

Smiling in Infancy

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CHAPTER 5

SMILING IN INFANCY¹

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Infant smiles are engaging. Few can look at an infant smile and contain a smile of their own. But infant smiles can teach as well as thrill us. They occupy a privileged position in theories of positive emotion. Infants provide evidence as to how smiles develop their original meanings.

As adults, we have tens of thousands of hours of interactive experience in which we smile and respond to the smiles of others. Despite our experience – or perhaps because of how we are immersed in experience - it is often difficult to systematically reflect on what our own smiles and the smiles of other adults mean. Social display rules as to when it is appropriate to smile may obscure the original significance of different types of smiling. Infants, however, do not yet have the social cognitive ability to appreciate or apply these social display rules. Infants, then, may allow us to better understand the original functions of smiling.

In this chapter, we focus on understanding what different types of smiling mean and the way they are coordinated into communicative messages before the development of speech. We begin with a brief developmental overview of

smiling in infancy, and explore its ramifications for the meaning of smiles in general. This is followed by a discussion of the meaning of different types of infant smiles and their similarities and differences from adult smiles. Finally, we explore how smiles are coordinated with other expressive behaviors in early interaction and the insight this provides into joyful emotional processes.

Between the neonatal period and the second year of life, smiles develop from an endogenous behavior occurring primarily during sleep to intentionally shared positive messages (Jones & Hong, 2001; Sroufe, 1996; Sroufe & Waters, 1976). The earliest smiles typically occur during REM sleep without any environmental stimulation (Emde & Koenig, 1969) and can have a rather mature form (Messinger, Dondi, Nelson-Goens, Beghi, Fogel, & Simion, 2002). For the next month, smiles are most likely when infants are drowsy and are reliably elicited by the human voice and other high-pitched sounds (Wolff, 1987). Between one and two months, infants become noticeably more reactive to their environment (Sroufe & Waters, 1976) and smile toward visual stimuli such as the human face (Spitz, 1946)

Shortly after one month of age, the social smile develops (Anisfeld, 1982). From this point on, smiling becomes a primarily social-emotional expression. Through at least six months of age, face-to-face interactions are a high point of the time the infant spends with the caregiver and smiles are a high point of face-to-face interactions (Weinberg & Tronick, 1994). Smiles help organize social and emotional exchanges, providing the parent with the feeling that they are in touch with and doing well by their baby (Spitz, 1949, Sroufe & Waters, 1976).

Both the frequency and amount of time the infants spend smiling during interactions increase through six months of age (Gewirtz, 1965; Messinger, Fogel, & Dickson, 1999). Within face-to-face interaction, infant smiles are most likely when infants are gazing at their mothers and when their mothers are also smiling (Kaye & Fogel, 1980; Messinger, Fogel, & Dickson, 2001; Weinberg & Tronick, 1994; van Beek, Hopkins, & Hoeksma, 1994). With age, in fact, infants become

increasingly likely to smile while gazing at mother rather than away from mother (Kaye and Fogel, 1980). At the same time, infants are more likely to use smiles to actively initiate interchanges with their mother whether or not she has smiled at the infant (Kaye and Fogel, 1980). With development, more generally, infants become less passive and more active participants in the exchanges that elicit smiles (Sroufe & Waters, 1976).

Beginning before and continuing through six months, infants' alternate attention with greater frequency from their caregiver to objects and physical elements in their environment during interactions (Rochat, 2001). Around nine months, infant smiles become integrated into the development of communication about objects (Adamson & Bakeman, 1984; Messinger & Fogel, 1998). Infants smile when they use gestures and eye contact to attract their caregiver's attention to both their own actions and to objects in their surrounding environment (Messinger & Fogel, 1998; Morales et al., 2000). Toward their first birthdays, infants begin to smile and then turn to their caregivers, as if sharing their emotional states (Jones & Raag, 1989; Jones & Hong, 2001).

HOW INFANTS SMILE

Smiles take various forms. All smiles involve the contraction of the *zygomatic major* which pulls the lip corners upward and toward the side of the face (Ekman & Friesen, 1978). Smiles can also occur with cheek raising produced by the contraction of the *obicularis oculi, pars lateralis*. In raising the cheeks, this muscular action squints the eyes and, in adults, wrinkles the eye corners (Oster & Rosenstein, in press) (see Figure 1). Ekman and his colleagues have made a classic distinction between these cheek-raise (Duchenne) smiles and other smiles (Ekman & Friesen, 1978; Ekman, Davidson, & Friesen, 1990). Smiles with and without cheek raising appear to have different meanings.

