

# 26 Infant Emotion Development and Temperament

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Caregivers of young infants are often well practiced in detecting and interpreting the presence or absence of infant emotion. This is particularly true in the case of negative emotions, motivating caregivers to take on the mantle of detective. Why is the baby crying? Is he/she hungry? Cold? Too hot? Angry? Gassy? Tired? Bored? A caregiver's need to search for clues reflects infants' rather limited communicative repertoire, coupled with a restricted behavioral toolbox. Over the first 2 years of life, children's expression and experience of emotion becomes more expansive, providing greater insight into the cause of any one emotional experience and the needed response. However, even at this point, parents and caregivers play an important role in modulating infants' emotional experiences, since much of emotion regulation is first implemented externally until the child can internalize and develop effective stand-alone regulatory responses.

Constructs as complex as emotion and emotion regulation have multiple contributing factors that reside in the individual, among social relationships, and within cultures that are then expressed over time. The current chapter will focus on one relatively thin slice of this network. In particular, we review the relations between emotion and emotion regulation as a function of early temperamental differences. These three essential components of socioemotional development (i.e., emotion, emotion regulation, and temperament) share five core features. First, all three components reflect aspects of functioning that are related to social and psychological well-being in childhood, adolescence, and adulthood (e.g., Degnan, Almas, & Fox, 2010). Second, all three have a constitutional/reflexive basis that is likely genetic in nature, but quickly develops into relatively less automatic and more elaborate forms with the maturation of brain and physiological systems in the first 2 years of life (Rothbart & Derryberry, 1981; Silvers, Buhle, & Ochsner, 2013). Third, basic attention processes that allow the infants to select, orient to, disengage, or shift from relevant stimuli in the environment (Posner, Rothbart, Sheese, & Voelker, 2014) are fundamental for the expression and regulation of infant emotion, as well as infant temperament. Fourth, the development of emotion, emotion regulation, and temperament influences, and is influenced by, the infants' experience of the social environment (Campos, Campos, & Barrett, 1989). This includes the immediate caregiving environment as well as the broader cultural context.

Finally, emotion, emotion regulation, and infant temperament are multilayered complex phenomena involving physiological, neural, and cognitive components that may work in parallel or interact to give rise to observed behavioral reactions. Thus, capturing emotion, emotion regulation, and temperament in infancy requires simultaneously taking into consideration how these different components operate in tandem over time.

In this chapter our discussion first begins by outlining the foundational approaches often taken with emotion and emotion regulation, including thorny issues of operational definition. After outlining behavioral and neurophysiological underpinnings of normative developmental trends in emotion and emotion regulation, we introduce temperament, a core source of individual differences. Individual differences also emerge in tandem with variation in the infant environment, parental characteristics, and culturally bound expectations. In the remaining sections of the chapter, we focus on the sociocultural context and discuss the influence that socialization forces, such as culture and parents, can have on early emotional development to guide future policies that enhance infant development.

## **26.1 Approaching Emotion and Emotion Regulation in Infancy**

Recent technological advances in infant-friendly research tools have allowed infant researchers to more systematically study the genetic and biological underpinnings of infants' development, helping capture the complexity of processes fueling the tremendous socioemotional changes observed in the first 2 years of life, through a better integrated interdisciplinary perspective. For example, a number of recent studies have begun to bridge biopsychosocial and developmental psychopathology perspectives to examine the early emergence of long-term socio-affective trajectories (Calkins, 2015). To tackle these interdisciplinary challenges, we must understand how early biological predispositions (including temperament) interact with the socioemotional environment during infancy to shape early patterns of adaptive and maladaptive behavior. These patterns, in turn, set the stage for later well-being or psychopathology.

## **26.2 Basic Constructs**

Building on previous research (Cole, Martin, & Dennis, 2004; Fu & Pérez-Edgar, 2015), we have adopted the following working definitions of emotion, emotion regulation, and temperament. By emotion, we refer to an evolutionarily adapted set of physiological, neural, cognitive, behavioral, and subjective reactions, triggered by the detection of a personally significant event in the environment. The personal significance of a given event is determined by one's perception of the event and one's own goals (Scherer, Schorr, & Johnstone,

2001). Early in development, these goals are largely confined to short-term states driven by immediate needs and sensations. Thus, they are likely to be more biological than social or cultural in origin. Social and cultural processes insert their influence early in life, as caregivers bring socialization goals to their increasingly interactive encounters with infants (Denham, Bassett, & Wyatt, 2007). Despite a general lack of consensus on the exact definition of emotion, emotion theories converge on the notion that emotions act as a rapid detection and response system and were preserved in our evolutionary history because they helped our ancestors stay away from threats to survival while enhancing opportunities for well-being and mastery of the environment (Cole et al., 2004).

By emotion regulation, we specifically refer to the processes that lead to changes in the occurrence, valence, intensity, duration, and timing of the physiological, neural, cognitive, behavioral, and subjective components of infants' emotional reactions to the environment (Cole & Hollenstein, 2018). Regulation can encompass processes within the self or actions undertaken by caregivers. In addition, while much of the focus on emotion-regulation research has been on modulating negative emotion, the expression and regulation of positive emotions are importance forces in infant emotional development.

