Emde describes these periods of rapid changes as developmental shifts (Emde, 1980b; Emde et al. 1976). He has focused specifically on the two developmental shifts occurring during the first year, at 2 and at 7-9 months. Both are marked by the onset of new facial expressions. These onsets themselves have precursors. Indeed, some components of emotional facial expression, not yet thoroughly organized or integrated, may appear as developmental antecedents. The new facial expressions bring dramatic changes in the infant's social life, and occur at a nexus of organizational changes in other systems (Emde, 1980b).

The biological maturation and experiential factors in facial expression. The changes occurring in the development of facial expression are functions of two factors. They are determined first by the biological adaptive forces selected during evolution, that guarantees adaptation to an average acceptable environment. Secondarily, experience and learning secure the individual's adaptation to a particular biosocial context.

The biological adaptation is determined by our phylogenetic heritage, which fixates the time of onset and the developmental pattern of facial expression of emotion. By its innateness and universality, facial expression reflects a maturational self-organizing tendency. It is a built-in message with the adaptive function of facilitating the

attachment bond, and of communicating with the social environment in general, and with the caregiver in particular.

The main role of experience and learning is to fully achieve the differentiation of the biologically given emotion expressions. For example, fearfulness and surprise emerge in an undifferentiated form and are distinguished through later experiences (Emde et al., 1978).

Emde (1980b) minimizes the importance of the socialization and experiential factors. For him, facial expression is not a signal due to the consequence of socialization. Rather, it is a signal to begin with, already shaped to the environment through its phylogenetic history. Facial expression is a social signal (communicating something to the environment) before being a psychological signal (communicating to the individual).

Conclusions

The main perspective of Emde is biological. The structure of affect in general and of facial expression in particular have been elaborated during the evolutionary history and are transmitted genetically. Facial expression fulfills an adaptive function of communication in highly social species. Some aspects of Emde's analysis refers to a psychological system of analysis. Indeed, affect is described as an active ego principle and individual learning achieves the differentiation of biologically given facial expression.

Emotion expression develops in a discontinuous way, moving through different stages or periods of "behavioral shifts". The sequence of their onset is innate, fixed by our phylogenetic history. However, each

fundamental expression has precursors. Thus, this model combines both differentiation and discrete onset schemes. The function of learning processes is considered to be secondary; as they operate, the final touch is added to the whole system's adaptation to a specific environment.

In sum, Emde offers an interesting account of the development of facial expression during the first year. His approach integrates psychoanalysis, Piaget's and Spitz's conception of development stages, and experimental findings. As noted above, Emde's model integrates the two prototypical schemes of facial expression development—differentiation and discrete onset—and combines the concepts of discrete category and dimensionality of emotion.

The core of his model however, is directly drawn from Spitz's genetic field theory. No significant conceptual improvement has been contributed by Emde. Other limits of the model are that (a) it does not specify the nature of the relationship between facial expression and emotion, (b) it does not provide a model for the production of facial expression, (c) it is limited to development during the first year of life, and (d) spontaneous and voluntary facial expressions are not distinguished.

Sroufe: a differentiation model

Sroufe (1979) proposes a general theory of affect development in infancy inspired by the work of Spitz (1959). His model focuses mainly on the interplay and inseparability of emotional and cognitive processes. As Emde, Sroufe offers no explicit definition of emotion nor does he list

components of emotion. However, a general conception of emotion can be extracted from his work.

What is emotion?

Although autonomic arousal and expressive behavior are part of the emotional process, they do not constitute emotion per se. Emotion implies cognitive processes that allow (a) an engagement in the environment which results in a psychophysiological tension different from normal arousal and (b) a subjective experience through awareness, recognition, and self-concept. From this perspective, then, one cannot speak of "true" emotion prior to the acquisition of the differentiation between self and surrounding. In sum, emotion is primarily the result of the appraisal of certain characteristics of a given situation.

The status of facial expression in infant emotion

According to Sroufe (1979), there is no isomorphic relationship between facial expression and emotional experience. Facial expression cannot be used as a criterion for determining emotion in infant. Indeed, affective states may be communicated by facial expressions which differ in infants and in adults. Thus, the absence in infants of a typical adult facial expression, does not allow one to conclude the absence of the corresponding emotional experience.

In Sroufe's (1979) model, facial expression serves two functions. First, facial expression communicates needs, feelings, and internal states to the social environment. Second, infants use facial expression to modulate indirectly their state of arousal. Indeed, via appropriate

facial expression, the infant can encourage or discourage caregivers' behaviors which affect the infant's state of arousal.

The ontogenesis of facial expression

In Sroufe's work, the study of facial expression is only secondary to the study of emotional development. Thus, in order to introduce the development of facial expression, a short summary of Sroufe's (1979) theory of emotional development will be presented.

Emotional development. Sroufe (1979) considers the development of emotion from the perspective of ontogenesis in general. He emphasizes the interrelations and interdependencies between cognitive and emotional development. The general organization of infant development structures emotional development.

Emotion evolves from a global and undifferentiated distress/non distress continuum to progressively distinct and specific emotions. This general developmental trend is characterized by both continuity and discontinuity. The continuity is marked by the fact that no emotion suddenly appears full-blown. Each emotion has precursors that emerge progressively and can be traced back to the original distress/non distress continuum. For example, Sroufe asserts that fear and anger have a common precursor, wariness, which is a psychological arrest in response to a mixture of familiar and unfamiliar elements.

However, this progressive emergence is also structured by a fixed succession of stages. At each stage, a reorganization of the previous structure and qualitative changes occur. Each stage leads to

discontinuities in the rate of emotional development. As for Emde (Emde et al., 1976), Sroufe's (1979) concept of stage is directly derived from the Piagetian concept of cognitive stage. In this respect, both authors defend very similar views.

Cognitive and emotional developmental reorganizations or stages parallel each other. For example, fear and anger emerge simultaneously with object permanence and the understanding of the concept of intentionality and causality (Sroufe, 1979). At each stage, new behavior patterns and qualitative changes in emotion and facial expression appear.

Sroufe (1979) lists a fixed sequence of eight stages which unfold during the first 2 years of life (table 1). The emergence of a new stage is linked to the maturation of the central nervous system and to social and cognitive development.

Facial expression development. Facial expression develops parallel to emotion, in a progressive differentiation through the same eight stages or periods of reorganization. Each stage is marked by the fixation of one or several new facial patterns. For each given facial expression, specific precursors can be identified. Thus primitive pre-emotional states may contain facial movements that appear later as emotion differentiates.

For example, the social smile and the stranger fear reaction are qualitatively different from earlier expressions of positive or negative affect (e.g., endogenous smile for positive affect and wariness for negative affect). Yet, these differentiated emotions have their roots in

TABLE 1

Stages of Affective Development

Age   Stages and Affect Development

0-1 m.   Absolute Stimulus Barrier

                   . Invulnerability to external stimuli

1-3 m.   Turning toward the Environment

                   . Relative vulnerability (openess to stimuli)
                   . Attention and motor activity coordination
                          (precursors of interest and curiosity)
                   . Smiling, cooing

3-6 m.   Positive Affect

                   . Reliable social smile
                          (reciprocal exchange with caregiver)
                   . Capacity for anticipation, thus for frustration
                          (rage and wariness)
                   . Laugh: pleasure becomes an exitatory phenomenon

7-9 m.   Active Participation

                   . Effort to elicit social response
                   . Awarness of own emotions
                   . Joy, fear, anger, surprise

9-12 m.   Attachment

                   . Fear of stranger
                   . Integration of emotional reactions
                   . Differentiation of emotional expression

12-18 m.   Practicing Stage

                   . Exploration, self-assertion
                   . Control of emotional expression

TABLE 1. (continued)

Stages of Affective Development

Age   Stages and Affect Development

12-24 m.   Formation of Self-Concept

        . Sense of self as actor: active coping, positive
          self-evaluation, shame
        . Sense of separateness: affection, ambivalence,
          conflict of wills, defiance

24 m. and   Identification
older

        . Further differentiation of the emotional system

these earlier expressions and they are also logically related to later affect expressions (e.g., happiness) as the emotionality continues to evolve.

However, as developed above, facial expression does not have an isomorphic relation to emotional experience. In the course of development, facial expression may appear before or after the emergence of the experience it expresses. In the latter case, facial expression lags behind the capacity for experience but it further amplifies and sharpens the experience.

Conclusions

Sroufe analyzes facial expression from a psychological perspective. Through cognitive maturation, learning, and experience, facial expression differentiates progressively from a distress/non distress state. Moreover, the functions of facial expression--communication and regulation of affect--are purely psychological.

Sroufe clearly proposes a differentiation scheme with a series of reorganization stages. He maintains that there is no isomorphic relationship between facial expression and emotional state, but he does not specify what the nature of an alternative relationship of facial expression and emotion could be. Similarily, the concept of emotion is left undefined. Finally, Sroufe does not consider the possibility of universal facial expression, nor does he distinguish between spontaneous and voluntary facial expression.

Lewis: a socialization model

Lewis's interests are centered on emotional development and socialization of affect. He presents a detailed model of emotion and of emotional development, and discusses within this context the ontogenesis of facial expression.

Emotion: working definition and model

According to Lewis, emotion is comprised of a complex set of behaviors occurring around an equally elaborate set of situations or stimulus events (Lewis & Michalson, 1983). Because of this complexity, instead of trying to define emotion, Lewis prefers to represent it in terms of a structural analysis. In this analysis, the components of emotion are specified, rather than explained (Lewis & Michalson, 1983).

Five major components, together, constitute emotion. They are labeled elicitor, receptor, state, expression, and experience (Lewis & Michalson, 1983, 1985; Lewis & Saarni, 1985).

The emotional elicitors refer to situations or stimulus events that trigger the emotional receptors. The elicitors can be internal (e.g., a thought) or external (e.g., a loud noise), and their capacity to elicit emotion can be learned or innate.

The emotional receptors are specific loci or pathways in the central nervous system that mediate changes in the physiological and cognitive state of the organism. The type of event to which receptors are sensitive as well as the development of their function in the emotional system can be either acquired through experience or genetically encoded.

The <u>emotional states</u> are made of particular constellations of changes in the somatic and neuronal activity. These states are the consequence of the activation of the emotional receptors. The notion of <u>change</u> is important. Unlike moods, emotional states are <u>transient</u> patterned alteration in ongoing levels of physiological activity.

The <u>emotional expressions</u> are observable facial, vocal, postural, and locomotor behaviors accompanying emotional states.

The <u>emotional experiences</u> are the individual's conscious or unconscious perceptions, interpretations, and evaluations of their emotional states and expressions. These experiences are the result of cognitive processes influenced by a range of prior socialization experiences.

Lewis argues that most of the connections between emotion components are the product of learning and socialization. However, certain connections might be innate. For example, certain receptors have a genetically programed sensitivity to some elicitors as for a stimulus releaser (Lewis & Michalson, 1985). The connections between components are not as unidirectional as they seem to be. The emotion phenomenon does not unfold linearly from elicitor to emotional experience, but, instead, feedback is exchanged among all components and information flows multidirectionally. For example, the emotional state can influence the activity of the receptors.

Lewis distinguishes between primary and secondary emotions (Lewis & Michalson, 1983). Primary emotions are the ones that ontogenetically appear first. Secondary emotions are constituted by the mixture of several primary emotions.

The status of facial expression in emotion

The emotional expression component includes facial expression which is a function of two main factors. First, it is determined by complex neuromuscular responses. These responses are unlearned, biologically programmed, and universal. The second factor, which receives much emphasis from Lewis, is the social rules resulting from the socialization process.

Lewis denies the existence of an isomorphic relation between expression, states, and experience (Lewis & Michalson, 1985). Even if biological forces may have linked facial expression and emotional state at an early point of the ontogenesis, these components are normally dissociated, and their interactions are controlled by rules resulting from the socialization process. Lewis argues that the universal aspects of facial expression reported by Ekman and Izard may simply be the result of inter-culture similarities (Lewis & Michalson, 1983). Thus, if within the expression component itself, Lewis acknowledges the existence of genetically encoded facial configurations, he denies the existence of innate one-to-one connections between these facial configurations and some subjective experiences or some physiological states (Lewis & Michalson, 1985).

In Lewis's model, facial expression serves several functions, one of which is to communicate emotional state changes. This information has itself two social purposes. First, the communication of emotional states elicits empathic behaviors by inducing in another the particular emotion that one is feeling (contagion). Second, facial expression tells others

what the person is feeling, and allows them to adjust, to facilitate, or to inhibit the emotion. Indeed, in most circumstances, emotion expression can be totally inhibited or it can be produced in absence of emotional state in order to influence those to whom the expression is addressed (in instance of deception).

Facial expression can also help to determine emotional experience, but, contrary to Izard's position, only via cognitive evaluation. By feedback, facial expression influences emotional state. Finally, facial expression can act as an internal elicitor and initiate the emotional process.

The ontogenesis of facial expression of emotion

Lewis divides the issue of emotional development into two questions. The first one concerns the formation of the different emotional components, the second, the establishement of the various connections among components (Lewis & Michalson, 1983). The development of both components and connections is determined by three factors: socialization, biological maturation, and cognitive development. In Lewis' perspective, the study of facial expression development becomes the study of how socialization, biological processes, and cognitive maturation interact to produce facial expression, and to connect facial expression to other emotional components.

The first point, how facial expressions, per se, emerge, has not been developed by Lewis. He recognizes the importance of biological and maturational processes in the onset of particular facial configurations (Lewis & Michalson, 1985). The emergence of different facial expressions

as a function of age seems to imply a systematic unfolding of emotion in emotion development. Lewis does not take position in the debate between the progressive differentiation hypothesis and the discrete onset hypothesis.