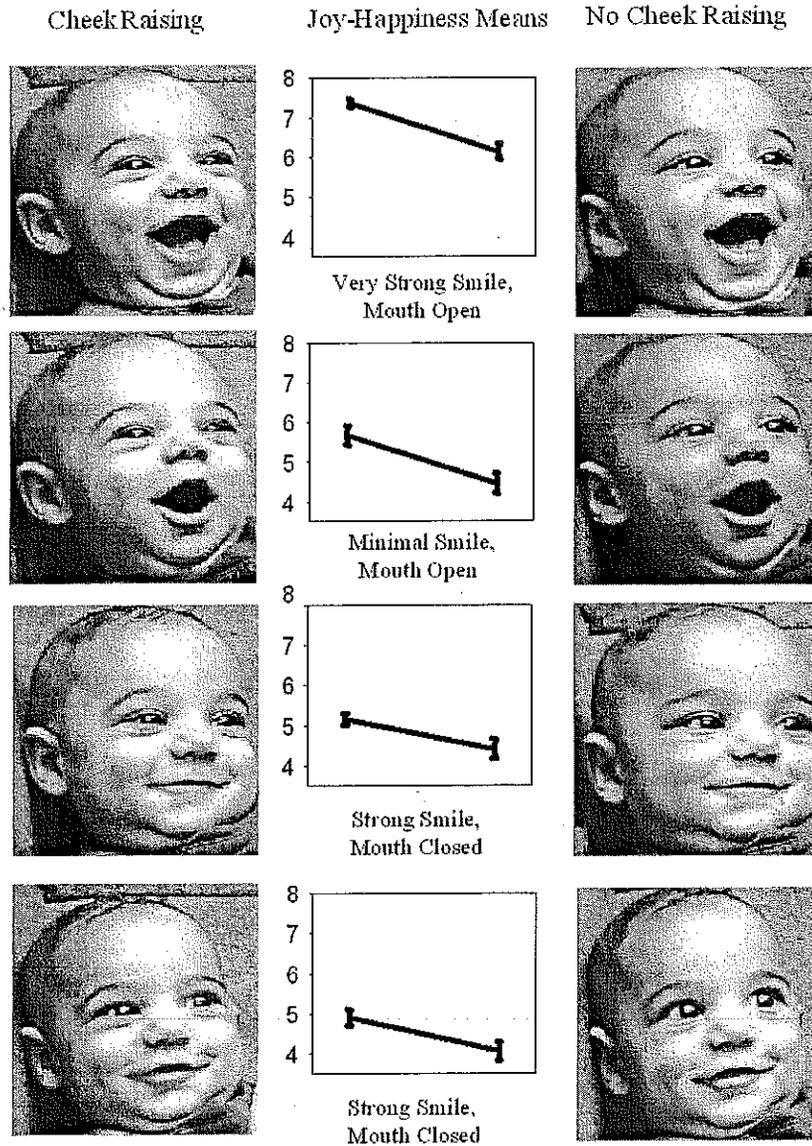


Figure 1. Positive emotion perceived in different types of infant smiles. Mean joy-happiness ratings (on a scale from 0-8) and their standard errors for each pair of smiles. The smiles on the left are cheek-raise (Duchenne) smiles, and the smiles on the right are not. The smiles in each horizontal pair were created with an identical smiling mouth. In each column, the top two smiles are open-mouth smiles and the bottom two are not. Pairs of smiles also differ in the strength of the smile portrayed. Adapted with permission from "Positive and negative: Infant facial expressions and emotions," by D. Messinger (in press).

Among adults, it may be that only cheek-raise or Duchenne smiles are linked to positive emotion. In an experimental study, cheek-raise smiles were more likely to occur during the presentation of amusing as opposed to gruesome films (Ekman, et al., 1990). Participants who engaged in more cheek-raise smiling also reported feeling greater positive emotion. But smiling without cheek raising was not more common in the amusing film and were not associated with self-reported positive emotion (Ekman et al., 1990). Instead, smiles without cheek raising are thought to lubricate social interactions and disguise negative or uncomfortable feelings. Ekman (1992; 1994) argues that in adults, smiles without cheek raising are a social signal unrelated to joy, while cheek raise smiles are indicative of joy. Is the same true for infants?

An initial study of infants indicated an emotional distinction between smiles with and without cheek raising. Fox and Davidson (1988) found that ten-month-old infants were more likely to display smiles with cheek raising when approached by their smiling mothers. Smiles without cheek raising tended to occur more frequently in response to the approach of an impassive stranger. Fox and Davidson's gathered electroencephalographic data during these smiles. Infants showed an association between cheek-raise smiles and greater left frontal brain activation, a pattern which has previously been linked to positive emotion in adults (Davidson, Schwartz, Saron, Bennett, & Goleman, 1979).

Fox and Davidson's (1988) work may indicate infant smiles with cheek raising are part of a joyful response while smiles without cheek raising are not. More recent descriptive research with one-to six-month-old infants suggests, however, that these two types of smile occur in close temporal proximity to one another (Messinger et al., 1999). Within a given session of mother-infant interaction, the amount of time infants spent smiling without cheek raising was correlated with time spent in cheek raise smiling. These findings suggest those features of an interaction which result in one type of smiling are likely to produce another type of smiling as well, suggesting an emotional parallel between the

types of smiles. Smiles without cheek raising also tended to occur immediately prior to smiles with cheek raising at greater than chance levels (Messinger et al., 1999). This suggests a process of intensification in which an initial feeling of positive emotion is reflected in a smile without cheek raising.