Marking the distinction between emotion and emotion regulation is not straightforward, since the processes that generate and regulate emotion involve overlapping brain and biological systems are closely intertwined in observed behavior, and dynamically unfold over time (Cole & Hollenstein, 2018). Further complications arise from the fact that emotional experiences, by definition, have inherent regulatory qualities as they modulate one's physiology, behavior, and subjective experience (Ekas, Braungart-Rieker, & Messinger, 2018).

By temperament, we refer to biologically rooted individual variations in children's emotional, attentional, and motor reactions to the environment as well as variation in their regulation of these reactions (Campos, Frankel, & Camras, 2004; Rothbart, 2011). The timing and intensity of infants' verbal, physical, and vocal emotional reactions reflect early temperamental dispositions in their rawest form, before social and cognitive processes start to systematically exert their influence (Goldsmith & Campos, 1982). There is an inherent puzzle in trying to disentangle the interwoven relations between emotion, emotion regulation, and temperament. That is, we often risk a circular argument in studying temperament in that we argue that variations in temperament fuel observed differences in expressed emotion and social behavior (Bowman & Fox, 2018) and we use expressed emotion and social behavior to assess temperament (Pérez-Edgar, 2019).

### 26.3 Thorny Questions of Operational Definitions

Although the utility of studying emotion regulation as a concept distinct from emotion is well acknowledged, the extent to which regulation

processes can be mechanistically distinguished from the initial emotional experience seems to vary with the specific definition of emotion in play (Gross & Feldman Barrett, 2011). The distinction seems to be relatively clear in models operationalizing separate emotions like joy, fear, anger, and surprise as discrete, unique mental states with their own distinct cause, form, and function (e.g., Izard & Malatesta, 1987) versus perspectives that define emotions as a continuously emerging, dynamic stream of experiences (e.g., Camras, 2011).

Discrete emotions models have been highly influential in both adult-focused and developmental approaches to emotions, shaping working definitions of emotion in infancy (Gross & Feldman Barrett, 2011). These models, such as the differential emotions theory by Izard and colleagues (Izard & Malatesta, 1987), operationalize different emotions as discrete hard-wired systems consisting of a neural, an expressive, and an experiential component programmed to emerge at different stages of development. This theory assumes that infants' expressions of emotion mirror their experience of emotion. It further relies on the perception of discrete emotions by adult observers. This model also argues for a direct correspondence between infant and adult morphology of emotional facial expressions, a direct relation between infants' facial and non-facial emotional expressions, and a discrete, reliable, link between emotional expressions and the events that trigger these expressions.

In contrast to discrete emotions models, differentiation-oriented perspectives on emotion build on the idea that emotions emerge globally in infancy and become more differentiated over the course of development (Camras, 2011). Thus, according to this perspective, emotions initially emerge on a broader level as positive and negative affective states in infancy, and gradually develop into discrete positive and negative emotions over the first 2 years of life.

Other perspectives highlight the interpersonal and functional utility of emotion in their operationalization. The functionalist perspective by Campos and colleagues, for example, highlights the relational quality of emotion expressions, which are operationalized as the person's attempts to manage his or her connection to the environment (Barrett & Campos, 1987; Campos et al., 1989). Thus, according to this perspective, the communicative utility of a given expression determines the likelihood an infant will express an emotion in a specific situation. For example, early expression of frustration or anger are useful as they may call on caregivers to address (and hopefully remove) the component of the environment blocking the infant's current goal.

More contemporary perspectives adopting a dynamic systems approach (Camras, 2011; Cole, Bendezú, Ram, & Chow, 2017) operationalize emotion as a dynamically developing system consisting of nested components (such as emotion expressions and other emotional behaviors) that continually interact with each other and the environment over the course of development. This shift towards more dynamic and integrative perspectives centers the challenge

on making a distinction between emotion generation and emotion regulation (Camras, 2011), often addressed through the use of novel dynamic statistical techniques (Morales, Ram et al., 2017). The focus, of course, inevitably turns to the type of empirical data that are (or can) be used to distinguish between emotion and emotion regulation.

## 26.4 Behavioral Markers of Emotion and Emotion Regulation

Although we see rapid changes in regulatory abilities in infancy, discrete emotion theory builds on the idea that infants are unable to voluntarily change or regulate their emotional expressions. Thus, an infants' *expressions* of emotion directly reflect their *experience* of emotion (Izard & Malatesta, 1987). As a result, much of the empirical evidence on behavioral indices of emotion generation in infants is focused almost entirely on infants' outwards expressions of emotion. These were systematically investigated in emotion-eliciting situations (such as visual cliff, or stranger approach; Hiatt, Campos, & Emde, 1979) and coded by human observers or using standardized protocols (MAX and AFFEX, Izard, 1979, Izard, Dougherty, & Hembree, 1983). In a parallel vein, the systematic observation of infant regulatory strategies relies highly on observing *changes* in a child's emotional reaction in situations that elicit an initial emotion. Because the field has historically been most interested in negative emotions such as fear, anger/frustration, and sadness, there are a wide range of paradigms eliciting negative emotions, such as stranger approach, parental separation, delay, and still-face situations.