Lewis has mainly studied the second question: the development of the links between facial expressions and other components. Facial expression is principally connected to states and elicitors, with the likelihood of observing an emotional expression depending on the nature of these connections.

The development of the state-expression connection. Lewis proposes a curvilinear relation between facial expression maturation and emotional state (Lewis & Michalson, 1985). The development of this relation can be summarized in three stages, as shown by figure 3.

Stage 1 is a biological asynchronous state which characterized by the relative undifferentiation of the internal states and by their absence of relation with facial expression. At this stage, infants do not display consistent patterns of facial expression, or, if they do, it is in the absence of a differentiated emotional state. To illustrate this stage, Lewis gives the example of the endogenous REM smile which is not elicited by a particular state or elicitor (Lewis & Michalson, 1983).

Stage 2 is marked by a greater synchrony: different patterns of facial expressions now correspond to different emotional states. Lewis proposes two hypothesis to explain that synchrony. In the first hypothesis, the link between facial expression and emotional state has been established by biological factors. The socialization processes are not powerful enough and/or the cognitive processes are not developed

FIGURE 3

The Relationship between Expression and Emotional State
during Ontogeny
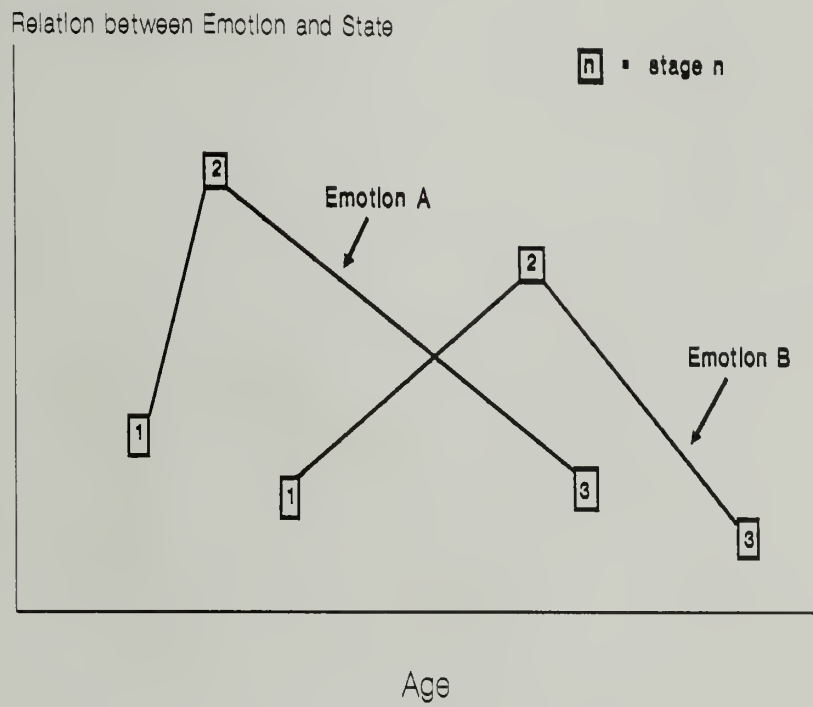
sufficiently to disengage the facial expression from the emotional state. In the second hypothesis, this link is the consequence of socialization practices which result in the selective display by the infant of particular facial expressions. Thus, for example, when caregivers reinforce a facial expression, they are also likely to be influencing the connection between that expression and the discriminable internal states that develop from an original undifferentiated form (Lewis & Michalson, 1985).

At stage 3, the maturation of the cognitive structures allows social reinforcement and socialization rules to be operative and facial expression and emotional state are once again independent. However, the degree of asynchrony may vary for different emotions. This variation is a function of five factors: (1) the nature of the emotion itself, (2) its degree of socialization, (3) the extent to which the emotion can be controlled, (4) its particular elicitor, and (5) the intensity of the elicitor.

As shown in figure 3, the development of each emotion has its own timetable, determined by both biological and social factors. This results in a unique temporal sequence in terms of (a) the first appearance of a particular facial expression and (b) its correspondence with a specific internal state. The time period between stages may also vary for different emotions (Lewis & Michalson, 1985).

Unfortunately, Lewis does not elaborate a model of the development of the connection between elicitor and expression. He just mentions that some elicitors are automatic and biologically given, although they may be

inhibited in the course of development. Other elicitors are learned by association (Lewis & Michalson, 1983).

How is facial expression socialized?. The same mechanisms prevail for facial expression as for other sets of behaviors. They can be classified in three categories (Lewis & Saarni, 1985).

Direct effects are the one where one or more agents of socialization act on the child. It can take the form of instrumental learning, classical conditioning, and diadic teaching.

In indirect effects, the child is socialized through the observation of other's behavior. This can be accomplished by identification (the child incorporates the values, goals, and behavior of another person), imitation and social learning.

Biological effects or contagion occurs when the emotion expression of another serves as an elicitor.

The socialization of emotion has five aspects, each of which is included in a feeling rule (Lewis & Saarni, 1985). Feeling rules determine (1) how, and (2) when to express emotion, how emotions are (3) managed, (4) labeled, and (5) interpreted. The two first rules, corresponding to the display rules of Ekman (1984), are particulary relevant for the socialization of facial expression (Lewis & Michalson, 1983, 1985). Through these rules, children learn when a display is appropriate. They also acquire knowledge about emotion expression apart from their actual experience.

Display rules start to operate at stage 3 of the dissociation between facial expression and emotional states. At this stage, facial expression becomes a symbol. It no longer has a one-to-one relation with

the objects or actions it is supposed to represent, but rather uses some arbitrary means to represent these objects or actions. This separation of expression from the internal state allows facial expression to function as an arbitrary code (Lewis & Michalson, 1985).

Conclusions

Although he emphazises more the social perspective, Lewis considers facial expression from all three levels of analysis. At the biological level, he acknowledges some innate pre-wiring in the morphology of facial expressions at their initial onset. From a psychological perspective, he stresses the importance of individual learning in the acquisition of facial expression and the function of facial expression as a regulator of emotion and as help in determining the emotional state. Last but not least, at the social level, facial expression, shaped by social rules and codes, serves as a medium to communicate emotional states.

This model presents a curvilinear relationship between age and the correspondance of facial expression and the internal states. It also proposes a succession of two factors as determinents of the ontogenesis of facial expression. In early infancy, biological maturation is responsible for the onset of consistent facial patterns and their relationship to internal states. Very soon, however, socialization processes influence the production of facial expression and shadow biological factors. Facial displays are then totally determined by social factors. As stated above, Lewis does not take a position in the debate between differentiation and discrete onset models.

Unfortunately, this model does not detail either the nature of the biological factors nor what processes these factors determine. Similarily, it is not explained fully how facial expression can help to determine or to regulate the emotional state. Lewis also defends a strong voluntary control of facial expression. Yet, a wealth of empirical evidence, reviewed in the next chapter, testifies how this control is difficult to achieve, even in adulthood.

General Conclusion

The integration of the six schemes of facial expression development presented above is hindered by the absence of consensus about a model detailing the encoding mechanisms of facial expression. Recently, Zivin (1986) tried to elaborate a general model of facial expression communication, attempting to discuss the development of expressive behavior within this context. As a skeletal model, she proposes an organizing framework consisting of six components (context, appraiser, emotional state, editor, expressive behavior, and reactor), and of 17 links among these components. In her analysis of the ontogenesis of nonverbal expression, Zivin reviews all the possible processes explaining how the components of her model and their links might develop. Zivin's approach however, considers expressive behavior in general, not specifically facial expression of emotion. Her model has also been criticized for overemphasizing cognitive processes (Hinde, 1986; Izard, 1986). This last section of the first chapter will attempt to extract a model specific to the development of facial expression of emotion from

Four of the six authors presented, Buck, Izard, Ekman, and Lewis, develop a structured model for the encoding of facial expression. Emde and Sroufe focus more on developmental concerns and do not offer an explicit account of the production mechanisms of facial expression.

A synopsis of the four structured models is presented in Table 2. It appears that these four authors roughly agree on a general framework and that six components can be extracted from their models: (a) an elicitor which consists of any internal or external emotional stimulus, (b) an appraiser which detects the elicitor and organizes the emotional response, (c) the expressive behavior including facial expression, (d) the autonomic responses, (e) the subjective experience of emotion, and (f) an editor which conforms the expressive behavior to the display rules. A model of facial expression development must determine how these components appear, evolve, and interact to produce facial expression during ontogenesis.

Most authors agree on the basic scheme of the process: An elicitor triggers the appraiser which in turn generates facial expression after being censored by the editor. A controversy appears however, about the nature of the link between facial expression and other components like subjective experience or autonomic responses. Similarly, there is little agreement about the determinants--genetic transmission or learning--of both these components and their links.

It also seems established that, with the exception of some stimuli functioning as ethological releasors, the elicitors are learned during the process of development. Still, theorists referring to biological systems of analysis tend to attribute more importance to innate releasors

TABLE   2

LEWIS

Emotional Elicitor
Emotional Receptor
Emotional State
Emotional Expression
Emotional Experience

BUCK

Emotional Elicitor → Primes → Experience State / Experience / Expression

IZARD

Elicitor Event → Neural Activation → Differentiation → Expression → Facial Feedback → Experience

EKMAN

Elicitor → Appraisal → Central Affect Program → Emotional Response System
ANS Responses
Expression
Experience
Display Rules
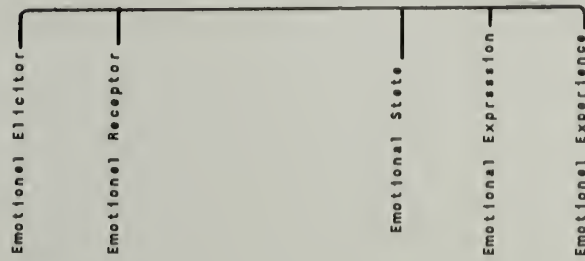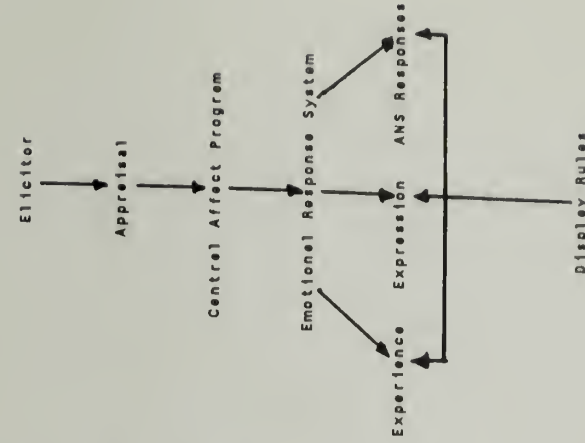
than do the authors espousing a social perspective. Similarly, Buck, Izard, Ekman, and Emde hold the motor and neural substrata of facial expression to be genetically pre-wired but for Sroufe, the facial patterns of emotion are entirely learned. The consensus is however, that at least the spontaneous facial displays of fundamental emotions lie in an innate biological basis. The debate concerning the relationship between components remains unsettled. While some authors state that the appraiser and its links to the elicitors are basically inherited from the phylogenetic history (e.g., Buck, 1984), others maintain that these components are learned during the process of development (e.g., Lewis and Michalson, 1983). Moreover, different hypothesis have been formulated about the interaction between facial expression and subjective experience or autonomic responses (e.g., facial feedback hypothesis). This topic is still vigorously debated.

Nevertheless, most authors recognize a direct relationship between appraiser and spontaneous facial expression. Similarly, all models attribute an important role to facial expression for assessing the emotional state and for determining the subjective experience of emotion. Yet, controversy persists about the necessity and sufficiency of this function of facial expression, and about the mechanisms involved. Finally, the importance of the display rules which determine the relationship of voluntary expression--learned, by definition--to the elicitors is largely recognized. Yet, this still recent concept needs to be further elaborated.

Concerning the general process of the developmental model itself, the consensus for an, at least minimal, biological basis for spontaneous

facial expression has contributed to abandoning the original formulation of the differentiation model. Most authors propose a discrete onset of full-blown prototypical expressions or an onset proceeding through a sequence of qualitatively different stages. Thus with Sroufe being the exception, the basic model of Bridges (1932) seems to have been abandoned by contemporary theorists.

At the more abstract level of the systems of analysis, one notices the prevalence of the biological and social perspectives. Facial expression has mainly been presented either as an adaptive behavior selected for by the laws of evolution during phylogeny or as functional code of communication determined by social and cultural norms. Unfortunately, the psychological perspective has often been ignored. For example, while most authors agree on the importance of facial expression in the regulation of emotion and behavior in general, the development of this function during ontogenesis has received very little attention.

Moreover, theorists have totally ignored the ontogenesis of the recognition of facial expression. This capacity is too easily assumed to be learned. Empirical evidence suggests that some facial expressions may function as potent pre-wired stimulus releasors and may have an innate signal value (e.g., Lanzetta & McHugo, 1986). Yet, a model of the development of facial expression recognition remains to be developed

In sum, the six theories introduced above offer more controversy than consensus. A general scheme though, seems to underlie most models: Some fundamental facial displays are inherited from the phylogenetic history and, given the appropriate stimulations and social interactions, appear early in infancy. It is still uncertain how these facial displays

are related to the appraiser and other components of the model during the process of development. Soon however, spontaneous expression is modified through the socialization processes. These modifications are later organized in a structured set of editing norms for the expressive behavior: the display rules. To find empirical evidence supporting this general scheme and to resolve part of the controversy, the next chapter will review the experimental data about the development of recognition and expression of facial displays and will confront the different theories on empirical grounds.