Messinger et al. (1999) also found that cheek-raise smiling was more likely to occur with mouth opening than not. The open mouth smile is characterized by jaw dropping (Oster & Rosenstein, in press) and is often referred to as a play smile. Research with non-human primates indicates that open-mouth expressions, typically occurring with the lips over the teeth, tend to occur during playful interactions (van Hooff, 1972). Among seventeen-month-olds, open-mouth smiles to mother were especially likely when mothers were attentive to their infants play (Jones, Raag, & Collins, 1990). This research suggests that infants' open mouth smiles are more apt to reflect a playful sociality than closed mouth smiles.

Although infant and adult smiles are anatomically similar, the meanings of the smiles appear to differ. The distinction between adult smiles of joy (cheek-raise smiles) and smiles of ploy (smiles without cheek raising) does not seem to fit the infant case. Among infants, smiles with and without cheek raising occur in close temporal proximity. If only infant cheek-raise smiles are indicative of joy, why are they frequently the culmination of a smile without cheek raising? Does the argument that infant smiles without cheek raising are not emotionally positive also apply to open mouth smiles? The most commonly occurring cheek-raise smile among infants involves mouth opening. Do these smiles have a different meaning than cheek-raise smiles without mouth opening?

The specific situations in which smiles occur are a clue to their meaning. To better understand the social and emotional significance of infant smiles, Messinger et al. (2001) examined the contexts in which different types of smiling occurred. Smiling was categorized as cheek-raise smiling, open-mouth smiling, combined open-mouth cheek-raise smiling and smiling alone (simple smiles) that

involved neither of these characteristics. These types of smiling were examined when infants gazed at and away from their mothers' faces and when their mothers were smiling and not smiling during naturally occurring face-to-face interactions. Infants, not mothers, had to initiate overlaps between smiling and these interactive periods.

Smiling alone was contrasted with periods without smiling. This was done by expressing time smiling alone as a proportion of time not smiling. Infants engaged in higher proportions of smiling alone when they were gazing at their mothers' faces rather than when they were gazing elsewhere (see Figure 2). They also engaged in higher proportions of smiling alone when their mothers were smiling than when their mothers were not smiling. Smiling alone, then, was related to both visual engagement with mother and her own positive displays.

Cheek-raise and open-mouth smiling, as well as the combined open-mouth cheek-raise smile were each expressed as proportions of time smiling alone. This allowed us to contrast smiling involving actions such as cheek raising to smiling without these actions. Infants engaged in higher proportions of open-mouth smiling when they were gazing at the mother's face rather than gazing away (see Figure 2). Infants engaged in higher proportions of cheek-raise smiling when their mothers were smiling than when she was not smiling (see Figure 2).

Combined open-mouth cheek-raise smiling was associated with patterns characteristic of both open-mouth smiling and cheek-raise smiling individually. Like open-mouth smiling, open mouth cheek raise smiles occurred at higher levels when the infant was gazing at their mothers' faces. Like cheek-raise smiling, it occurred at higher levels when the infants mothers were smiling. When both events overlapped and infants were gazing at their smiling mothers, open-mouth cheek-raise smiling occurred at its highest levels (see Figure 2).