To infer infants' self-regulatory strategy or intent, three broad categories of behaviors are most commonly used (Ekas, Lickenbrock, & Braungart-Rieker, 2013): Attentional strategies (e.g., shifting gaze away from the distress elicitor and towards the mother), self-comforting (e.g., touching the head, bringing hands to mouth, thumb-sucking), or active avoidance (e.g., arching the back or pushing away, withdrawing the hands, or retracting the arms). In this way, researchers attempt to decouple the emotion (operationalized as facial and bodily expressions) and regulation (operationalized as larger-order responses). However, studying the effectiveness of these strategies relies highly on simultaneous or subsequent measurement of infants' emotional expressions of affect using a shared operational definition of emotion and emotion regulation (Buss & Goldsmith, 1998). In this way, emotion and emotion-regulation processes are inferred from time-series data working to capture an overlapping variable of interest – emotional expression. One strategy for decoupling emotion from emotion regulation has been to introduce multiple levels of analysis that encompass behavioral, neural, and physiological components (Morris, Robinson, & Eisenberg, 2006; Pérez-Edgar & Bar-Haim, 2010).

## 26.5 Neural and Physiological Underpinnings of Emotion and Emotion Regulation

The most rapid and radical developmental changes in the structure and functions of brain systems occur in the first 2 years of life (Herschkowitz, 2000). Neuroscientific approaches to adult emotion and emotion regulation typically make a broad distinction between two interconnected brain systems underlying the arousal/reactivity component of an emotional state and the regulation of the emotion state (Dennis, O'Toole, & de Cicco, 2013). A ventral system consisting of amygdala, the insula, the striatum, and the medial orbitofrontal cortex is involved in relatively nonvoluntary and rapid responses to motivational goals. In comparison, a dorsal system consisting of the lateral and medial prefrontal cortex, the lateral orbitofrontal cortex, and the anterior cingulate cortex is implicated in the more effortful processes underlying the regulation of emotional experiences. The ventral system, which is ontogenetically older in human evolution and development, is functional and preeminent in the early years of life, while the dorsal system is thought to only have limited functionality and follow a more protracted developmental course (Casey, Getz, & Galvan, 2008). Note, however, that the experience (and regulation) of emotion triggers largely distributed neural networks that include the ventral and dorsal system, with the relative "weight" varying with the individual's state and task at hand. Thus, over the course of development, the key structures in the ventral and the dorsal systems are interconnected, mutually influence one another, and operate together to give rise to observed emotion (Ochsner et al., 2009). Taken together, it seems that our measures of brain activity reflect the cooperation and interaction of emotional arousal as well as regulatory processes, just like our measures of infants' observable behavioral responses.

While there is a rich tradition of using neuroimaging in emotion research with adults and older children, parallel studies with infants are only now emerging (Graham, Fisher, & Pfeifer, 2013; Sylvester et al., 2017). In the infant literature, a greater emphasis has been placed on (electro-)physiological indices of emotion functions. Similar to behavioral indices, electroencephalogram (EEG) measures of infant brain activity in response to negative elicitors such as maternal separation and stranger approach (Hane, Fox, Henderson, & Marshall, 2008) were used to assess both emotion generation/arousal and regulation processes.

For example, asymmetry in frontal EEG activity (particularly in alpha power) has been used both as an index of emotional arousal and regulation beginning in the first months of life (Hane et al., 2008; Reznik & Allen, 2018). Right frontal EEG activity is thought to reflect withdrawal tendencies and is often associated with more negative arousal and less regulation. In contrast, left frontal EEG activity reflects approach tendencies, evident typically in more positive arousal and presumed to reflect better regulation (Fox, Henderson, Rubin, Calkins, & Schmidt, 2001). Right frontal EEG asymmetry is associated

with more negative affect (stress and crying) during maternal separation and greater activity in the left (vs. right) frontal area is shown to predict infants' responses to positive stimuli (Hane et al., 2008).

One benefit of EEG is the ability to capture processes at baseline and in response to socially challenging situations (such as adults giving a speech about one's most embarrassing moment; Pérez-Edgar, Kujawa, Nelson, Cole, & Zapp, 2013). Observing changes in EEG activity can provide insight into trait-level proclivities and the individual's active response to challenge or reward. Similarly, overall frontal EEG activity during a frustration task (vs. baseline) can capture levels of regulation. For example, 5-month-old infants who process a novel stimulus quicker (shorter looking times to novelty) are more likely to use regulatory strategies during a frustration task and respond with higher EEG activity during the task, which is considered an index of effective effortful regulatory strategies (Diaz & Bell, 2011).

Similar to behavioral indices of emotion and emotion regulation, researchers have used "state" measures of time-sensitive physiological responses such as event-related potentials (ERPs), electromyography (EMG), and heart rate as an index of emotional arousal. In part, change in these physiological responses over time has been used to capture emotion-regulation processes. Here we highlight cardiac measures, namely heart rate and vagal tone, as an example of state measures that have been incorporated into the study of both emotional arousal and regulation. Higher respiratory sinus arrhythmia (RSA) during baseline and more RSA suppression during emotionally arousing situations reflect more positive and responsive emotional states (Stifter & Corey, 2001), as well as better regulatory abilities (longer attention span, better soothability, and better dyadic synchrony; Calkins & Hill, 2007; Moore & Calkins, 2004). Changes in heart rate seem to go hand in hand with changes in the expression of negative affect, thus its regulation (Haley & Stansbury, 2003). For example, an acceleration in heart rate was found to precede crying in an aversive situation in 8- to 18-month-old children (Vaughn & Sroufe, 1979).