C H A P T E R   I I

REVIEW OF THE EMPIRICAL STUDIES OF
THE DEVELOPMENT OF FACIAL EXPRESSION OF EMOTION

This chapter reviews the recent research on the development of facial expression of emotion from birth, up to but not including adolescence. Parallel to a renewed interest in emotion and facial expression, the research on the ontogenesis of the emotional displays has developed dramatically in the last 10 years.

To systematize the large and diverse spectrum of experiments related to this area, the studies presented have been classified into three sections. The first section reviews the studies concerning the development of the encoding or expression of facial expression. The second section reviews the studies concerning the development of the decoding or recognition of facial expression. Finally, the last section reviews the studies concerning the development of display rules. While the first two sections correspond to a classic subdivision of this area of research (Buck, 1984), the third section reflects a more recent but developing domain of interest.

Almost all of the studies to be presented in this chapter have been published within the last fifteen years, since earlier research has been reviewed by Charlesworth and Kreutzer (1973). The conclusions of these authors will be summarized and integrated with the findings of recent research in the conclusion of each section.

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Encoding Facial Expression

The research investigating how facial expression of emotion develops
in infants and in children will first be presented. Since numerous
authors have reported differences between spontaneous and voluntary
facial displays, these two forms of facial expression will be reviewed
separately (Buck, 1984; Ekman, 1984; Izard, 1979a).

Spontaneous facial expression

The review of the studies on the development of spontaneous facial
expression of emotion can be best understood in term of the ontogenic
sequence of development. Accordingly, we will first consider the early
facial displays of neonates, next, we will review facial expression in
infant and children.

Early facial displays in neonates

It has been well established that all the muscles of the face are
anatomically and physiologically functional as early as the seventh month
of gestation (Humphrey, 1970). This suggests a potential for facial
expression even before birth. Also, most of the theories of facial
expression development hold precise and differentiated predictions about
neonatal facial expressivity. Despite the important theoretical
implications that could be drawn from careful and systematic observations
of neonatal facial expressions, very few recent studies have been
conducted on this topic.

Approaching this question, Field and her colleagues studied the reactions of neonates (mean age: 36 h.) to a model posing three emotions: happiness, sadness, and surprise (Field, Woodson, Greenberg, & Cohen, 1982). From the videotaped facial expressions of the neonates, judges could guess with a significant accuracy the model's facial expression.

Using a more analytic and fine-grained technique of decoding --a version of FACS adapted for infants-- Oster and Ekman (1978) analyzed facial expressions of 20-minutes- to three-months-old neonates. They observed that all but one discrete facial action listed in FACS can be clearly identified in both full- and pre-term infants. The exception was AU 13, which raises the lips' corners in a smirk. Ekman and Oster, however, noted that this facial action is very rare in adults and thus may have been missed in the sample.

All the other facial actions were distinctive in appearance and could be finely discriminated. They were often displayed in combination with other facial actions. Ekman and Oster suggest the existence of some consistency in the occurrence of these combinations. Unfortunately, they did not investigate this question in their data.

These two studies confirm that at least the neuromuscular prerequisites for facial expression are present at birth. Neonates can perform all the facial muscular actions necessary for the total range of facial expression. Also, the data of Field and her colleagues (Field et al., 1982) suggest that facial expression is potentially intelligible to the infant's caregivers.

Spontaneous facial displays in infants

The young children's proficiency in spontaneous facial expression has generally been studied by placing infants in emotion arousing situations in which their facial behavior is observed. A wealth of situations varying in specificity and in type of emotion elicited have been used. For example, in a general study by Izard and his colleagues, untrained judges had to identify facial expressions of one- to nine-month-old infants (Izard, Huebner, Risser, McGinnes, and Dougherty, 1980). Slides of peak facial expressions were taken from videotapes of infants in a variety of situations. Judges identified the facial expressions of the eight basic emotions listed by Izard (1977): interest, happiness, surprise, sadness, anger, disgust, contempt, and fear, although the consensus was low for the expressions of anger, disgust, and contempt. However, as facial displays were not related to the context, this study offers no basis to establish a correspondence between facial expression and emotional states.

Other studies relate facial expressions to their context. For example, Hiatt, Campos, and Emde (1983) placed 10- to 12-months-old infants in situations that typically arouse happiness, surprise, and fear. Each emotion was elicited by two different situations. The subjects' videotaped facial expression was coded with (a) an adaptation of FACS (Ekman & Friesen, 1978) and (b) a forced choice of one of seven emotions (happiness, fear, disgust, anger, surprise, sadness, and neutral state). Raters produced reliable judgments without any knowledge of the context. The authors, however, noted that almost all situations elicited blends rather than discrete emotions.

Other authors focussed their research on facial displays in specific situations. Izard et al. examined changes infants' response to acute pain (Izard, Hembree, Dougherty, & Spizirri, 1983). In this longitudinal study, infants were filmed during and after four vaccination inoculations occurring between the second and the eighteenth month of the infant's life. Judges rating infants' facial expressions with the discrete coding system MAX (Izard, 1979b) reported expressions of interest, anger, distress, and sadness at all ages. Distress expressions decreased with age, especially after eight months, while anger increased in parallel. Individual differences were also observed: infants who were slow to be soothed expressed anger for longer durations.

In the same vein, Stenberg, Campos, and Emde (1983) studied seven-month-old infant's reaction to a frustrating experience. The infant was given a biscuit which was repeatedly taken away and the infant's videotaped expressions were coded with FAST (Ekman & Friesen, 1976). The authors concluded that the capacity to express anger is well developed in seven-months-old infants and that the expression of anger increases with the repetition of a frustrating episode.

Another line of research in the development of emotion expression examines the infant's facial expression during episodes of separation from the mother. All the studies in this area use the Ainsworth strange-situation. This procedure is a separation and stranger confrontation paradigm which has been designed mainly for infant-caregiver attachment research (Ainsworth, Blehar, Waters, & Wall, 1978). Infants are placed in an unfamiliar setting, typically a laboratory room furnished with toys, where they play with their caregiver in the presence of a stranger.

After a short time of familiarization, the caregiver exits the room for a brief period, usually two to three minutes, leaving the infant alone with the stranger. The caregiver then comes back and plays again with the infant. In a second separation episode, the infant is left totally alone in the room. Infants' facial expressions and behaviors are usually videotaped during the session and are later rated by a pool of judges.

Malatesta and her colleagues conducted two experiments using Ainsworth's procedure with 2.5- to 7.5-month-old infants (Malatesta, & Haviland, 1982; Malatesta, Grigoryev, Lamb, & Culver, 1986). Infants facial expressions were rated with the discrete decoding system MAX (Izard, 1979b). They found that infants display a large variety of expressions, including (in order of frequency): knit brow, happiness, anger, discomfort, interest, brow flash, surprise, and sadness. In these studies, no facial pattern of fear or disgust was observed. Malatesta and her colleagues also noted a linear increase with age in the display of positive affect, especially interest and happiness, and a corresponding decrease in (a) the rate of expression changes and (b) negative affect, especially discomfort and knit brow.

As evidence for early socialization process of emotion, Malatesta and her colleagues noted in both studies that mothers responded more frequently with contingent responses to positive expressions and tended to ignore negative expressions. This trend in maternal responses is even more marked toward males than toward females. Also, these authors reported similarities between mother and infant expression in the preferential use of particular emotion type and particular facial region (brow vs. mouth) for expression.

The same procedure has been used with older infants. From data of the second and more stressful period of separation in Ainsworth's procedure, Schiller, Izard, and Hembree (1986) investigated the relationship in 13-month-old infants between facial expression patterns and type of attachment as defined by Ainsworth (Ainsworth et al., 1978). Infants' facial expressions were coded with AFFEX, a coding system which proceeds by holistic judgments of the face (Izard & Dougherty, 1980). They found that the emotions expressed the most often were, in order of frequency, anger, sadness, and fear, this latter result being in contrast to the findings of Malatesta et al.'s investigation of younger children. Schiller et al. also discovered a correspondence between facial expression and the type of attachment. Infants who showed an anxious-resistant attachment pattern displayed more sadness and less interest than infants in the securely attached group.

Furthering the study of individual expressive differences in the strange-situation procedure, Hyson and Izard (1985) demonstrated individual continuities in anger, sadness and interest expression. They also found correlations between infants' expressions at 13 and 18 months for (a) each discrete emotion, (b) emotion blends, and (c) rate of expression changes. As a whole, facial expression blends tend to increase between 13 and 18 months. Indeed, in 1.5-years-old infants, different emotions are more often expressed simultaneously with separate regions of the face.

These studies suggest that, with the exception of fear, the whole range of facial expressions can be observed before the third month of life. Indeed, disgust, happiness, anger, interest, surprise, and sadness

have been reported in two-month-olds. The relationship between facial expression and context or state, however proven for seven-month-old and older children, has not yet been established for younger infants. Fear seems to appear later, between the seventh and the ninth month, as observed by Emde, Gaensbauer, and Harmon (1976).

The above reviewed studies also establish developmental and individual trends in emotional reactivity. The same situation will elicit diverse facial expressions in different infants, depending of their age and individual characteristics. With age, the ratio of positive over negative emotions increases. Finally, emotional blends become more frequent during the second year of life.

Spontaneous facial display in post-infancy children

In older children, the major question investigated is the extent to which children communicate nonverbally and spontaneously their emotional state. Children are induced into an emotional state by empathic reaction to a story or a movie which is presented to them. Hamilton (1973) pioneered this paradigm in a study where he showed 5- to 11-year-old children two films of a model portraying happiness or sadness. Judges were able to guess accurately the type of film shown from the videotaped infants' facial expressions. However, Hamilton did not find effects for children's age or sex on the judges' performance.

Similarly, Buck (1975) presented four- to six-year-old children with pleasant and unpleasant slides. Again, undergraduate judges and children's mothers were able to guess successfully the type of slide shown from the children's videotaped facial expressions. In addition,

Buck noted large individual differences in sending abilities. Extraverted children were more successful senders than introverted children. No sex difference was reported.

Feinman and Feldman (1982) used the same procedure with similar subjects. However, they presented slides of four emotions (happiness, sadness, fear, and anger) rather than two and the slides were accompanied with comments describing the emotion-arousing situation. In this study, mothers could only decode happiness and anger better than chance while undergraduate judges were totally unsuccessful. Moreover, male children encoded happiness better than females and females were decoded worse than chance for anger.

Finally, to induce emotion in their subjects, Schwartz-Felleman and colleagues used a different technique which led to more differentiated results. In their study, four- to five-year-old children were told stories inducing happiness, sadness, anger, or a neutral state (Schwartz-Felleman, Barden, Rosenberg, & Masters, 1983). Judges guessed the type of story children were told from photographs of the children's facial expressions at better than chance levels.

In sum, the face seems to carry some information about children's subtle emotional states as induced by slides or stories. However, this information is poorly differentiated and the spontaneous sending accuracy of emotional information varies greatly among individuals and types of emotion. Finally, the fact that parents are better decoders than other adults of their children facial expressions suggests the existence of consistent idiosyncrasies in facial expressive style.

Voluntary facial expression

Two forms of voluntarily controlled facial expression have been studied in children. In the former, the subjects have to pose an emotion of which they receive the label; in the latter, they have to imitate a model or photograph of a model posing an emotion.

Posed facial expression

In two studies children were asked to pose emotional expressions. Zuckerman and Przewuzman (1979) showed that 2.5- to 5-year-old children could successfully pose happiness, sadness, anger, surprise, fear, and disgust. This ability increased with age for females, while it slightly decreased for males. Schwartz-Felleman and her colleagues compared spontaneous and posed facial expressions. In the same study discussed earlier, these authors had four- to five-year-old children successfully pose happiness, sadness and anger (Schwartz-Felleman et al. 1983). Children's expression of happiness were more recognizable when posed than when spontaneous but no difference in decodability was found between spontaneous and posed expressions of sadness and anger.

Imitation of facial expressions

Children's ability to imitate the facial expression of a photographed or videotaped model has also been investigated. Odom and Lemond (1972) found that imitative accuracy increases between five to ten years of age. These results are the opposite of what is generally

observed for spontaneous facial expression which is reported to be increasingly inhibited during childhood.

Studying more discrete components of facial expression, Ekman, Roper, and Hager (1980) asked 5- to 13-year-old children to imitate the facial actions identified in FACS (Ekman & Friesen, 1978). Children observed a videotape of a model posing a single action unit or a combination of action units. In this study, children's performance also improved with age or with the help of a mirror or a coach. All children could express happiness (AU12) and surprise (brow raise: AU1+2). Nine- and thirteen-year-old children encoded the facial actions of surprise and disgust, but had difficulties with some facial movements included in fear, anger, and sadness.

Investigating imitative ability at a younger age, Field and Walden (1982) had three- to five-year-old children imitate facial expressions in several conditions: children either received the help of a mirror or did not, and were or not given the label of the emotion portrayed by the model. Children in the imitation-alone condition could perform most successfully. They encoded, in order of accuracy, happiness, sadness, surprise, interest, disgust, anger, and fear. The children's ability to imitate facial expression was not related statistically to their age or to spontaneous expressivity during free play. This latter finding is contrary to what Lemond and Odom, and Ekman et al. reported in older children.