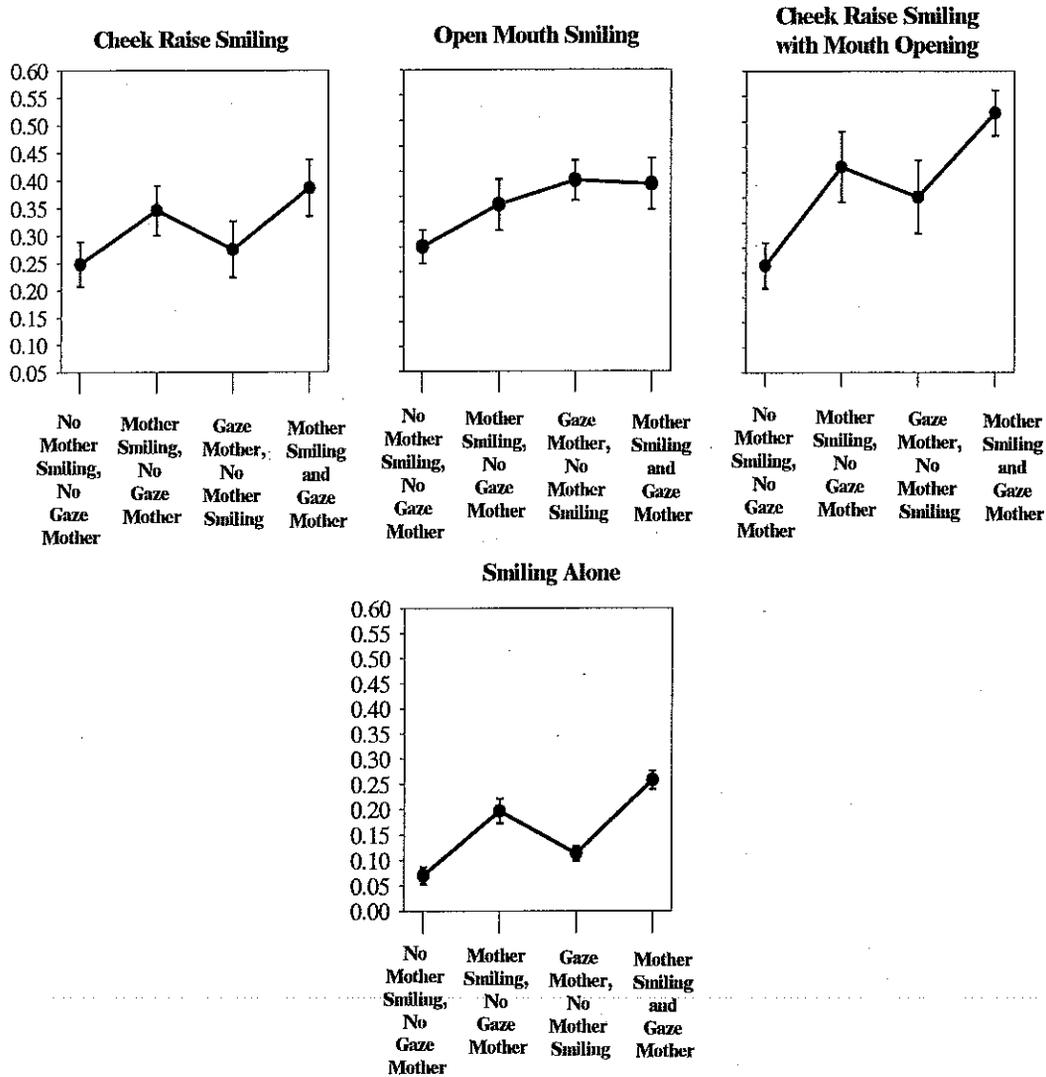


Figure 2. Infant smiles by periods of mother smiling and gazing at mother. Within each period of social interaction, smiling alone (below) is expressed as a proportion of time smiling alone and time without smiling. Smiling types (above) are expressed as proportions of the given smiling type and smiling alone. Standard error bars surround each mean. Adapted from "All smiles are positive, but some smiles are more positive than others," by D. Messinger, A. Fogel, and K. L. Dickson (2001). *Developmental Psychology*, 37, p. 647. Copyright © 2001 by the American Psychological Association. Adapted with permission.

The development of smiling also provides clues to the meanings of different types of smiling. All smiles rise with age in early infancy. The developmental trajectories of different types of smiling are statistically indistinguishable if one does not have reference to the contexts in which the smiles occur (Messinger et al., 1999). With age, however, certain types of smiling become more likely than others in specific interactive periods (Messinger et al., 2001).

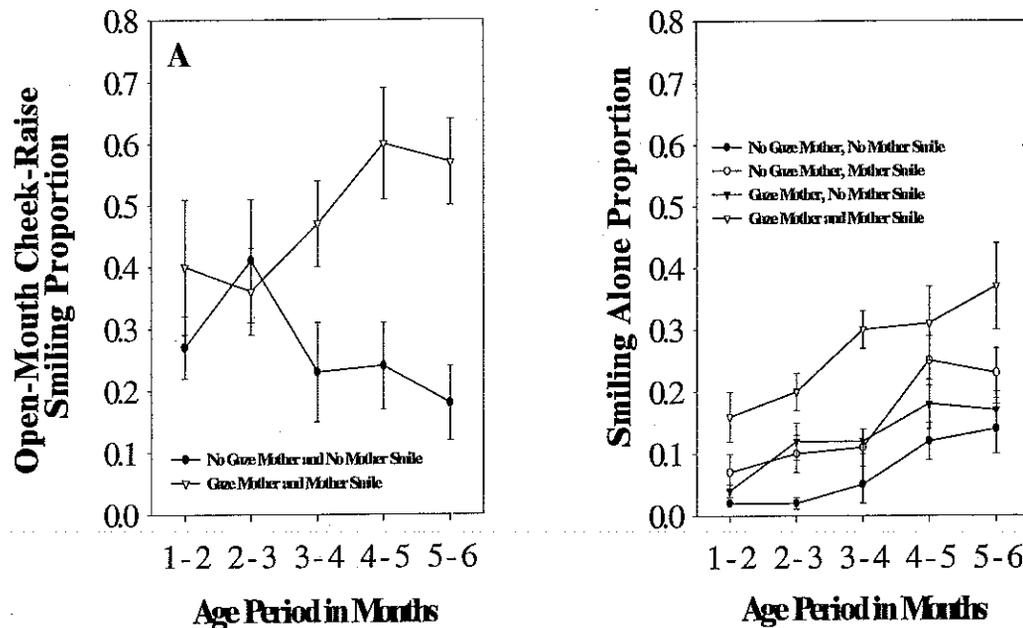


Figure 3. Infant smiles by periods of mother smiling and gazing at mother. Within each period of social interaction, smiling alone

Proportions of open-mouth cheek-raise smiling increased when infants were looking at their smiling mothers (see Figure 3). Proportions decreased when neither of these events was occurring – when infants were looking away from their mothers and their mothers were not smiling. Cheek-raise smiling also increased with age when infants were gazing at their smiling mothers, suggesting that smiles with cheek raising, both with and without mouth opening become more strongly linked with positive emotional exchanges (see Figure 3). By contrast, proportions of smiling alone showed a non-specific increase across all periods of interaction (see Figure 3). As infants grow older, they are no more likely to respond to especially positive periods of social interaction with smiling alone. Instead, they are more likely to participate in these positive periods with cheek-raise smiling and especially open-mouth cheek-raise smiling. These patterns suggest that open-mouth cheek-raise smiles become an increasingly valid index of positive emotional engagement during the first half year of life.