## 26.6 Using Time to Distinguish Emotion and Emotion Regulation

Temporal dynamics have been at the center of empirical efforts to delineate emotion generation from emotion-regulation processes (Cole & Hollenstein, 2018). Establishing the construct validity for emotion-regulation strategies (for example based on behavioral and/or physiological correlates) relies on the assessment of consecutive changes in emotion-linked biological markers, behaviors, and expressions over time. This two-factor approach assumes that regulation starts to operate only after the emotion is activated, and that it is possible to capture the transition from an early phase of emotional experience, in which "pure" arousal processes are observed, to a later



phase in which cooperation between arousal and regulation can be observed. Here, the focus is on temporally sensitive measures and repeated assessment of infants' emotional experiences. One critique of this approach argues that we lack an ontological or neurobiological distinction between arousal and regulation, rejecting the idea of an early phase in which emotional arousal would be observable in the absence of regulatory processes (Campos et al., 2004). These models suggest instead that regulation can take place at all phases of the emotional reaction, even before the arousal becomes observable.

Note however that regulation processes embedded within the individual may apply to more mature and effortful forms of regulation that only develop at later stages of development, when reactive and regulation processes become increasingly better integrated (Fox & Calkins, 2003). This sequence implies that it may be possible to observe in early infancy an early phase of emotional reactivity, before regulation processes start to come into play.

## **26.7 Normative Developmental Trends in Emotion and Emotion Regulation**

Recent advances in technology have revealed that infants express a variety of positive and negative facial emotion even before birth (Reissland, Francis, & Mason, 2011; 2013) and an array of expressions are evident in the early months of life (Galati & Lavelli, 1997). Recent work challenges several assumptions of the discrete emotion perspectives. First, there is little empirical support for a direct correspondence between infants' emotional expressions and emotion-eliciting situations. For example, 2- to 6-month-old infants may express negative emotions like anger and disgust during putatively pleasant face-to-face interactions with their mother (Matias & Cohn, 1993).

Second, adults often perceive infants' negative emotional expressions as an ongoing blend of multiple "discrete" negative emotions, rather than a specific category of emotion (e.g., Oster, Hegley, & Nagel, 1992). Specific discrete negative emotions seem to be relatively more differentiable at 12 months compared to 4 months, suggesting an increase in the specificity of infants' negative emotional expressions in this period (Bennett, Bendersky, & Lewis, 2005). (A more thorough review of these developmental processes can be found in Mitsven, Messinger, Moffitt, & Ahn, Chapter 27 this volume.)

On the flip side, evidence on infants' processing of others' emotional expressions suggests that infants categorically perceive and can discriminate between several discrete adult emotional expressions (see Grossmann, 2010, for a review). Making use of habituation–dishabituation paradigms researchers have shown that newborns can discriminate between surprised, sad, or happy facial expressions despite poor visual acuity (T. M. Field, Cohen, Garcia, & Collins, 1983). Moreover, studies reveal that infants show a general interest for positive emotional expressions from the neonatal period onwards in the first 5 months of life



(i.e., longer preferential looking to happy than neutral or fearful faces; Bayet et al., 2015; Farroni, Menon, Rigato, & Johnson, 2007), followed by a shift to biases in infants' attention in favor of negative, especially fearful expressions between 5 and 7 months of age (see Vaish, Grossmann, & Woodward 2008).

An accumulating body of evidence has consistently revealed that 7-month-old infants look longer at fearful than neutral or happy faces, and are slower to disengage from fearful, as compared to happy and neutral faces (e.g., Peltola, Hietanen, Forssman & Leppänen, 2013). This biased processing of fear is also evident in neural (e.g., ERPs; Yrttiaho, Forssman, Kaatiala & Leppänen, 2014) and physiological (e.g., heart-rate variability; Peltola et al., 2013) indices of emotion and attention. Importantly, infants do not seem to display fearful reactions while processing fearful expressions, illustrating that a bias to attend to a specific emotional state is not equivalent to the *experience* of an emotional state (Morales, Fu & Pérez-Edgar, 2016).

Affect-biased attention (particularly to fear) may be evolutionarily programmed to emerge at around the time of locomotion in typical development, as infants start to gradually move away from the caregiver with the onset of crawling and walking. A bias, in this developmental context, may increase infants' chances of survival during their exploration of the distal environment (Campos et al., 2000; Vaish et al., 2008). We know relatively less regarding the developmental course of the fear bias in the period between infancy and childhood (A. P. Field & Lester, 2010). Preservation of this fear bias beyond this specific period in infancy may be an early marker of later maladaptive developmental pathways and psychopathology (A. P. Field & Lester, 2010; Morales et al., 2016), as it no longer serves the acute protective role.

## 26.8 Rudimentary Regulation Emerges in Infancy

Although infants show some rudimentary ability to regulate their own emotional experiences in emotionally arousing situations, these initial capabilities are limited to more reflexive strategies such as sucking or visual reorienting (Kopp, 1982), and have a limited effectiveness in regulating infants' emotional experiences (Cole et al., 2017). Although still primitive, the first forms of voluntary regulation start to emerge at around 3 months of age. Infants' emotion self-regulation abilities in the early months of life are highly social in nature and rely on parents' assistance as external sources of regulation (Denham et al., 2007). Infants will display an emotion and caregivers will proceed to interpret the emotion, identify the putative cause, and seek to remediate (or sustain, if the emotion is positive). Thus, early emotion regulation is an inherently social process, embedded in dyadic interactions. While internal regulatory processes will soon emerge, it is important to note that these early socially embedded regulatory relations shape long-term socioemotional profiles, carrying the effects of parental socialization and cultural expectations of emotion.