In sum, the voluntary facial expression of emotion seems to be mastered after the spontaneous facial expression. Voluntary facial expression skills are progressively developed throughout all of childhood

and even later. As reported by Ekman et al. (1980), even adults have problems in voluntarily producing certain components of common spontaneous expressions. Also, at all ages, facial expressions of positive emotions are generally easier to pose or imitate than facial expressions of negative emotion. Happiness is the easiest emotion to express voluntarily.

Conclusion

In their 1973 review of the literature, Charlesworth and Kreutzer reported that expression of distress and delight were well developed at two months of age, anger at six, and that fear appeared sometime during the first six months (although no precise time of onset could be determined). Surprise had not been observed before the first year unless in a weak, attenuated form. The same authors could not cite any systematic investigation of the neonates' expressive capabilities. They also reported that, during childhood, while the occurrence of smiling and laughing increased with age, the frequency of crying progressively diminished.

Since then numerous gaps have been filled in our knowledge of the ontogenesis of the facial expression of emotion. Oster and Ekman (1978) established that the facial musculature is fully formed and functional at birth. Also, several emotions have now been proven to be expressed earlier in life than what was reported by Charlesworth and Kreutzer. Facial expressions of happiness, sadness, disgust, and surprise have all been identified prior to or at the third month of life. Fear display,

however, is consistently reported to appear later, between the seventh and ninth month. The development of discrete techniques to decode facial displays (e.g., FACS) may be responsible for detection at an earlier age of the onset of facial expression in more recent research. In preschool children, spontaneous empathic emotional displays have been observed in response to both adults' and children's facial expression.

Confirming Charlesworth's and Kreutzer's earlier reports, the expression of positive emotion increases with age, while the expression of negative emotion decreases. Later in life, negative emotions are more difficult to express voluntarily than positive ones. With age, the emotional blends also develop in frequency and diversity. Finally, the ability for expressing voluntarily emotion develops later. Preschoolers can imitate and voluntarily produce recognizable facial expressions. However, not until their tenth year can they do this convincingly.

Unfortunately, the studies investigating young infants (seven-month-olds or younger) rarely, if ever, relate facial displays to the context in which they occur. Emotional states are too often inferred from facial expressions without seeking confirmation from converging evidence. Several authors, however, point to the existence of discontinuities in the relationship between facial displays and their context (Izard et al, 1980; Zivin 1982, 1986). The same situation (e.g., the approach of a stranger) may elicit different emotions and related facial expressions according to the developmental stage of the infant or to individual characteristics.

Very few studies have investigated such individual and developmental trends. Among the few exceptions are the studies of the ontogenesis of

smiling and of the fear of strangers. Hence, the two domains of the relationship of facial expression to its context and individual differences in expressive reactions to a situation remain largely unexplored, and they may constitute a promising area of research for the future.

Decoding Facial Expression

This second section specifically addresses the ontogenesis of facial expression decoding skills. We will review the literature on the development of facial expression recognition for different types of emotion.

Infants' ability to decode facial expression of emotion

A wealth of research using the habituation-recognition paradigm have investigated young infants' ability to discriminate among different facial expressions. With this procedure, infants as young as one-day-old have been studied.

Typically, infants in this habituation-recognition paradigm are presented with photographs of faces of different actors posing diverse emotions. The dependent variable is the amount of time that the infant fixates on each photograph. From the infant's pattern of fixation to a series of photographs combining same and different emotions and actors, the infant's ability to discriminate between different facial expressions

Is established. Moreover, given that infants generally allow more fixation time to a novel stimulus, one can deduce whether the infant reacts differentially to a photograph of the same actor posing a different emotion as to a novel stimulus. Infants' reactions to photographs of different persons are typically used as a control.

The studies using the habituation-recovery paradigm yields relatively divergent results. Field and colleagues found that neonates (mean age: 36 hours) could discriminate between facial expressions of happiness, sadness, and surprise posed by a model (Field, Woodson, Greenberg, & Cohen, 1982). Using photographs as stimuli, Barrera and Maurer (1981) produced evidence of discrimination between smiling (happy) and frowning (angry) faces in three-month-old infants. The same results have been reported in four- and five-month-old by La Barbera, Izard, Vietze, and Parisi (1976). Studying three-month-old infants, Young-Brown and colleagues observed that surprise was discriminated from happiness and sadness, and that happiness was discriminated from surprise, but that sadness was not distinguished from either happiness or surprise (Young-Brown, Rosenfeld, & Horowitz, 1977). In five-month-old infants, Schwartz et al. found some evidence of discrimination between angry, fearful, and sad faces but they failed to establish any differential recognition of happy, angry, or interested face (Schwartz, Izard, & Ansul, 1985).

In contrast to Field et al. (1982) findings, Caron and colleagues did not find differentiation between happiness and surprise before seven months of age (Caron, Caron, & Meyers, 1982). In this latter study, while four-month-old infants did not show any evidence of differentiation, five-month-olds could discriminate surprise following

habituation to happiness, but not the reverse. Similarly, Nelson, Morse, and Leavitt (1979) demonstrated that seven-month-olds could differentiate between happiness and fear.

Several hypothesis have been proposed to explain these divergent results. Caron et al. (1982) note that the studies reporting differentiation in infants younger than six months have a common methodological characteristic: they use a single actor posing the different emotions. These studies fail to respond to the question of whether infants had in fact perceived differences of expressions, or had differentiated some isolated features having no emotional meaning. This interpretation receives support from a study by Oster and Ewy (in Oster, 1981). These authors reported that four-month-olds fixated on photographs of toothy smiles longer than on photographs of sad faces but showed no preferences for closed-mouth smile over sad faces.

Schwatz, Izard, and Ansul (1985) propose a more theoretical explanation. According to these authors, the habituation-recognition paradigm underestimates the infant's ability to detect differences among stimuli of different social and emotional signal value. For example, the angry face of the caregiver may indicate an interruption of the interaction with the infant and, as such, has an important emotional signal value, while the sad face of the caregiver may not be predictive of anything for the infant and thus has no emotional signal value. From this perspective, young infants would learn to differentiate between only those facial expressions having social and emotional signal value.

These two hypotheses are certainly not exclusive. However, whatever virtues or limitations the habituation-recognition paradigm may have, the

divergent data call for a conservative conclusion: There is no strong evidence of differentiation in the decoding of facial expression of emotion before the age of six months. Even at this age, the existing data only investigate facial expression of a very limited range of emotion.

Other procedures have also been employed. For instance, Klinnert (1986) studied older infant use of emotional facial expression from adults. One-year-old infants were confronted by unusual toys in presence of an experimenter expressing happiness or fear. The infants used the adults' emotional facial expression to regulate their own behavior.

Children's ability to decode facial expression of emotion

Overall, two main aspects of facial expression decoding skills have been studied in children. The first aspect concerns children's ability to categorize facial expression of emotion, while the second has examined their ability to relate facial expression of emotion to a context or a situation.

Categorization of facial expression of emotion

As part of their research investigating developmental differences in the perception and production of facial expression, Odom and Lemond (1972) asked preschoolers and fifth-graders to sort photographs of faces expressing the eight fundamental emotions of Izard (Izard, 1977). Children had to match together the persons who "felt the same". The ability to discriminate facial expressions appeared to improve with age.

Hamilton (1973) reached the same conclusion by asking subjects of the same age to pair photographs of facial expressions with a photograph of a standard facial expression.

The same procedure has been used by Walden and Field (1982), who asked four- to five-year-olds to choose from an array of drawings the face of the person that "felt the same" as a standard. The drawings of faces were portraying happiness, sadness, surprise, and anger. The faces in the choice array varied on one or more features of the standard facial expression, or had identical elements. In this study, happiness was decoded slightly better than sadness, which in turn was categorized more accurately than surprise and anger.

In other experiments, children had to label the emotion expressed in a face represented by a drawing, photograph, or videotape. In a study by Zuckerman and Przewuzman (1979), preschoolers decoded emotions of happiness, sadness, anger, fear, and surprise (listed in order of accuracy) from Ekman and Friesen's (1976) set of photographs. Overall decoding skill increased with age. Field and Walden (1982) had three- to five-year-olds decode videotaped faces of children of the same age voluntarily expressing emotion. The subjects discriminated better than chance happiness, sadness, shame, surprise, interest, disgust, anger, and fear (in order of accuracy).

In two studies, Masters and collaborators investigated children's discrimination between happy, sad, angry, and neutral faces (Felleman, Barden, Carlson, Rosenberg, & Masters, 1983; Reichenback & Masters, 1983). In both studies, children had to label photographs of facial expressions posed by eight four- to five-year-old children. In the first

study (Felleman et al., 1983), preschool children tended to attribute emotion to neutral faces more often than adults. They were also somewhat less accurate than adults in recognizing happiness and anger. However, they were as accurate as adults in recognizing sadness which may be the consequence of the children's overuse of sadness as a label.

In the second study (Reichenback & Masters, 1983), four-year-olds and third-graders received or did not receive the help of contextual cues which led to greater accuracy in labelling the facial expressions. If there were inconsistencies between the facial expression and the given context, younger children relied more on facial expression, while older children based their judgement on the contextual and situational cues.

Stifer and Fox (1986) had the same emotions (happiness, sadness, and anger), encoded by three videotaped models, identified by preschoolers and adults. These authors noted responses about chance level at all ages. While three-year-olds identified the three emotions at the same level of accuracy, five-year-olds did better on happiness and anger than on sadness. Adults, however, recognized sadness and happiness better than anger.

In sum, these studies confirm that performance in categorizing and labelling facial expressions of emotion increases with age between three and seven years. Happiness seems to be the first emotion whose expression is correctly identified and the most recognizable at all ages. Sadness identification usually emerges second, while the results for other emotions are mixed. All of the studies reviewed above either did not find or did not report sex effects.

Relating facial expression to its context

Camras and Allison (1985), and Kirouac, Tremblay, and Dore (1986) used a very similar procedure to examine how children could relate a situation and the facial expression of the person experiencing this situation. In both studies, children were told stories depicting situations which typically arouse one of the six fundamental emotions identified by Ekman. Camras and Allison illustrated the stories with drawings without faces; children had to choose one among three photographs of facial expressions posed by a 12-year-old. Kirouac et al. used drawings of photographs rather than photographs of faces. Camras and Allison observed that their three- to seven-year-old subjects steadily improved in accuracy with age. Similarly, in the study of Kirouac et al., seven-year-olds were more accurate than five-year-olds, but the nine-year-olds did not outperform the seven-year-olds. The patterns of decoding accuracy for each emotion are somewhat similar in the two studies. The subjects of Kirouac et al. decoded happiness, sadness, and anger better than fear, surprise, and disgust, while in Camras and Allison's study, happiness and sadness were decoded better than anger, fear, and surprise. Disgust yielded the lowest accuracy.

These data are parallel to the results of the studies on categorization and labelling. Performance improved with age, with a ceiling being reached between seven and nine years of age. Happiness was more accurately inferred than sadness, followed by anger, fear, surprise, and disgust. Once again, none of these studies reported or found sex effect.

Conclusion

Based on the literature review of Charlesworth and Kreutzer (1973), it can be concluded that five-month-old infants can discriminate between facial expressions of happiness, sadness, and anger. No strong evidence indicates discrimination at any earlier ages or discrimination between other facial expressions. Charlesworth and Kreutzer also reported a wealth of research on the children's ability to recognize facial expression of emotion. Their conclusion was that the children's performance increased continuously up to the tenth year and leveled off thereafter.

Even though far more research has been done since then and more detailed findings have been obtained, the same general conclusions still hold. One- to three-month-old infants may be unable to discriminate facial expression because of the immaturity of their sensory system (Oster, 1981). Moreover, there is no strong evidence of the differentiation of facial expression before six month of age. Even for infants of that age, more experiments involving a wider range of facial expressions are needed to evaluate more definitively the infant's ability to recognize facial expression and how this ability develops. The only consistent finding in the investigation of young infants is their overriding tendency to respond positively (smiling) to the human face, whatever that face may express.

The research on social referencing has definitively established that one-year-olds discriminate and use facial expressions displayed by adults. Preschoolers can match or identify by labelling or telling a

story different facial expressions at better than chance level, an ability which improves with age and reaches a ceiling between seven and nine years. A consistent finding is that happiness is the first expression to be correctly discriminated and, throughout the life span, is the easiest display to recognize. Sadness follows and the findings are mixed for other facial expressions. Further research still has to investigate beyond mere accuracy levels the mechanisms responsible for the development of the ability to recognize facial expression of emotion.

Learning Display Rules

This third and final section presents the studies investigating display rules, a relatively new domain of interest in the study of facial expression of emotion. Display rules are the norms prescribing the appropriateness of specific facial expressions in a given context. They determine who can show which emotion to whom, when, where and how.

Display rules may originate from socio-cultural and/or personal norms. In both instances, they serve as strategies to regulate emotional processes. Ekman (1984) have listed four categories of facial expression regulation by which display rules operate: individuals can either minimize or exaggerate their spontaneous facial expression; they can neutralize it by keeping a "poker face"; or finally, they can substitute a facial display for another.

Studies of display rules

Saarni (1978) conducted the first study directly investigating the development of display rules in children. She presented 6- to 10-year-old children with personal conflict situations depicted in comic strip style but with photographs of real children. In the final frame of each series, the child-actor's face could not be seen in the photograph. Subjects had to select from a set of facial expression photographs the face which fitted best with the situation. They were also asked to justify their choice. Saarni noted an increased usage of display rules with age (e.g., "It is impolite to show you feel that way") but no sex difference.