Work on different types of smiling among infants in the second half year of life carried out by Fogel and his colleagues continue our developmental story (Fogel, Nelson-Goens, Hsu, & Shapiro, 2000). Six- and twelve-month-old infants showed similar patterns of smiling when playing games with their mothers. Infants participated in multiple trials of *peekaboo* and *tickle* with their mothers. Fogel et al. divided each trial of *peekaboo* as a sequence of setup (covering the face) and climax (uncovering of the face). Similarly, each trial of *tickle* was designated as a sequence of setup (looming hands) and climax (tactile contact). Infant smiles tended to occur during different parts of these games, leading Fogel et al. to suggest the smiles were associated with different types of joyful processes.

While gazing at their mother during the set-up of *peekaboo*, infants displayed smiling alone, suggesting a joyful readiness or anticipation. Furthermore, smiles with cheek raising were displayed when the infant gazed at the mother in the initial trials of the climax of the tickle game. Infants also

expressed smiles with cheek raising during the climax of the tickle games while they gazed away from their mothers. These smiles may indicate joy in participation and escape, respectively. Open-mouth cheek-raise smiling occurred in the climax of the final trials of tickle (a tactile game) and in the climax of peekaboo (a more visual game) when the infant was gazing at the mother. This suggests that open-mouth cheek-raise smiling was especially associated with the most exciting and engaging periods of interaction.

Dickson, Walker, and Fogel (1997) also reported that specific types of smiles predominated during specific types of play. In a study of 12-month-olds, smiling alone tended to occur during book reading. Narrative descriptions suggested that when cheek-raise smiles occurred during book reading, they reflected visual attention to a person rather than to the book in question. Open-mouth cheek-raise smiling tended to occur during physical play, which is consonant with the position that this smile is associated with the most positive periods of interaction.

Oster and Rosenstein (in press) defined big smiles as overlaps of open-mouth smiling and a stronger smiling action. This adds a new dimension, the strength of smiling, to our discussion of the meaning of different types of smiling. Stronger smiles, involving stronger action of the zygomatic major, are likely to involve cheek raising (Schneider & Uzner, 1992). Segal et al. (1995) found that full term infants were more likely than preterm infants to display big smiles during face-to-face interactions. This suggests that stronger open-mouth cheek-raise smiles reflect the arousing sharing of positive affect that typifies the behavior of full-term (but not premature) infants during face-to-face interaction.

This research on infant smiling has important implications for our understanding of positive emotion. First, infant smiles without cheek raising appear to be positive emotional signals. In adults, smiles without cheek raising may serve as social signals that occasionally mask negative emotion (Ekman, 1992; 1994). This does not appear to be the case for infants. Smiles without cheek

raising may sometimes signal wary acceptance of an impassive stranger (Fox & Davidson, 1988). During interaction with a familiar caregiver, however, smiling alone - smiling without cheek raising or mouth opening - occurs during periods of positive interaction. Smiling alone appears to be part of joyful processes. If it is not the case that some infant smiles reflect joy while others do not, what is the meaning of these different types of infant smiles?

The second implication of the research is that different types of smiling may have qualitatively different meanings. Proponents of social process and dynamic systems theories argue that each type of smile may be associated with a distinct type of positive emotion (Fogel et al., 1992; Lewis & Douglas, 1998; Dickson, Fogel, & Messinger, 1998; Messinger, Fogel, & Dickson, 1997). Smiling alone varies in its meaning. It may reflect wary receptivity to a stranger (Fox & Davidson, 1998) or engagement with a caregivers' positive overtures expressed either by the mother's smiling (Messinger et al., 2001) or her initiation of a game (Fogel et al., 2000). Cheek-raise smiling is more specifically involved with sharing positive feelings with a smiling or playful social partner (Fogel et al., 2000; Fox & Davidson, 1988; Messinger et al., 2001). Open-mouth smiles are more specific to a process of visual engagement with an attentive partner (Jones et al., 1990; Messinger et al., 2001). Open-mouth cheek-raise smiling combines these positive emotional processes. This type of smiling signifies arousing engagement in sharing positive interactions (Dickson et al., 1998).