A shift from more reflexive and primitive to relatively more elaborate and active forms of emotion self-regulation emerges in infants between 3 and 7 months thanks to maturational changes in attentional, motor, and cognitive systems (Kopp, 1989). For example, they use gaze aversion in more sophisticated ways, more actively search the environment, and exert control over (sustain or redirect) attention at the end of the first year (Ekas et al., 2013). Developmental trajectories for different emotion-regulation strategies suggest that primitive strategies (such as mouthing or thumb-sucking) get replaced by more effective regulation (seeking stimulation, active engagement, shifting attention towards or away from the caregiver) strategies with further maturation of cognitive and motor skills (Rothbart, 2011).

Moreover, there is some support for long-term impacts on regulatory ability based on the presence of these early strategies. For example, infants who disengage attention from the nonresponsive parent during the still face, and engage in self-soothing behaviors, show a decrease in negative affect from 3 to 7 months of age (Ekas et al., 2013). Similarly, infants who at 6 months engage in self-soothing and look away when confronted with a novel toy show subsequent reductions in stress (Crockenberg & Leerkes, 2004). Although also present by 12 months, self-soothing behaviors and problem-focused regulation strategies become more common around 18 months of age (Parritz, 1996). Between 12 and 24 months active regulatory strategies such as self-distraction and help seeking were also more frequently observed, along with enhanced ability to delay gratification (Bridges & Grolnick, 1995).

Although the overall consistency or uniformity in the regulatory strategies adopted by infants starts to increase by the age of 12 months, adopted strategies show some context specificity (Parritz, 1996). Moreover, the effectiveness of a given regulatory strategy depends on the intensity of stress that the infants experience, illustrating the fragility of these newly emerging skills. For example, infants are more likely to use approach as a regulation strategy when they experience low levels of fear, but avoidant strategies such as withdrawal or shifting attention to mother when experiencing higher levels of fear (Buss & Goldsmith, 1998). Finally, the effectiveness of a given regulatory strategy also seems to differ as a function of the type of stress elicited in the situation. For example, strategies like looking away, looking at mother, or looking to the experimenter seem to be effective in reducing anger, but not fear, in 6- to 18-month-old children. Thus, the specific negative emotions experienced by the infant may require different regulatory strategies.

## **26.9 Temperamental Variations on Emotion and Emotion Regulation**

Up to this point, much of the current discussion has focused on broad, generally applicable patterns of emotion and emotion regulation in

infancy, in line with our often nomothetic view of development (Pérez-Edgar & Hastings, 2018). However, there are systematic and well-documented variations in the pattern and intensity of emotion, and subsequent regulation, that are long-lasting, evident across contexts, and emergent in the first months of life (Pérez-Edgar, 2019). Some of these differences reflect variation in the infant environment, parental characteristics and behavior, and culturally bound expectations. Each of these will be discussed in turn below. First, however, we look to an individual difference variable, temperament, which is biologically based, early-appearing, relatively stable, and often bound, by definition, to variations in the experience, expression, and regulation of emotion (Goldsmith & Rothbart, 1996). Much of the temperament literature in infancy begins by examining variations in infants' responses to discrete sensory stimuli and novel people and objects. Often, the measures used center on the display, perception, and processing of emotion. This can place the field in a bit of an ontological conundrum.

On the one hand, there is the belief that temperament traits are conceptually separable from emotion (Bates, Goodnight, & Fite, 2008). Indeed, Bowman and Fox (2018, p. 54) make the clear declaration that "emotion is not a core feature of temperament." Instead, they argue that temperament encompasses individual differences in the response to specific stimuli, particularly those that convey threat, novelty, and reward. There is no inherent need to invoke emotion under this formulation. Rather, one can focus on motor activity, attention, biological markers, and broad approach-withdrawal behaviors. The Bowman and Fox (2018) approach argues that temperament is centered on a child's reactivity and subsequent regulation in response to the environment, but it need not center on the child's reactivity to and subsequent regulation of *emotion*.

This approach contrasts with other lines of work that center the experience and expression of emotion in the approach to temperament. Indeed, temperament is often conceptualized as the probability of showing a specific emotion within specific contexts (Goldsmith & Campos, 1982). For example, the laboratory temperament assessment battery (LAB Tab; Goldsmith & Rothbart, 1996) is designed to assess patterns of expressed emotion and behavior by manipulating events putatively linked to anger (arm restraint), joy (peek-a-boo), and fear (stranger approach), among others. Here, emotion is the marker of temperament, while at the same time temperament is seen to be the driver of emotion reactivity and subsequent emotion regulation. Thus, although researchers take different conceptual approaches, the data generated are often circular in practice, if not in theory.

One way to move beyond this problem is to place a temperamental trait within a constellation of emotions, cognitions, and behaviors, in the context of a specific trigger. Across the multiple approaches to temperament (Fu & Pérez-Edgar, 2015), there are a set of temperamental traits most often represented in the literature. For example, infants marked by high temperamental negative affect will respond to novel or threatening stimuli with negative vocalizations

or utterances (depending on age), withdrawal, and clear outwards signs of distress, including facial sadness, fear, and crying. In contrast, temperamental positive affect is marked by joyful vocalizations, approach, and happy facial expressions. In addition, profiles of temperament couple valence with additional markers characterizing the expanse of the emotion. This includes the stimulus threshold needed to trigger the emotion, the speed, and intensity of the emotion, and the time course until the return to baseline.