In a naturalistic study, Saarni (1984) observed 6- to 10-year-old children's reactions when receiving a disappointing gift. Younger children (especially males) were more likely to show negative faces than older children. From the pattern of her data, Saarni suggests that the only difference between sex is that females are socialized earlier than males in the usage of display rules. The results of this experiment have been replicated by Cole (1985). To further investigate the likelihood that children were regulating their affective display via some social norms, Cole (1985) had the examiner remain present with the child in some case and not in others. Significantly more smiling occurred when the examiner remained present versus when he left.

Finally, Gnepp and Hess (1986) studied the different developmental patterns of verbal and facial display rules in 6- to 15-year-olds. The subjects were presented with eight stories of social interaction and were

asked to predict what the protagonist would say, and what their face would look like. The children's knowledge of how and when to control emotional displays increased up to 10 years of age and leveled off thereafter. The children also manifested a control of verbal display rules at an earlier age than for the facial expression display rules.

Deception and voluntary expression

If very few studies have directly investigated display rules and their ontogenesis, two relevant and related fields, deception and voluntary facial expression, have been more extensively studied. The research on the voluntary control of facial expression has already been reviewed above. Two consistent findings are that the accuracy of voluntary facial encoding increases with age and that positive emotions are easier to express voluntarily than negative emotions. Research on the development of deception has been summarized by De Paulo and Jordan (1982), who concluded that successful encoding and decoding of facial deception appears between seven and nine years of age and is well established by the eleventh year.

Conclusion

In sum, the mastery of display rules parallels the development of voluntary control of facial expression. After a continuous increase until 10 years of age, the display rules knowledge seems to level off. The present data do not allow any conclusion regarding sex differences. Unfortunately, no study has yet investigated how display rules are

acquired, the relative importance of personal versus socio-cultural display rules, or how display rules are used to regulate internal emotional processes.

General Conclusion

Summary of the findings and relationship between encoding and decoding facial expression

From the above literature review, a general picture of the development of encoding and decoding facial expression can be drawn. At birth the neonate already has an impressive capacity for nonverbal expression a potential which is used very early in life. By the third month all the facial display of the fundamental emotions have been expressed, with the exception of fear that appears by the ninth month. After the first year spontaneous facial expression is well established and seems to undergo very few changes, except for an increase in emotional blend expression and some modifications in the frequency of expression of some specific emotional displays. The voluntary control of facial expression, however, is mastered later. Even though preschoolers can already imitate recognizable facial expressions, perfectly convincing facial displays are rarely produced before the tenth year. The acquisition of display rules parallels the evolution of voluntary expression.

The results of the research on facial expression recognition are somewhat more difficult to interpret. Some evidence seems to indicate that six-month-old infants can discriminate different facial expressions

of emotion and that one-year old toddlers understand and use the facial displays of adults to regulate their behavior. However, a more general and categorical knowledge of facial expression of emotion and of its relationship to specific situations is only achieved later and more completely around the eighth year.

Thus, it seems that there is a lag between the acquisition of the different nonverbal skills. While spontaneous facial expression seems to appear very early in life, voluntary facial expression and facial expression recognition seems to be achieved later. Indeed, Hamilton (1973) did not find any difference between the spontaneous facial expression performances of kindergardeners and fifth-graders. Their ability to decode facial expression however, significantly increased with age. Odom and Lemond (1972) found parallel results with a similar population. Their subjects were better decoders than imitators of facial expressions and although both performances improved with age, the lag between decoding and voluntary encoding increased. These two studies suggest a developmental sequence whereby spontaneous expression appears first, followed by facial expression recognition, and where voluntary facial expression is the last skill to be acquired. At the individual level, it has generally been found that in adults, there is no relationship between encoding and decoding ability (Buck, 1984). Zuckerman and Przewuzman (1979) confirmed this absence of relationship in preschoolers.

Data and Theories

The degree to which the theoretical models presented in the first chapter are confirmed or invalidated by empirical evidence can now be assessed. A first consideration is that facial displays of the fundamental emotions appear earlier than predicted by Bridges (1932). Furthermore, the sudden onset of fear demonstrated by Emde et al. (1976) and the fact that facial expression develops similary in blind children (reviewed by Charlesworth & Kreutzer, 1973) and in seeing children strongly suggests (a) the existence of a biologically given and pre-wired set of facial displays and (b) the inadequacy of the progressive differentiation model. Very soon, however, the facial displays' repertory is diversified but this later development proceeds by blending the fundamental displays rather than by further differentiating them. The occurence of these blends may have been mistaken by some theorists as a process of progressive differentiation.

Unfortunately, with the exception of fear display and smile, the relationship between facial expression and elicitor, appraisor, autonomic responses, or subjective experience, remains largely unexplored before 7 months. In older infants however, some studies have established that the relationship between elicitors and facial displays changes over time. For example, Emde et al. (1976) demonstrated how the elicitors of smile evolve from a pattern of electophysiological activity in the brain to social objects. Similarly, Izard et al. (1983) showed how pain elicits different emotional and expressive responses across age. Still, the

processes determining the evolution of the relationship between elicitors and displays remain to be understood.

The few studies about the acquisition of display rules demonstrate that, under the pressure of social norms, children learn to dissociate their facial expressions from their subjective experiences. This capacity evolves parallel to the ability to voluntarily control facial expression and to the knowledge of the expectations about emotion. However, no study has yet investigated the existence of a causal link between these three capacities.

In sum, the general model presented at the end of the first chapter seems to be supported by the empirical data reviewed in this second chapter. Indeed, fundamental facial displays appears early in infancy and are later blended to increase the diversity of the repertory of emotional facial expressions. Before adolescence, a partial voluntary control of facial expression is acquired and the display rules specific to the culture are learned.

However, further research needs to investigate the nature of the relationships between the diverse components of the model (elicitor, appraisor, etc.) and how these relationships evolve over time. More specifically, the development of the links between elicitor and facial expression, and between subjective experience and facial expression, largely remain to be explored in infancy and childhood.

<u>Remarks on the methodologies used in studying facial expression development.</u>

Most of the methodological problems already noted by Charlesworth and Kreutzer (1973) still hamper the recent research. From a developmental point of view, the most important handicap is the absence of longitudinal studies. With two exceptions (Izard et al., 1980, and Hyson & Izard, 1985), all the comparisons across ages reported in this chapter were the results of cross-sectional studies. This aspect of the research constitutes a serious obstacle for the attempt to discover a sequence in the onset of specific facial expressions in decoding or encoding. It also prevents the study of continuities and discontinuities in the relationship between facial displays and their contexts. In addition, lack of longitudinal data hinders the studies of idiosyncrasies and personal styles in facial expressivity.

Another problem in tracing nonverbal abilities across ages is that different methodologies and paradigms are used at different ages and periods of development, thereby confounding the specific effects of the methodologies and ages in the observation of performance changes. Different procedures may also answer different questions, making it hazardous to relate the findings of studies using different procedures. For example, links between the results obtained with the habituation-recovery paradigm and with the Dashfield story-telling procedure are difficult to establish and interpret.

Unfortunately, too, the distribution of the studies across ages is unequal. Nonverbal abilities at certain critical ages still need to be

explored for a theory of facial expression development. For example, in this review covering fifteen years of research, no study has investigated the encoding abilities in 1.5- to 3-year-old toddlers, with the exception of Zuckerman and Przewuzman's (1979) paper. Similarly, only three studies researched the decoding abilities in one- to three-year-olds. These gaps may be due to the absence of a satisfying methodology needed to explore the nonverbal capacities of these age groups.

One can also regret the absence of a standard terminology to specify the emotional states reflected in the facial expressions. For example, in referring to the same emotional states, various authors employ labels as different as distress, wariness, or fear, or love, delight, pleasure, or happiness. Although there is a tendency, however, to refer to Ekman's or Izard's terminologies (which are very similar), it is still unclear whether these two terminologies can successfully give account of the young infants' states.

Finally, the ecological validity of most of the procedures used in this area of research has often been questionable. "Natural" emotions are indeed difficult to induce in a laboratory setting in infants as well as in adults. Yet, the development of videographic techniques provides easy and reliable decoding of naturalistic observations and ethological studies have often supported the evidences gathered in the laboratory.

Thus, future research has to trace more systematically developmental trends across ages. New methodologies still need to be developed to permit the study of unexplored age groups and to allow comparison of the results across ages. Ideally, longitudinal designs should be used.

Still, some important methodological progresses have already been made. The most important one is definitively the development of standard and discrete techniques for decoding facial expression and the adaptation of these techniques to infants' and children's facial expression. The FACS technique of Ekman and Friesen (1978) has been adapted by Oster (1981) to decode neonates' facial expression. Izard's (1979b) systems, MAX and AFFEX, have also been used successfully with infants. These techniques, increasingly widely used by researchers, constitute an important step toward the standardization and comparability of the results of the numerous facial expression studies currently produced.

CHAPTER III

FACIAL EXPRESSION AND SOCIAL SKILLS: THE PRESENT STUDY

Social Skills and Facial Expression

Both common sense and the psychological literature suggest that the ability to identify others' feelings and to appropriately express one's affect would be an important factor in determining the social adaptation of an individual. Indeed, emotion recognition and expression are central to in a number of social activities. For example, nonverbal communication of emotion plays an important role in empathic responding and more generally in the maintenance and facilitation of social interaction (Camras, Grow, & Ribordy, 1983; Feldman, White, & Lobato, 1982).

Thus, the ability to correctly encode and decode facial expressions of emotions can be considered a social skill that must be, at least partly, acquired and develop during ontogenesis. Social skills generally refer to the complex set of behavioral and cognitive skills that are used to direct and facilitate social behavior (Eisler & Frederiksen, 1980). The importance of social skills at a young age has been stressed by different studies establishing a relation between social skills in childhood and later interpersonal adjustment in adulthood (VanHasselt, Herson, Whitehill, & Bellack, 1979; Combs & Salby, 1977). For example, children who have had poor social relationships with their peers later demonstrate a greater rate of delinquency (Roff, Sells, & Golden, 1972)

and adult mental health problems (Cowen, Pederson, Babigan, Izzo, & Trost, 1973).

Numerous deficits in facial expression encoding and decoding may contribute to hinder social adjustment. At a first level, some individuals may have failed to learn the display rules of their culture and, as a consequence, are incapable of appropriately expressing or recognizing facial displays normally determined by the social context. It is also possible that, although they know the display rules, some individuals do not apply them as they perform their behavior. For example, they can fail to accurately identify the context or to relate it to the display rules. Finally, some persons could also be lacking of the motivational incentive to conform to the display rules.

At another level, low socially skilled individuals may be insensitive to nonverbal cues and not use the information provided by others' spontaneous facial expression to adjust their behaviors to social interactions. The intensity and frequency of facial displays may also be inappropriate and generate uneasiness in social interaction.

In sum, numerous aspects of facial expression can be considered as social skills whose acquisition determines the social competence of the individual. Hence we postulate that there are inter-individual differences in expression and recognition of emotion and that these differences contribute to the general social adaptation of these same individuals.

Facial Expression as Social Skills: Empirical Evidence

Studies aimed at establishing a relationship between social skills and nonverbal competence in adults have often been inconclusive. For example, Goldenthal (1985) asked female undergraduates from a dorm, rated by their peers as highly or poorly socially skilled, to pose Ekman's six fundamental emotions (happiness, sadness, fear, surprise, disgust, and anger). No difference in portrayal ability was found between the two groups. Similarly, Sternberg and Smith (1985) failed to establish a relationship between decoding skills in nonverbal communication and several standard psychometric-type tests of social intelligence. Moreover, studying nonverbal sensitivity in an interview situation, Christenson, Farina, and Boudreau (1980) noted that even the low social skilled subjects accurately perceived and described nonverbal cues from their partner, although they failed to adapt their behaviors to these cues as high social skills subjects did.

On the other hand, similar research in children has yielded clear-cut and contrasting results. In the studies of the development of facial expression of emotion in preschoolers described in the previous chapter, Field and Walden (1982) found a positive correlation between children's ability to express eight basic emotion and their sociometric rating. Similarly, Zuckerman and Przewuzman (1979) observed that preschoolers' adjustment to school was related to their capacity to express and recognize happiness, sadness, anger, surprise, and fear.

Parallel results have been found in research using older children. For example, Edwards, Manstead, and McDonald (1984) had the sociometric status of 8- to 11-year-olds assessed by their classmates. The children were then presented with Ekman's photographs of faces portraying happiness, sadness, fear, disgust, anger, and surprise, and they were asked to match a label from a given list with each photograph presented. High sociometric status children outperformed low sociometric status children.

In a similar procedure, Zabel (1979) compared the performance of elementary and junior high students either from regular schools or from special schools for children with emotional and behavioral problems. Overall, children from regular schools did better than children from special schools, although the accuracy for happiness was identical for the two groups, and junior high students from the special schools were more accurate for anger and sadness than students from regular schools.

In a study by Feldman, White, and Lobato (1982), normal and emotionally disturbed adolescents were shown a series of scenes designed to evoke emotions that were positive, negative, and neutral in character. While viewing the scenes, subjects' reactions were videotaped so that judges could later determine their expressive skills. Subjects' degree of social competence was assessed by their teachers. Later, as a measure of decoding skills, subjects were asked to determine from the videotapes of persons exposed to the same scenes the character of the emotion evoked by each scene. Subjects high in social skills and normal subjects were better encoders than subjects low in social skills and emotionally disturbed children. Similarly, in the decoding portion of the study,

normal adolescents were more accurate than emotionally disturbed adolescents.

More recently, using a similar encoding/decoding procedure, Custrini (1987) showed videotaped clips eliciting anger, disgust, fear, happiness, and sadness to 9- to 12-year-old children. In this study, females rated low in social skills were less accurate both in encoding and decoding than females high in social skills. The performance of the males was identical in the two groups.