There are three difficulties with the intuitively appealing suggestion that different types of smiling reflect different qualities of positive emotion. The first concerns our own results (Messinger et al., 2001). They suggest that young infants' smiles occurring during naturalistic play may not be as differentiated in their meaning as the smiles of older infants. We found that, in comparison with smiling alone, proportions of cheek-raise and other types of smiling were elevated in specific social situations. But though levels of specific types of smiling were elevated, they almost never exceeded smiling alone. In other words, though

percentages of different types of smiling (calculated with respect to smiling alone) rose in specific social situations, they rarely exceeded 50% (see Figure 1). Different types of smiling appear to be *especially* associated with specific types of positive engagement. But among young infants in naturalistic interactions, we do not have evidence that different types of smiling are *uniquely* associated with those feelings. The exception was open-mouth cheek-raise smiling in infants over four months of age, which occurred more than smiling alone in the most positive period of interaction, when infants were gazing at their smiling mothers' faces. Experimental studies of infants six months of age and beyond (Fogel et al., 2000; Fox & Davidson, 1988) and observational studies of 12-month-olds (Dickson et al., 1998) do show a preponderance of specific types of smiling in specific situations, suggesting that these among older infants smiles may reflect qualitatively different types of positive emotion.

A second difficulty with qualitative interpretations of infant smiles is that studies of different types of infant smiles are themselves in their infancy. To date, researchers have studied a limited number of social situations - face-to-face play, play with objects, social games, and encounters with a caregiver and stranger. Associations of different types of smiles with different periods during these social situations have been described. It is not yet clear, however, to what degree conclusions about the meaning of these smiles can be generalized across the contexts studied by different investigators. Additional studies, descriptive and experimental, describing how infants smile in various situations will illuminate the degree to which different types of infant smiles may have specific social and emotional meanings.

The third difficulty with determining the meaning of different types of smiles is theoretical. The anatomical description of a smile does not exhaust its meaning. Instead, the infant's goals in a specific social interchange contribute to the meaning of the smile. The same type of smile would, then, have different meanings in different social situations (Barrett, 1998; Fogel et al, 1992). Smiling

alone, depending on when it occurred, might indicate both anticipation of being tickled and relief after being tickled (Fogel et al, 2000). Attention to infants' possible goals in a given social situation is clearly important to the hypothesis that different types of smiles have qualitatively different meanings. But it is also possible that different types of smiles reflect quantitative differences in positive emotion.

The quantitative position is that some smiles are more emotionally positive than others. Different types of smiles, by this account, differ in the degree to which they reflect positive feeling and pleasure. The idea is consonant with theories of affect that emphasize variations in pleasantness as a defining feature of emotions (Russell & Barrett, 1999). It may also be consistent with discrete emotion theory (DET). DET argues that there are a limited set of basic emotions that are rooted in specific neural programs. By this account, a single emotion program of joy produces smiles (Ackerman, Abe, & Izard, 1998; Izard & Malatesta, 1987). The theory does not acknowledge the possibility that there are qualitatively different types of joyful emotion (though a single joyful emotion might be linked to different cognitive expectations and memories). This seems to preclude the possibility that different types of smiling reflect different types of joy. But the theory may be consonant with the position that there can be different degrees of joy depending on the degree of activation of the neurologically based emotion program. Differences in the intensity of joy, or positive feeling, would be reflected in different types of smiling.

This quantitative hypothesis also explains the data. Smiling alone occurred both when infants gazed at their mothers and when their mothers smiled, suggesting this type of smiling reflects a baseline level of positive emotion. Smiles involving cheek raising, mouth opening, and their combination, were even more likely than smiling alone in the positive periods of interaction studied. This suggests that smiles defined by these characteristics, and especially open-mouth cheek-raise smiles, reflect stronger positive feelings than does smiling alone. By

the same token, Dickson et al. (1997) and Fogel et al. (2000) found that smiling alone occurred during positive periods of interaction. But open-mouth cheek-raising occurred during the most positive periods of interaction, presumably because it is involved in stronger feelings of joy. More dynamically, in all these studies, infant smiling alone tended to be a positive preamble to more intensely positive engagement reflected in cheek-raise smiles that typically involve mouth opening.

Naïve observers' perceptions of different types of smiles are another index of the emotional meaning of the smiles. Ongoing studies in our lab examine the effect of cheek raising and mouth opening, the same features studied in the observational research, on adult perceptions of infant positive emotion (Messinger, in press). We chose different base smiles of varying strength and mouth opening. Using Adobe Photoshop, smiles were systematically altered to examine the effects of cheek raising on adult perceptions of infant joy. First the mouth portion of smiles that varied in the intensity of lip corner raising and mouth opening was digitally cut out of the image. The upper border of mouth portion of the smiles was approximately described by the ridge of the infant's cheek bones. These smiling mouths were pasted over the mouth portion of one smile with cheek raising and one smile without cheek raising. This allowed us to experimentally isolate the impact of cheek raising on adult perceptions of positive emotion in infant smiles.

Fifty University of Miami students were asked to rate the happiness and joy perceived in each infant smile. Results apply both to ratings of each emotion term individually and to the mean of ratings of both terms. Smiles with cheek raising were consistently perceived as more emotionally positive than the same smile without cheek raising (see Figure 1). Open-mouth smiles were also perceived as more positive than closed-mouth smiles (see Figure 1). Stronger smiles are rated as more positive than weak smiles (see Figure 1). Thus strong open mouth smiles with cheek raising were rated as expressing the highest levels

of positive emotion (see Figure 1). Finally, adults rated smiling alone as more positive than neutral expressions.