Temperamental approaches to emotion incorporate the tight convergence between initial emotional reactivity and subsequent emotion regulation. Rothbart (2011), in particular, put forth the model that both reactivity and regulation are themselves separate, though interacting, temperamental traits. Thus, individual children with mellow or intense emotional responses to the world could also deploy inefficient or effective emotion regulation strategies. Although some argue that emotion and emotion regulation are functionally inseparable (Campos, Frankel, & Camras, 2004), temperament researchers typically have worked under the goal of disentangling each component from the other.

Another methodological strategy has been to examine variation in emotional and behavioral responses as early as possible. Indeed, Kagan and Snidman (1991) and Fox et al. (2001) first looked for differences in temperamental reactivity at 4 months of age. The argument is that this time window follows the definitional axiom that temperamental variation is early appearing, while allowing for individual differences to emerge above and beyond the brain-stem functional cycles (eat, sleep) that dominate the first months of life. Among many temperament researchers, 4 to 6 months of age is a critical window into “pure” temperamental reactivity before variation in temperamental regulation can systematically take hold. As the overall expression and intensity of emotion decreases with age, it can become more difficult to capture distinct markers of temperament.

Thus, the second methodological strategy has been to incorporate biological and cognitive markers of temperamental variation. In initially describing the temperamental trait of behavioral inhibition, García-Coll, Kagan, and Reznick (1984) suggested that the observed phenotype reflected a hyper-responsive amygdala response to novelty. This neural signature was then expanded to include neural regions associated with reward and regulation, as well as peripheral markers such as EEG, RSA, and EMG (Fox, Hane & Pérez-Edgar, 2006). Other temperamental traits, such as exuberance, also have distinct neural and biological profiles centered on reward and decision-making regions (Degnan et al., 2011). In addition, cognitive measures, such as attention biases, are also evident early in life (Morales et al., 2016). While a normative marker in infancy, variation in affect-biased attention can predict long-term variations in socioemotional functioning when coupled with specific emotional profiles or parental contexts.

One benefit of a multi-method approach is that it allows researchers to examine measures across a wider age range, making it easier to examine rank-order stability in the individual response to the environment, even in the face of developmentally expected changes in the phenotypic expression of temperament-linked emotional reactivity (Morris et al., 2006). Thus, we can better assess how socioemotional profiles in later childhood and adulthood are outgrowths of early variations in temperament.

Lamb (2015) suggests that in examining temperament we should remember that these traits are not immutable, evident, and unchanging from the first days of life. Rather, they are “biogenic propensities shaped by sociogenic experiences.” To this mix, we would also add that they are constrained by cognitive mechanisms. Thus, the initial patterns of emotion and emotion regulation rooted in temperament are open to being shaped by the environment, aided by the child’s own assessment of his or her place in the larger social context. Although temperament is not the same as emotion, its strongest expression is often in the open display of emotion.

### **26.10 Placing Temperament and Emotion in a Developmental Context**

The experience-expectant and experience-dependent nature of emotion development suggests that child temperament may modulate both how emotion generation and regulation processes emerge and the extent to which extrinsic contextual/environmental influences shape their emergence. Thus, in addition to their unique and independent contributions to emotional development, temperament and contextual forces may interact to determine emerging trajectories of emotional development. The dynamic interactions between infants’ temperament and contextual influences are at the center of diathesis-stress/dual-risk (Ingram & Luxton, 2005) and differential susceptibility (Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007; Ellis, Boyce, Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2011) models. Both of these theoretical perspectives suggest that temperamentally negative children display an increased receptivity to environmental influences. Diathesis-stress/dual-risk models primarily focus on the increased vulnerability of temperamentally negative children in the face of environmental or contextual adversity, whereas differential susceptibility models extend the idea of a greater sensitivity/receptivity of temperamentally negative children to supportive/positive contextual influences. These theories propose that temperamentally negative infants are not only affected more by adverse environments, but they also benefit more from supportive environments. Thus, they are open to environmental influences both “for better and for worse” (Belsky et al., 2007).

## 26.11 Parenting as a Moderator of Temperamental Expression

Parenting is among the most extensively studied contextual factors in early development and its links to children's later socioemotional development and well-being are well established (Kiff, Lengua, & Zalewski, 2011). Note, however, that the moderating role of child temperament on parental influences has only recently been incorporated in infant emotion research (Hinshaw, 2008). This may reflect underlying presumptions regarding the maturational progress of the earliest emotions, relative to the clear evidence of emotional variability in older children. As it is, studies investigating infant outcomes in the context of temperament–parenting interactions have had a broader focus on social behavior and psychological functioning, rather than a tight focus on specific measures of emotion and emotion regulation (Kiff et al., 2011).