In conclusion, a good deal of evidence supports the hypothesis that the ability to decode and encode facial expressions of emotion is related to social skills, at least in children and adolescents. The discrepant findings between adults and children may be explained by the fact that, with the exception of Goldenthal (1985), studies in adults were not investigating expression of emotion, but rather nonverbal communication in a more general sense. Moreover, Goldenthal investigated only posed facial expressions, and the results might be different with more naturalistic spontaneous facial expressions. It is likewise possible that nonverbal skills are less critical for social competence in adults than in children. Indeed, while children typically are expected to display most of their emotions, in most circumstances, adults usually are supposed to conceal their feelings.

In sum, while experimental evidences are inconclusive for adults, in children the ability to encode and decode facial expressions of emotion seems to be related to various measures of social competence. Evidence supporting this relationship has been reported in both normal children and atypical children populations.

The Present Study

To date, no investigation of preschoolers' abilities to recognize or display facial expressions of emotions has yet been done which also directly assesses their degree of social competence. While there is some pertinent data, they are peripheral to other aspects of the studies in which they were collected. For example, Field and Walden (1982) and Zuckerman and Przewuzman (1979) report correlation coefficients from studies which used only very approximate or imprecise measures of social skills (sociometric rating or school adjustment).

In the present study, preschoolers were directly assessed as being low or high in social competence using a standardized measure. These subjects were then compared in their accuracy on both their encoding and decoding abilities for several facial expressions of emotion.

To assess their decoding abilities, children were shown a series of videotaped scenes which typically evoke happiness, sadness, or fear. In each scene, a character, whose face was blackened out on the television screen, was experiencing the emotion appropriate to the situation. The children were asked to choose the face that best fit the character in the given situation from an array of three photographs of faces expressing happiness, sadness, or fear. In order to rate their encoding abilities, the children's faces were filmed while viewing the emotional scenes. Later, from the children's videotapes, judges determined which emotion was portrayed in each scene being attended to by the children.

Congruent with the experimental findings reviewed above, it was predicted that, overall, high social skills children would outperform low social skills children for both encoding and decoding. Further predictions were derived from previous research reviewed in the second chapter. These studies reported evidence suggesting that preschoolers' decoding performance improves between 3 and 5 years of age (Zuckerman & Przewuzman, 1979; Stifter & Fox, 1986; Field & Walden, 1982; Schwartz-Felleman, Barden, Carlson, Rosenberg, & Masters, 1983). However, spontaneous expression was found to be stable in preschoolers (Feinman & Feldman, 1982; Hamilton, 1973; Zuckerman & Przewuzman, 1979). Hence, it was predicted that while decoding performance would improve with age, encoding performance would remain stable.

Finally, specific predictions about the decoding performance of the different emotions were formulated. As unanimously reported by the studies reviewed in the second chapter (e.g., Field & Walden, 1982; Zuckerman & Przewuzman, 1979), happiness was predicted to be the easiest emotion to decode. Previous research, however, does not yield clear-cut prediction for fear and sadness. Thus, no specific prediction was made concerning these two emotions.

In sum, they were three hypotheses:

(a) Overall, the highly socially skilled preschoolers should outperformed the poorly socially skilled preschoolers for both encoding and decoding;

(b) The general performance should improve with age for decoding, but remain equal for encoding;

(c) Happiness was expected be easier to decode than fear and sadness, but no specific prediction was made for these two later emotions.

CHAPTER IV

METHOD

Subjects

Thirty-eight subjects were recruited from the classrooms of two preschools in a small New England town and from birth lists compiled from public town records. A letter explaining the procedure and purpose of the study was mailed to the parents of all children aged 3 to 5 attending the preschools or randomly selected from the birth lists. Parents were subsequently contacted by phone and, for those interested in participating in the study, an appointment was arranged for them to come to the laboratory. Children, who were run individually, received toy stickers for their participation. There was an approximatively equal number of subjects for each of the three age groups--12 three-year-olds, 13 four-year-olds, and 13 five-year-olds--with an equal distribution of males and females in each age group.

Experimental Materials

Emotional scenes

Nine 10- to 20-second videotaped silent scenarios, with three for each category of emotion, were constructed. Each videotaped clip consisted of a short scenario presenting an adult character in a setting that typically evokes a specific emotion. The script of each scenario was designed so that preschoolers could understand it and empathize with

the adult character. For example, one movie presented the character receiving several presents at his birthday party, a situation in which he would be expected to display happiness.

In a pilot test, each videotaped clip was presented to a panel of 20 undergraduate students who were asked to rate the category of emotion depicted in the movie. Only clips yielding interjudge agreement of 95% were selected for the study.

To train the subjects for the procedure, movies similar in nature to the experimental clips were created. These movies depicted non-emotional situations that are nevertheless associated with specific non-emotional facial patterns. For example, the character was shown falling asleep, displaying a typical sleeper's face: eyes closed and relaxed facial muscles and the subjects were asked to choose the face fiting the character from among three photographs of faces, one of which was a sleeper's face.

Photographed faces

Facial expressions were presented to the subjects in form of 10 X 12 cm. glossy black and white photographs. Each photograph showed the face of an adult male model posing a facial expression of one of the three emotions studied: happiness, fear, and sadness. The model was instructed to perform the facial actions described by Ekman and Friesen (1978) as prototypical of each of the three emotions. To be selected, a photograph had to be judged typical of an emotion by two judges trained to the FACS coding system (Ekman & Friesen, 1978).

For training of subjects, photographs of a similar format were presenting the same model portraying the different non-emotional facial displays appropriate for each training scene. Photographs of two square wooden objects were used as distractors.

Questionnaire

Subjects were assigned to either the high social skills group or to the low social skills group based on their score on the Social Competence scale of the Achenbach Child Behavior Checklist (Achenback & Edelbrock, 1982). This scale assesses a child's performance in areas such as peer and family relationships, participation in organized groups, and recreational activities from parental responses to a series of questionnaire items. Within each age group, subjects were divided by a median split into two groups demonstrating either above- or below-average levels of social competence.

Decoding Procedure

Subjects accompanied by a parent were tested in a laboratory room in a university psychology building. The room contained a low table and two small chairs of the type generally used in a preschool classroom, as well as an armchair, a black and white television monitor, and a false speaker. Inside of the speaker was a camera used to record the subjects reactions to the movies. The camera's location enable the filming of a frontal view of the subject's head and shoulder. Also, a wooden box of 15 X 20 X 40 cm. with three small drawers was placed on the low table in

front of the chair facing the television screen. The videorecorders were operated from an adjacent room equipped with a two-way mirror.

The parents were asked to complete the Parental Consent Form and the items of the Social Competence scale of Achenbach Child Behavior Checklist. Meanwhile, the children were told by a female experimenter that they were about to play a game in which they could win stickers. They would see several movies on television depicting a man whose face would not always be seen. The children were told that their job was to choose among several photographs the face most appropriate for the man in the situation depicted in the movie. After having ensured that the children understood, the experimenter asked them to pick the stickers that they would like to win from a large selection.

A progressive training technique designed to teach the procedure to the subject was then begun. The subjects were first shown the non-emotional movies. After viewing a scene, they had to choose among three photographs the face that fit the character. Three photographs were displayed on the top of the wooden box. The children were told that the drawer under the correct face contained a sticker and that they should pull the drawer under the photograph they thought to be correct. Thus, stickers were used to reinforce each correct trial.

To allow progressive shaping, the difficulty of the task was increased after each successful trial. First, the face of the character was seen in the videotape, and the subjects simply matched the appropriate face. Later, the face was masked and the subjects again had to pick the appropriate face in an array of three photographs. Also, the children first had to choose between a photograph of face and two

distractor photographs of irrelevant objects; later, they had to choose among three faces. The training was considered to be accomplished when the subject correctly matched one of three faces with a scene where the character was masked, three time in a row.

In contrast to the training phase, the senarios in the actual experimental task were only presented once, always with the character masked, and the subject had to choose directly from an array of three photographs the appropriate face. More specifically, the subjects were presented with the nine emotional scenarios in an identical, fixed randomized order, with the exception that no more than two stimuli representing the same emotion was permitted to occur sequentially. After each senario, the experimenter displayed the three photographs of facial expressions of happiness, fear, and sadness in a random arrangement. Again, the subjects were asked to determine which face would be appropriate for the character in the situation depicted by the movie. In the case of a wrong answer, the experimenter removed the incorrectly chosen photograph and asked the subject to reconsider his or her choice with the two remaining photographs. Once a trial was completed, the subject were praised and given a sticker to reinforce his or her participation and motivation. After the experimental task, the child and accompanying parent were thanked and any questions about the study was answered.

Encoding Procedure

The subject's reactions to the nine scenarios were secretly filmed.
These videotaped reactions were edited in 5-sec. segments corresponding
to the peak emotional period of each scene. Three hundreed and six clips
were obtained, 36 of them being eliminated for technical reasons. These
segments were arranged on two new videotapes in a partially random order,
subject to the restriction that no more than four serial segments could
consist of the same subject or of the same category of emotion. Each
videotape contained half of the total number of segments.

Thirty two undergraduate students from a large state university
volunteered to rate the videotapes. In compensation, they received class
extra credit or a small amount of money. Each videotape was shown to 16
judges who had to determine from the filmed face of the subject which
emotional categories was being displayed. Judges were offered a forced
choice between happiness, fear, and sadness.

CHAPTER V

RESULTS

Decoding

Decoding accuracy

Each subject received three scores, corresponding to each category of emotion investigated. The scores consisted of the total number of correct initial choices (choosing the appropriate facial expression at the first trial) over the three emotional scenarios, and ranged, expressed as percentage, from 0% to 100%.

The main analysis consisted of a 2 x 2 x 3 x 3 mixed design analysis of variance. There were three between subjects factors, social skills (high and low), sex, and age (three-, four- and five-years of age), and one within subjects factor, category of emotion (happiness, fear, and sadness).

The results of the analysis of variance are presented in Table 3. A significant main effect due to social skills was observed, $F(1,26) = 7.09$, $p < .02$. As expected, the high social skills subjects, who averaged 79.7 percent correct responses, proved to be more successful decoders of facial expression than the low social skills subjects, who scored an average of 68.7 percent correct responses (see Figure 4).

A significant main effect for age, $F(2,26) = 10.94$, $p < .0005$, and a significant main effect for emotion category, $F(2,52) = 33.50$, $p < .0001$, were also observed. Post hoc comparisons using the Duncan New Multiple Range Test (Duncan, 1955) were employed to determine the nature and

TABLE 3

Analysis of Variance for Decoding Accuracy

Source	df	MS	F	
Between Subjects				
Sex	1	.36169	.88	
Age	2	4.49946	10.94	***
Social Skills	1	2.91725	7.09	*
Age x Sex	2	3.67070	8.92	**
Social Skills x Sex	1	.16725	.41	
Age x Social Skills	2	.61362	1.49	
Age x Sex x Social Skills	2	.47331	1.15	
Error	26	.41132		
Within Subjects				
Emotion Category	2	16.89120	33.50	****
Emotion x Sex	2	.34259	.68	
Emotion x Age	4	.14864	.29	
Emotion x Social Skills	2	.51620	1.02	
Emotion x Sex x Age	4	2.01857	4.00	**
Emotion x Sex x Social Skills	2	.28704	.57	
Emotion x Age x Social Skills	4	.50005	.99	
Emotion x Age x Sex x Soc. Ski.	4	.31857	.63	
Error	52	.50427		

  * p < .05
 ** p < .01
*** p < .001
**** p < .0001

FIGURE 4

Effect of Social Skills on the Accuracy of Recognition
of Facial Expression
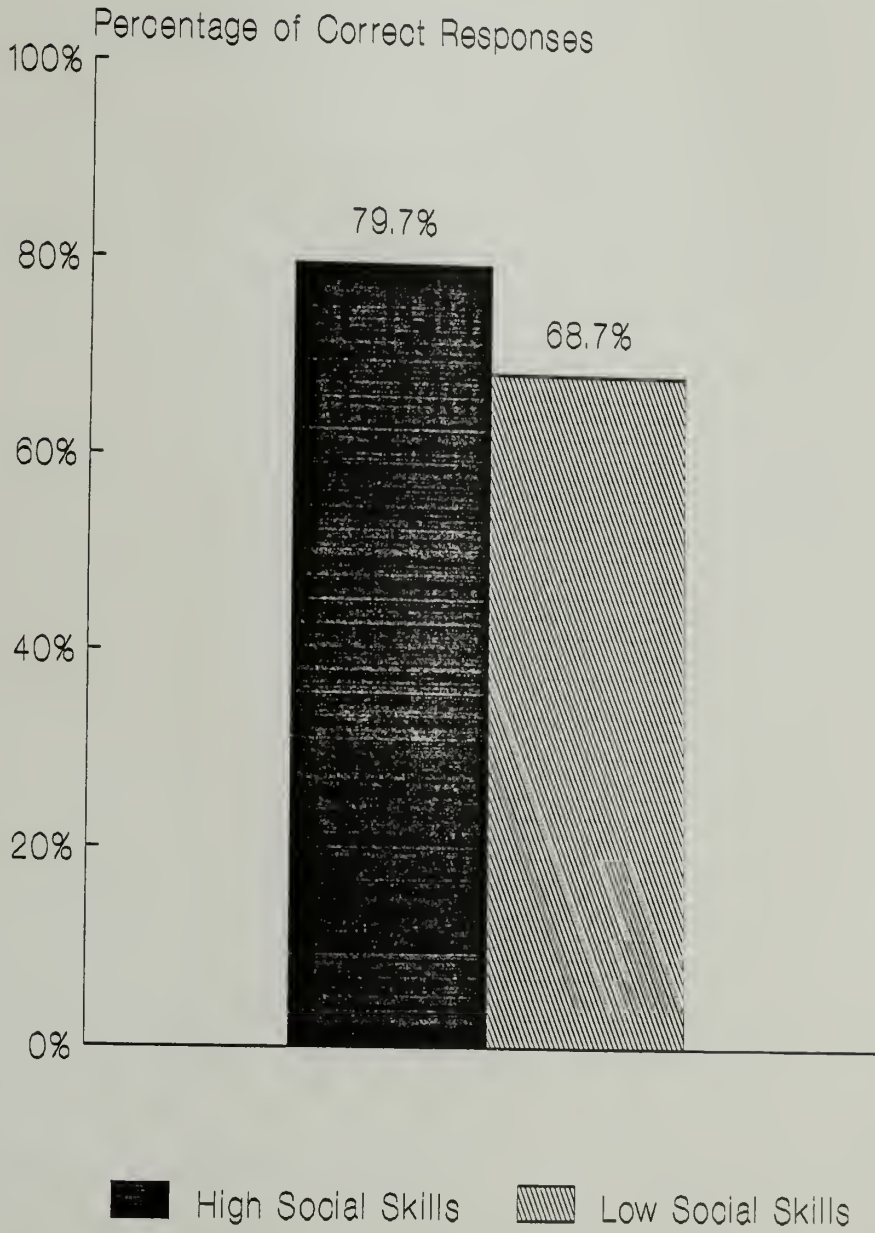
direction of the significant variations. It appeared that overall, the decoding accuracy of the four-year-olds (78.7 percent) and the five-year-olds (83.3 percent) was significantly greater than the accuracy of the three-year-olds (60.3 percent), $p < .05$ (see Table 4). However, no significant difference was found between the four- and five-year-olds. All age groups performed significantly better than chance, $p < .05$.