The rating study shows striking parallels with studies of when infants produce different types of smiling. Smiles with cheek raising and mouth opening are perceived as more positive than smiles alone (which do not involve cheek raising or mouth opening). Open-mouth cheek-raise smiling, especially when the smile itself is strong, is perceived as the most positive. Equally important, even smiles with none of these characteristics are perceived as more positive than neutral expressions, just as smiling alone was relatively more likely than non-smiling to occur in positive situations. More broadly, the ratings of naïve adults suggest that some types of smiles reflect more positive emotion than other smiles.

The rating study offers evidence that some smiles are more positive than others. It may, however, be possible to design similar studies that could highlight qualitative differences between different types of smiles. The degree to which a smile reflects arousal, for example, may be indexed by the presence of mouth opening. If so, smiles involving mouth opening should be perceived as involving more arousal than other smiles. More generally, observer ratings of a particular feature of smiling do not exclude the possibility that the expressions differ on an as yet, unmeasured emotional or communicative dimension.

Recent research makes it clear that all types of infant smiles reflect positive emotional processes and that one type of smile transitions to another type in the course of positive interactions. It is possible, then, that different types of smiling are dynamically linked constituents of a family of positive emotions (Barrett, 1998; Barrett & Campos, 1987; Fogel et al. 2000; Messinger, 2002). These positive emotions are linked in that they motivate engagement with and continuation of satisfying experiences. It is not clear, however, whether the member of this positive family emotion differs from one another qualitatively as well as quantitatively. The parsimonious possibility that different smiles reflect

differences in the intensity of positive emotion does not preclude the possibility that the smiles have qualitative differences as well.

In the section that follows, we continue our examination of the meaning and development of infant smiles. The research examines how smiles in general (not specific types of smiles) are sequenced in time with other expressive actions. This review covers the three to six month period and ends with a consideration of infant smiles at the beginning of the second year of life.

HOW INFANTS SEQUENCE SMILES WITH OTHER EXPRESSIVE BEHAVIORS

The manner in which smiles are sequenced with other expressive actions is also essential to understanding their role in the communication and expression of emotion. Young infants typically smile more frequently when gazing at their mothers' faces than when gazing away (van Beek et al., 1994). This smiling tends to occur with neutral and positive vocalizations (Weinberg & Tronick, 1994). But it may be that the meaning of expressive behaviors depends on the sequence in which they occur. How, then, are smiles sequenced in time with gazes and vocalizations?

During interaction with a parent, infants tended to begin and end vocalizations within ongoing smiles at greater than chance levels (Yale, Messinger, Cobo-Lewis, Oller, & Eilers, 1999).² This embedded sequence suggests that infant vocalizations may punctuate or add communicative emphasis to a smile's continuing emotional message. This interpretation is particularly plausible because while it is difficult to reliably distinguish infant neutral and positive vocalizations, infant smiles are reliably perceived as positive. It is problematic, however, to interpret the communicative impact of these sequences without understanding how smiles and vocalizations are each sequenced with a clearly social behavior, gazing at the mother's face.

In a subsequent study, we examined how infants sequenced smiles both with vocalizations and with gazes at a parent. Forty infants were observed interacting with their mothers at 3 and 6 months of age (Yale, Messinger, Cobo-Lewis, & Delgado, in submission). Infant smiles were sequenced at greater than chance levels with both vocalizations and with gazes at the mother. Vocalizations and gazes at mother were not themselves sequenced at greater than chance levels, suggesting the importance of smiles in organizing early infant communication (see also Weinberg & Tronick, 1998).

Infants sequenced smiles and vocalizations very differently than they sequenced smiles and gazes at their parents (Yale et al., in submission). The sequence in which infant vocalizations were embedded in the course of ongoing smiles did not change with age suggesting the developmental stability of this pattern. By contrast, the sequences in which smiles were sequenced with gazes at a parent became stronger with age. More importantly, infants produced different coordinated sequences at each age. At three months, infant smiles were typically embedded within a gaze at the mother (Yale et al., in submission). The infant looked at the mother, began the smile, ended the smile, and only then looked away. At 6 months, infants began a smile during a gaze at the parent and continued the smile after gazing away. There are profound differences between these sequences.

The pattern of embedding a smile in a gaze at mother is characteristic of young infants during face-to-face interaction who often seem transfixed by the parent and will smile several times during a single gaze at mother (Kaye & Fogel, 1980). Positive emotional communications begin and end during periods of continuous visual contact with the parent. Infants at this age are relatively unlikely to visually discontinue positive emotional contact.

The transition to gazing away during a smile suggests that infants are regulating the positive emotion elicited during the gaze at the parent. By five months of age, stronger infant smiles are more likely to involve or be followed by

infants averting their gaze from mother's face than are weaker smiles (Stifter & Moyer, 1991). Periods of stronger positive emotion are more likely to result in infants visually disengaging from the interchange, however briefly. Why does this occur?