### 26.11.1 Parenting Behaviors Impacting Emotion and Emotion Regulation

Theoretical accounts of early emotional development converge on the view that parents' positive emotional expressions, and their accompanying synchronous and sensitive responding to infants' emotional expressions, provide the main framework for both the early experience and regulation of emotion (Tronick, 1989). In line with this idea, observational studies consistently find that young infants seem to instantly tune in to changes in their parents' expressions of emotion and their emotional expressions seem to mirror those of their parents during these interactions (Aktar & Bögels, 2017). Thus, infants are more positive when parents express more positive affect. Additionally, infants express less positive and more negative affect when parents stop responding in these dyadic interactions, such as in the still-face paradigm (Mesman, van IJzendoorn, & Bakermans-Kranenburg, 2009).

Infants' self-regulatory capacity develops within early relationships with caregivers. Parents who are positive, sensitive, and responsive towards their infants in early interactions are thought to provide the optimal environment for supporting self-regulation. Therefore, the infancy literature typically focuses on parenting dimensions that relate to the early parent–child relationship, such as mutual responsivity, synchrony, attachment security, or to parents' interactive quality such as emotional synchrony, availability, and sensitivity (e.g., Kiel & Kalomiris, 2015; Kim, Stifter, Philbrook, & Teti, 2014). Synchrony between parent and infant emotion in early face-to-face interactions, captured in both behavior and physiology, is suggested to be the key co-regulation process providing the foundation for infants' self-regulatory skills (Feldman, 2003).

Earlier evidence has shown that positive aspects of parenting and mutual responsivity in early parent–child relationships seem to be especially beneficial for emotion regulation in children with temperamental difficulties. For



example, children who experience more affective synchrony in their emotional expressions during face-to-face interactions with their mother at 3 months and 9 months were found to show better self-regulation at 2 years of age, especially if they have high levels of difficult temperament (Feldman, Greenbaum, & Yirmiya, 1999). In a parallel vein, high levels of mother–child mutually responsive orientation at 15 months seems to be related to better self-regulation at 25 months, only for children with high levels of temperamental negative affect (Kim & Kochanska, 2012).

On the flip side, lower levels of maternal emotional availability and sensitivity, as well the lack of secure attachment, seem to have stronger links to emotion regulation in children with high levels of temperamental negative affect. For example, Kim et al. (2014) showed that children high (vs. low) in temperamental negative affect were more likely to employ a maladaptive regulatory strategy at 12 and 18 months when the mother is emotionally less available. Moreover, infants with an insecure/avoidant attachment type, coupled with high levels of temperamental negative affect, were more likely to engage in a less effective regulatory strategy than securely attached infants with high temperamental negative affect. Likewise, evidence suggests that infants with negative temperament show more dysregulated behavior and less adaptive regulation in frustrating situations when mothers have low levels of sensitivity (at 3 and 6 months; Gunning, Halligan, & Murray, 2013; Thomas, Letourneau, Campbell, Tomfohr-Madsen, & Giesbrecht, 2017). Taken together, the evidence supports the differential susceptibility hypothesis, showing that temperamentally negative infants' emotion regulation skills are more susceptible to parenting influences both “for better and for worse” (Belsky et al., 2007).

### **26.11.2 Parental Characteristics**

Parents play an active and outsized role in scaffolding infants' expression and regulation of emotions as they are the most prominent source and target of emotional expressions in an infant's environment. As such, there is no doubt that individual variation in parents' reactivity and regulation is likely to have a direct influence on infants' developing emotion and emotion regulation skills. The effects of parents' emotional reactivity have most often been investigated in the context of parents' emotionality, depression, and anxiety, which is the main focus in the following sections.

### **26.11.3 Parental Characteristics in the Context of Emotion and Emotion Regulation**

The effect of parental affective style on parents' emotional expressions, parenting, and relationship quality have been predominantly investigated in the context of parental depression and anxiety. Observational studies find that both parents with depression and their infants are more affectively “flat,”

expressing less positive and more negative emotion during early face-to-face interactions (Aktar, Colonnese, de Vente, Majdandžić, & Bögels, 2017; Feldman et al., 2009). Behaviorally, the interactive style of depressed parents is described as intrusive, overcontrolling, and overstimulating on the one end of the continuum, and as passive, withdrawn, and understimulating on the other (Malphurs, Raag, Field, Pickens & Peláez-Nogueras, 1996).

Moreover, depression seems to interfere with a mother's ability to sensitively respond to, and synchronize with, their infants' emotional expression (Feldman, 2003; Granat, Gadassi, Gilboa-Schechtman & Feldman, 2017) and to provide an optimum level of stimulation for infants' emotional development (Paulson, Dauber, & Leiferman, 2006). For example, depressed parents are less likely to read, tell stories, sing, or play with their infants. Mothers with depression are additionally more negative and less positive during parent–infant interactions involving emotionally ambiguous stimuli (Hart, Field, Del Valle, & Peláez-Nogueras, 1998) and may be less available to provide appropriate emotional reactions for the coregulation of infants' emotional responses to these situations (Gewirtz & Peláez-Nogueras, 1992).

Moreover, there is some evidence for indirect links between anxiety and depression diagnosis in mothers' and infants' processing of facial expressions. For example, infants of mothers with, versus without, depression show less interest to sad facial expressions at 3 and 6 months (Diego et al. 2004; T. M. Field, Pickens, Fox, Gonzalez, & Nawrocki, 1998), and take longer to disengage from happy facial expressions at 3 months (Hernandez-Reif, Field, Diego, Vera, & Pickens, 2006). These differences are thought to reflect the enhanced novelty of positive expressions for infants of depressed parents. Moreover, 3- to 6-month-old infants of parents with depression are less positive and more negative in their interactions with mothers and strangers, they show greater right frontal EEG asymmetry to happy and sad facial expressions during and elevated salivary cortisol levels following these interactions (Diego et al., 2004).