Examination of the mean accuracy scores for the different categories of emotions showed that happiness was most accurately decoded (95.7 percent), followed by fear (79.0 percent), with sadness decoded least accurate (50.0 percent). Post hoc analysis revealed that these three means were all significantly different from each other and from chance level (33 percent), $p < .05$.

The main effects for age and emotion category were modified by two interactions revealed by the analysis of variance: an interaction of age and sex, $F(2,26) = 8.92$, $p < .005$, and a three-ways interaction of category of emotion and sex and age, $F(4,52) = 4.00$, $p < .01$. No other main effects nor interactions were found to be significant. The interaction of sex and age is illustrated in Figure 5 and the cell means are presented in Table 4. While the males' performance is stable between three and four years, and improves at age five, the females' performance increases between three and four years and then declines somewhat at age five.

It should be noted however, that this interaction between sex and age is modified by the further three-ways interaction between category of emotion, sex, and age. This effect is illustrated in Figure 6, and the cell means are reported in Table 5. It appears that the difference

TABLE 4

Mean Accuracy Scores as a Function of Sex and Age (%)

	3-year-old	4-year-old	5-year-old	OVERALL
Females	54.0a	92.7b	81.3b	76.0
Males	66.6a	64.7a	83.3b	71.5
OVERALL	60.3	78.7	82.3	73.7

(Similar subscripts indicate nonsignificant differences between means.)

FIGURE   5

Sex x Age Interaction for Decoding
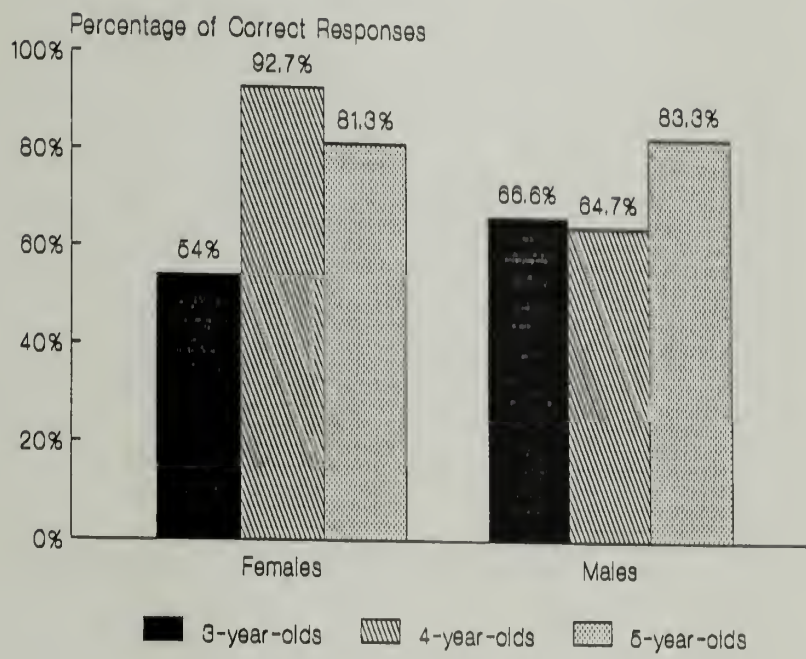
TABLE 5

Mean Accuracy as a Function of Age, Sex, and Emotion (%)

	3-year-old		4-year-old		5-year-old	
	Female	Male	Female	Male	Female	Male
Happiness	87.3de	83.3cde	100.0e	96.0de	100.0e	100.0e
Fear	54.0bc	70.7bcde	89.0de	80.7cde	90.3de	89.0de
Sadness	20.7a	46.0ab	89.0de	19.3a	54.3bc	66.7bcd

(Similar subscripts indicate nonsignificant differences between means.)

FIGURE 6

Sex x Age x Emotion Interaction for Decoding
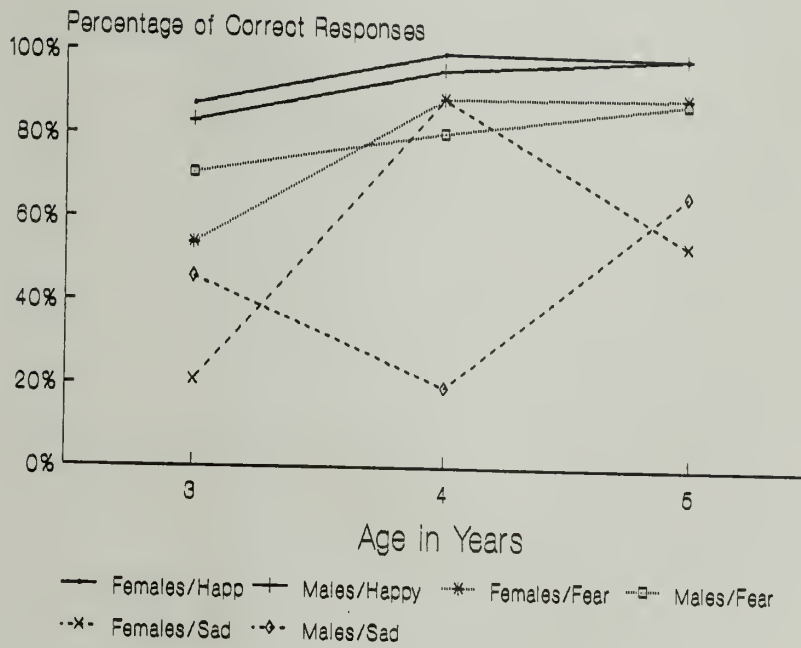
between males and females in decoding facial expressions of sadness is responsible of the overall interaction between sex and age. Indeed, post hoc analysis did not reveal any difference between males and females in decoding happiness and fear. For sadness, however, the developmental patterns seem different for males and females. While females dramatically improve their performance from chance level at three-years of age to an accuracy of 89% at four-years (p < .01), males' performance remains at chance levels between three- and four-years of age, and increases at five-years (p < .05). It should also be noted that the performance of the females in decoding sadness significantly decreases between four and five year (p < .05) to a score that does not differ significantly from chance level.

The performances of the various groups of subjects according to their sex, age, and category of emotion were also tested against chance levels. It appeared that subjects in all groups performed better than chance level for all categories of emotion with the exceptions of both male and female three-year-olds for sadness, the female three-year-olds for fear, and the male four-year-olds and females five-year-olds for sadness (p <.05).

Decoding errors

To analyze the type of decoding errors made by the subjects, a 3 x 3 contingency table comparing the accurate response with the response given by the subjects was constructed (see Table 6). It appears very clearly that while happiness was correctly identified most of the time, fear was almost exclusively mistaken with sadness (1 = 16.37, p < .001) and

TABLE 6

Children's Choices as a Function of the Correct Choices (%)

Emotion Displayed	Emotion Chosen by the Children		
	Happiness	Fear	Sadness
Happiness	95	1	4
Fear	3	76	47
Sadness	3	47	51
OVERALL	31	38	31

sadness with fear (1 = 44.10, p < .001).

The general pattern of the results suggests that the ability to recognize facial expression developed at different periods of ontogeny according to the specific emotion being decoded. It seems that children may first learn to discriminate happiness from fear and sadness, but still confuse these two latter expressions. In a second stage, children accurately identify both happiness and fear while mistaking sadness for fear. Finally, in a third stage, all three emotion are decoded accurately.

To test this hypothesis, the children were classified into one of eight categories according to their successes or failures in identifying each emotion (see Figure 7). To meet the criterion of successful identification for a given emotion, a child had to have at least 2 correct trials out of three for this emotion. Supporting our hypothesis, most of the children fell in one of the three patterns corresponding to the three stages, leaving the five other categories empty. Because the expectancies for some of the eight categories were close to 0, no statistical test could compare this pattern of distribution of the subjects with a chance model. Therefore the eight different categories were collapsed into two groups, group A with the subjects falling in the three categories predicted by our hypothesis and group B with the subjects falling in the other categories. The difference between these two groups was consistent with the hypothesis, with 36 of the 38 subjects classified in group A (1 = 120.40, p < .0001).

To further test the developmental aspect of this pattern, the age differences of the children classified in each of the three stages were

FIGURE 7

Age and Distribution of the Children as a Function of their

Patterns of Responses in the Decoding Portion of the Study

Children's pattern of Responses	Stage	# of Subjects	Mean Age	
Ha+ — Fe+ — Sa+	Stage III	18	4.3	Group A
Fe+ — Sa–	Stage II	13	3.8	
Fe– — Sa–	Stage I	5	3.4	
Fe– — Sa+		2	4.0	Group B
Ha– — Fe+ — Sa+				
Fe+ — Sa–				
Fe– — Sa+				
Fe– — Sa–				

Ha = happiness
Fe = fear
Sa = sadness

+ = at least 2 out of 3 trials correct for a given emotion category
− = less than 2 trials correct for a given emotion category

examined with t-tests. It appears that significant age differences, in the expected direction, are found between Stage I (mean age: 3.4) and stage III (mean age: 4.3), $\underline{t}(21) = 3.065$, $\underline{p} < .005$, and between Stage II (mean age: 3.8) and Stage III $\underline{t}(29) = 1.701$, $\underline{p} < .05$. The age difference between Stages I and II, however, are not statistically significant.

Encoding

Encoding accuracy

Three accuracy scores corresponding to the three categories of emotion investigated were computed for each subject. These scores represented the percentage of judges that were able to identify the emotion category depicted in the scenario from the subject's facial expression while he or she was viewing it.

The main analysis consisted of a 2 x 2 x 3 x 3 mixed design analysis of variance. There were three between subjects factors, social skills (high and low), sex, and age (three-, four- and five-years of age), and one within subjects factor, category of emotion (happiness, fear, and sadness).

The results of the analysis of variance are presented in Table 7. Only one factor, category of emotion, appears to be significant, $\underline{F}(2,46) = 3.87$, $\underline{p} < .05$. Post hoc comparisons using the Duncan New Multiple Range Test (Duncan, 1955) indicated that while there were no significant differences between subjects displaying sadness and fear, or between sadness and happiness, happiness was encoded with a significantly greater accuracy than fear ($\underline{p} < .01$). These results are presented in Figure 8.