Current theories of emotion indicate that joy, which is thought to be linked to smiling, motivates one to continue pleasurable actions (Ackerman et al., 1998; Izard & Malatesta, 1987). To explain why infants discontinue pleasurable actions, it is necessary to suggest that joy is, by its nature, patterned in time. Positive emotion may involve a decrease in tension or arousal that occurs with disengagement from the eliciting situation (Sroufe, 1979; Sroufe, 1996; Tomkins, 1962). A related possibility is that joy occurs when a goal is achieved faster than expected (Carver, in press). When this occurs, we coast and attend to other aspects of the environment. This would suggest that after three months of age infants are showing the first signs of reacting to intensely positive affect by actively disengaging and attending to other aspects of the surround.

DET and other theoretical perspectives suggest that joy motivates behavior and that infant smiles are associated with joy (Ackerman et al., 1998; Izard & Malatesta, 1987). It appears to follow that an infant smile should be associated with the motivation to engage in a pleasurable action such as gazing at an engaged parent. However, our investigation indicated that sequences in which a smile preceded a gaze at the parent occurred at less than chance levels through six months of age (Yale et al., in submission). Early infant joy is associated with the here and now experience of positive interaction, not its anticipation.

Anticipatory smiling in which infants smile and then gaze at an attentive parent does not occur consistently among randomly selected infants until 10 months of age (Jones, Collins, & Hong, 1991). These gazes at the parent may be motivated by joy, but it is important to note that the infants continue to smile during at least the initial portion of the gaze at mother. Infants, then, appear to be sharing their positive emotional feelings and are frequently rewarded by a

maternal smile. Recent reports indicate this type of affective sharing appears to be dependent on infants' understanding of simple means-ends relations with objects and their ability to use rudimentary gestures and words to communicate with their mothers (Jones & Hong, 2001). Between 8 and 12 months of age, infants who use means to attain ends are more likely to use anticipatory smiles to engage in positive interaction. This suggests that infants are smiling with the expectation of engaging in a positive interchange with mother.

Around their first birthdays, infants begin to use conventional hand movements and shifts of visual attention to share an experience or an event with another person (Messinger & Fogel, 1998; Mundy, Kasari, & Sigman, 1992). These infant initiated joint attention events are related to future expressive language development and social functioning. Smiling is more likely to occur during joint attention behaviors designed to share attention with another than during behaviors of similar cognitive complexity that are used to request objects (Adamson & Bakeman, 1985; Kasari, Sigman, Mundy, & Yirmiya, 1990; Messinger, & Fogel, 1998; Mundy et al., 1992). This difference is especially pronounced for joint attention acts that involve eye contact compared to requests that also involved eye contact (Yale, Henderson, & Yoder, 2001). Smiles continue to be a salient feature of early communications as they become more conventional (Messinger & Fogel, 1998). In sum, a one-year-old's smiles are part of the communicative mélange out of which conventional communication emerges and may themselves be used to voluntarily engage in positive emotional interchanges with another.

CONCLUSION

We began the chapter, somewhat paradoxically, by noting that infancy allows us to see how the original meanings of smiles develop. Infant smiles, as noted, initially occur in sleep and drowsy states in the absence of environmental stimulation. By two months of age, infant smiles occur primarily in social

situations. We know of no research in which infant smiles were consistently elicited by non-social stimulation. Even the smile of assimilation is elicited by cognitive processing of mildly discrepant social stimuli such as images of faces (Farris, 2000; Oster, 1978). One possibility is that infants experience joy in nonsocial situations, but express smiles only in social situations. It seems more plausible to suggest, however, that infant joy is intrinsically social.

It is likely that infant smiles help constitute as well as reflect positive emotional processes. Infant smiles make parent smiles and other positive responses more likely. Smiles may also be part of infant's subjective experience of happiness. Before eight months of age, infant's joy cannot be reliably related to future goals but exists in a present of ongoing interactions. When parents react with smiles and other positive expressions to their infants' smiles, they appear to be creating the conditions in which infants become aroused and desirous of continuing those interactions. In that sense, the increasing specificity with which infants respond to positive situations by actively engaging in intensely positive smiles is a window on the development of joy.

We hope that insights from infant smiles suggest possibilities for research with adults. In infants, for example, smiling without cheek raising can reflect either wary acceptance or a moderate level of positive emotion. Smiling without cheek raising in adults can certainly reflect wary acceptance, but the possibility that it can express moderate levels of positive emotion has not been precluded. Similarly, all indications are that strong open-mouth cheek-raise smiling is the most positive of infant smiles. There has, however, been little investigation of open-mouth smiling in adults. Mouth opening accompanies laughter in adults as well as children suggesting that open-mouth cheek-raise smiling reflects positive emotional processes throughout the life cycle (see Keltner & Ekman, 2000).

ENDNOTES

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²To examine how infants sequenced smiles with other expressive behaviors, we created simulation software to examine different patterns of paired actions. This software allowed us to compare the number of patterned sequences created by a given infant with the number of sequences expected by chance. The simulation software ensured this sequence of embedding a vocalization in a smile did not occur simply because the vocalization had shorter durations than the smiles.

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