TABLE 7

Analysis of Variance for Encoding Accuracy

Source	df	MS	F
Between Subjects			
Sex	1	29.56	.06
Age	2	353.60	.77
Social Skills	1	1.31	.00
Age x Sex	2	351.83	.77
Social Skills x Sex	1	2.76	.01
Age x Social Skills	2	117.70	.26
Age x Sex x Social Skills	2	168.36	.37
Error	23	457.00	
Within Subjects			
Emotion Category	2	1655.43	3.87 *
Emotion x Sex	2	221.83	.52
Emotion x Age	4	428.95	1.00
Emotion x Social Skills	2	523.19	1.22
Emotion x Sex x Age	4	434.22	1.01
Emotion x Sex x Social Skills	2	292.69	.68
Emotion x Age x Social Skills	4	284.70	.66
Emotion x Age x Sex x Soc. Ski.	4	124.72	.29
Error	46	428.29	

* $p < .05$

FIGURE 8

Encoding Accuracy as a Function of the Category of Emotion
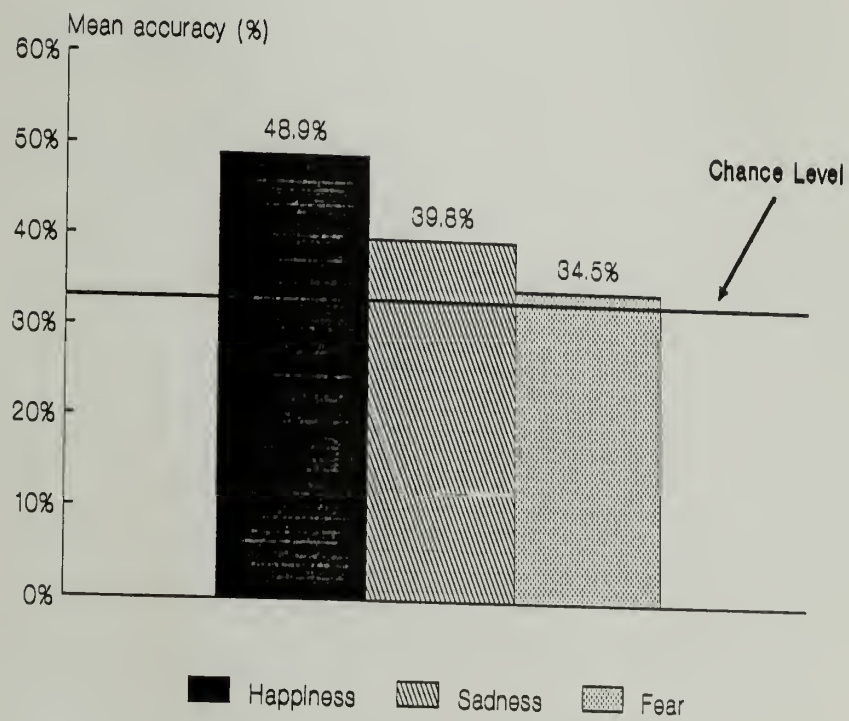
T-tests were computed for each emotion to determine whether judges performed better than chance level. It appears that while the judges' accuracy for fear did not differ from chance, happiness ($t(35) = 3.28$, $\underline{p} < .005$) and sadness ($t(35) = 1.44$, $\underline{p} < .10$) were identified by the judges at better than chance levels.

As predicted, no effect of age could be observed. There were no other significant main effects or interactions found to be significant on the analysis of variance.

Encoding errors

To determine the type of errors made by the judges, a 3 x 3 contingency table comparing the expected response with the response given by the judges was constructed (see Table 8). It appears that the judges were more likely to misidentify happiness with fear rather than with sadness (1 = 10.39, $\underline{p} < .005$) and to misidentified sadness with fear rather than with happiness (1 = 26.73, $\underline{p} < .001$). The errors made in identifying sadness did not differ from chance level. The results obtained with high social skills children as senders were compared with the results obtained with low social skills children. No difference was found in any of the cells of the contingency table.

TABLE 8

Raters' Choices as a Function of the Correct Choices (%)

Emotion Attended to by the Children	Emotion Chosen by the Raters		
	Happiness	Fear	Sadness
Happiness	45.6	32.2	22.2
Fear	29.7	35.1	35.2
Sadness	24.0	35.1	40.9
OVERALL	34.9	32.5	32.7

Relationship between Encoding and Decoding

The correlation coefficient between the average accuracy for decoding and for encoding all three emotions appeared not to be significant (r = .08, $t(33)$ = .47, ns.). Similarly, correlation coefficients obtained for each category of emotion yielded low and non-significant values.

CHAPTER VI

DISCUSSION

The data analysis largely confirms the three experimental hypotheses. As predicted, highly socially skilled preschoolers outperformed poorly socially skilled preschoolers, at least in the recognition of facial expressions of emotion. In total support of the second hypothesis, while emotional expressivity remained equal between three- and five-year olds, the decoding performance of both groups improved with age. Finally, preschoolers found that happiness was indeed easier to identify than fear, with sadness being the most difficult.

Social Competence

Consistent with previous observations by Field and Walden (1982) and by Zuckerman and Przewuzman (1979), highly socially skilled preschoolers did outperform their poorly socially skilled peers in decoding facial expression. Moreover, this effect of social skills is strengthened by the fact that it was independent of age, sex, or emotion category and that it was obtained in a normal population of children from middle-class families.

The idea that social skills and the ability to recognize facial expression are related has already been established in older children and in adolescents (Custrini, 1987; Edwards, Manstead, & McDonald, 1984; Zabel, 1979). However, the present study is the first to demonstrate a

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similar relationship in preschool-age children, thus establishing the existence of a direct relationship between social skills and facial expression recognition in children as young as three-years of age.

Given the correlational character of the experimental design, the causal direction of this relationship cannot be determined. Indeed, several possibilities regarding causation are plausible. A first possibility would be that some individuals do not learn to discriminate nonverbal cues or to use them as information about the states of their social partners. As a consequence, they have difficulties in relating and "tuning" into others, and show poor social competence. Conversely, it may be that because of their social withdrawal, poorly socially skilled individuals miss the opportunity to be sensitized to nonverbal cues and to differentiate facial expressions. Finally, it is also possible that both social competence and the ability to recognize facial expressions of emotions are related to some general factor encompassing affective and social skills which would determine the adaptation of individuals to their social surroundings.

To further examine this relationship, future research could investigate whether improving the nonverbal sensitivity of children poor social skills children also affects their social competence. Such research would have the double advantage of addressing practical concerns as well as theoretical considerations. The broad concept of social skills could also be broken into more specific concepts whose relationships with facial expression decoding skills could be examined, leading to a more precise definition of the observed effect of social skills. For example, it could be determined whether the ability to

recognize facial expressions is related to the frequency or type of interactions with peers of the same age group rather than with adults.

The hypothesis that there would be a difference in emotional expressivity between high- and low-socially skilled preschoolers was not supported by the present data. Indeed, judges did not discriminate better the category of emotion displayed in the scenarios when observing the facial expressions of high as opposed to low social skills children. It should be noted, however, that the overall accuracy of the judges was low; this measure may not have been sensitive to subtle differences between high and low socially skilled individuals.

Moreover, the facial expression of the character experiencing the emotion in each scenario could not be seen, a characteristic of the stimuli that may have diminished their emotional impact. Indeed, the viewing of facial expressions of emotion has been proven to be a potent elicitor of affective and mimicry reactions (Ekman, 1984; Izard, 1977). Future research could investigate the differential facial reactions of high versus low social skills preschoolers viewing emotionally loaded scenarios where facial expressions would be displayed. A recent investigation by Custrini (1987), where the subjects were viewing emotional scenarios with visible facial expressions, in fact did find a difference of expressivity between highly and poorly socially skilled 8- to 13-year-olds.

Still, judges were able to decode children's reactions to happy and sad scenarios at better than chance levels. Hence, the children at both levels of social competence did successfully express at least some affective states. This suggests that if there is a difference in

emotional expressivity between high and low social skills children that has been undetected in the present study, this difference is not dramatic. As proposed in the conclusion of the second chapter, spontaneous facial expressions of emotion are largely determined by biological and maturational factors. They thus constitute a "given" more than a "skill-to-be-acquired". However, they can be modified by display rules which are progressively learned during childhood. If, as suggested by some authors (e.g., Feldman, White, & Lobato, 1982), poorly socially skilled individuals suffer from learning deficits, it should be expected that, in preschool-age children, spontaneous emotional expressivity, which is largely independent from learned display rules, would not be differentiated between highly and poorly socially skilled children.

Age Considerations

The second hypothesis was fully supported by the data. While the performance for the recognition of facial expressions improved between three- and five-years, spontaneous expressivity was not related to age. It should be noted that no previous study that has investigated this particular age range found an improvement of the decoding abilities. This finding, then, validates the sensitivity of the present procedure. It also supports the idea defended in the conclusion of Chapter II, namely, that the recognition of facial expressions and the knowledge of their relationships to specific situations are learned during the early years of childhood.

Conversely, spontaneous expressivity was not related to age. This finding suggests that spontaneous facial expressions are relatively independent of learning that occurs during the three to five year range and that, once established, they undergo few changes.

On the other hand, the differences of decoding abilities related to age were modified by an interaction between emotion category, sex, and age. Although the level of performance was noteworthily not influenced by sex in itself, females appeared to develop their decoding skills between three- and four-years while males follow with a delay of one year. The recognition of sadness fits this pattern particularly well. This differentiated trend is congruent with developmental patterns noted in several studies in which males show delays in the recognition facial expression (Buck, 1984) and in social and intellectual development in general (Maccoby & Jacklin, 1974). This finding further supports the idea that the recognition of facial expression of emotion is learned during ontogeny and is related to the general cognitive and social development of the individual. Surprisingly, though, females' performance in recognizing sadness in the present study droped at five-years of age, a finding which is not easily explained. Because only three subjects of the sample are responsible for it, this effect may be spurious.

Findings Related to the Emotion Category

As predicted by the third experimental hypothesis and comparable to previous findings, happiness was the easiest facial expression to

recognize for the preschoolers. Even three-years-olds identified it at levels better than chance. However, contrary to the findings of two previous studies (Camras & Allison, 1985; Kirouac, Tremblay, & Dore, 1982) which have investigated similar age groups, sadness appeared to be more difficult to recognize than fear.

However, methodological differences may account for the discrepancy between the present study and previous research. While the previous two studies presented verbally the emotional scenarios, the present study used more realistic videotaped scenes. It seems reasonable to assume that sadness, elicited by less material and visible factors (the loss of an affective bond or love object) would be more difficult to infer in real life than fear. In contrast, the elicitor for fear (a frightening object or agent) is usually present and visible in the situations that evoke fear. This factor may have been missed by studies relying on a verbal description of the emotional context. The present study, then, which uses more naturalistic stimuli, probably offers a better assessment of real life performances of preschool-age children.

The results also suggest a stage-like developmental pattern where the capacity to recognize certain facial expressions is preceded by the capacity to recognize other facial expressions. More specifically, the ability to recognize sadness is preceded by the ability to recognize fear, which follows happiness recognition. Given the type of errors made, it also seems that children first could discriminate the positive expressions (happiness) from the negative expressions (sadness and fear) and later were able to differentiate the two negative expressions.

Children's reactions to happy scenarios were easier to identify than their reactions to sad scenarios, with the frightening scenarios yielding no detectable reaction. Several authors have suggested that early in life spontaneous expressions of negative emotions may be discouraged by various practices of the caregivers (e.g., Malatesta, Grigoryev, Lamb, & Culver, 1986; Feinman and Feldman, 1982). Congruent with this idea, the results of the present study indicate that the recognizability of the expressive displays varied as a function of their social acceptability.

Finally, as generally reported (e.g., Buck, 1984), decoding and encoding skills appeared to be unrelated. Again, this finding supports the idea that the determinants for encoding and decoding facial expressions are different, the former being shaped by biological factors and the latter by leaning processes.

Conclusion

This study demonstrates the existence in preschool-age children of a relationship between facial expressions recognition and social competence, a relationship already established by previous studies in older children and adolescents. The present piece of evidence is even strengthened by the fact that the effect of social skills was observed in a normal population and is not modified by other variables.

The fact that this relationship has now been established in very young children further suggests that the deficits of poorly socially skilled individuals might be acquired early in life. To partially test this hypothesis, a follow-up longitudinal study could examine if there is

any covariation between social competence and facial expression decoding skills across ages in the same individuals. Similarily, the nature of this relationship should be more narrowly defined by relating decoding skills to specific social skills.

Future studies could also investigate if these results can be extended to clinical populations known for their deficits in social competence. For example, a study using a similar procedure could compare the performance of preschool-age autistic children with normal children of similar intellectual and verbal level.

The present results also indicate several developmental patterns in the ability to recognize facial expressions. Overall, this ability seems to increase with age in a stage-like manner in which the ability to identify particular facial expressions of emotion is preceeded by the ability to discriminate others. It should be noted, however, that any developmental interpretation of the results of the present study is limited by the cross-sectional character of its design. The hypotheses and interpretations formulated above should be further tested in studies using longitudinal designs.

Thus, the present findings are consistent with the conclusions of the two first chapters. The changes found in the recognition of facial expressions are congruent with the notion that there are learning processes that operate during childhood. In contrast, spontaneous expression of emotion seems to remain largely unchanged up to five-years of age. At this age, children should develop their knowledge of display rules. Future studies could investigate possible deficits of poorly

socially skilled children in their acquisition and practice of display rules.

Yet, numerous questions are still to be answered. Do individuals with poor social competence remains poor decoders of facial expression across ages? Could a training of sensitization to nonverbal cues of affect improve their social competence? Do some clinical populations suffer a similar deficit? Are there different patterns of development for males and females in the ability to recognize facial expression of emotion? Is this ability acquired through a succession of stages?

From a more general perspective, this study could constitute a first step toward a much needed but still missing developmental model of the recognition of facial expression. As presented above, the present findings suggest several developmental patterns involving the interactions of various determinants such as sex, age, or category of emotion displayed. Similarly, up to this time, no evidence of an improvement of the decoding performance between age three and five and no evidence of a stage-like acquisition for the different categories of emotion has yet been reported. Future research still has to further establish and elaborate these results.

Moreover, the novel procedure designed for this study has proven to be sensitive to subtle differences of performance in decoding facial expression that in other studies have gone undetected. Very recently this procedure has also been used successfully at a pre-test stage with younger children (two years of age) and with preschool-age autistic children. Hence, it seems that with minor adjustments such as adapting the stimuli to the age of the target population, the present procedure

could be used to gather in a controlled and standardized way data on the development of facial expression recognition among a wide age span, ranging from preverbal children to adolescent. The traditional methodological pitfall of changing the type of procedure with age would thus be avoided.

Finally, at an applied and clinical level, the present procedure could be developed in a test assessing children's and adolescents' ability to decode facial cues of emotion. This test could constitute an early detection of possible deficits in sensitivity to nonverbal emotional information and a basis for compensatory training, in typical as well as in clinical populations.

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