The described effects of parental depression on the expression of emotion and sensitivity seem to be especially pronounced in cases of comorbid high-trait parental anxiety in the first (e.g., in 3- to 6-month-olds; Weinberg & Tronick, 1998) and second (10- to 14-month-olds; Nicol-Harper, Harvey, & Stein, 2007) half of the first year. In contrast, parental anxiety without comorbid depression does not seem to affect parents' expressions or synchrony of emotion in everyday face-to-face interactions with their 4-month-old infants (Aktar et al., 2017).

Strikingly, none of the studies mentioned so far in this section have considered the modulating role of infant temperament on early emotional exchanges between infants and their parents in face-to-face interactions. The only exception is the study by Aktar et al. (2017), which did not find a significant moderation by temperament on the link between parents' depression or anxiety and 4-month-old infants' facial expressions.

In comparison to studies focused on early parent–infant interactions, the role of infant temperamental negative affect is relatively better integrated into studies investigating the role of parental anxiety on the child’s anxious reactions to ambiguous stimuli at the end of first year. To highlight, Murray et al. (2008) reported a longitudinal change in infants’ observed avoidant reactions to strangers: Behaviorally inhibited infants (measured at 14 months) showed a larger increase in their avoidant responses to strangers from 10 to 14 months when mothers had a diagnosis of social anxiety disorder. This effect was linked to heightened parental anxiety expressions in the stranger situation. A later study (Aktar, Majdandžić, de Vente, & Bögels, 2013) reported a similar interplay as behaviorally inhibited 12-month-olds were more avoidant of strangers if the parents expressed higher levels of anxiety towards the stranger in the situation. To summarize, both studies point to an enhanced vulnerability of temperamentally inhibited children to parents’ nonverbal expressions of anxiety during confrontations with a stranger.

The link between parents’ anxiety and infants’ emotion processing has also been investigated as a function of infant temperament. Although only now emerging, it appears that maternal characteristics may “set the stage” for temperament-linked variation in emotion and emotion processing. For example, recent work by Morales, Brown et al. (2017) suggests that greater maternal anxiety is associated with difficulty in disengaging from angry faces in infants ages 4 to 24 months. This link was not significantly moderated by infants’ temperamental negative affect.

As with most traits of interest, the initial relations with emotional expression and experience are also then associated with individual variation in emotion regulation. As an example, Feldman et al. (2009) targeted mothers low and high in anxiety and depression and observed that mothers with depression and anxiety showed less sensitivity and had less socially engaged infants. Another study by Granat et al. (2017) noted that infants of depressed parents were more likely to use the maladaptive regulation strategy of avoidance, and were less likely to engage in social gaze, during play interactions.

## 26.12 Emotion Development in a Cultural Context

The previous sections outline the impact parental behaviors, and parental characteristics, may have on variation in infant emotion and emotion regulation. In particular, parents can potentiate infant patterns among children temperamentally open to environmental input (Ellis et al., 2011). Shifting slightly our view of this relation, we can also see that specific temperamental traits can elicit targeted parental socialization attempts (Denham et al., 2007). Consciously, or unconsciously, parents will try to mitigate emotional profiles they view as maladaptive or problematic while reinforcing and potentiating

valued traits. These behaviors, in turn, are shaped by cultural expectations of adaptive and “ideal” profiles of emotion and emotion regulation (Chen, Rubin, & Li, 1995). Within Western cultures, this often means that parents try to increase the display of positive emotions while minimizing the displays of negative emotions (Chen et al., 1995; Holodynski & Friedlmeier, 2006).

Early in infancy, regulation is often embedded in social relationships. Parents will shape and mirror acceptable emotions and reinforce preferred emotion-regulation strategies (Holodynski & Friedlmeier, 2006). For example, Western mothers tend to minimize signs of shyness in children, particularly in boys, but are unlikely to discourage boisterous exuberance (Degnan et al., 2011). In the United States, we often note decreases in the phenotypic expression of behavioral inhibition in children over time as parents and teachers try to draw out the withdrawn child (Fox et al., 2001). In contrast, up until recently, one often saw increases in behavioral inhibition over time in mainland China. This reflects the traditional values of demure or reserved demeanor. Indeed, inhibited children were often held up as leaders in their school community (Chen et al., 1995; Chen, Rubin, Li, & Li, 1999). This pattern is still evident in rural, more traditional, areas of the country. In contrast, behaviorally inhibited children in rapidly urbanizing cities now show the same negative outcomes – shyness, withdrawal, loneliness – seen in the West (Chen, 2010). This shift in pattern suggests that socialization agents, namely parents and teachers, are now evaluating patterns of emotion and emotion regulation in a more Westernized manner and are responding accordingly.

Cultural norms and ideals also shape how we come to assess maternal sensitivity. As noted above, noncontingent, dismissing, and overly intrusive behaviors are linked to maladaptive socioemotional profiles, marked by increased negative affect and poor self-regulation skills (Kiel & Kalomiris, 2015). Cross-cultural work suggests that infant outcomes are not necessarily tied to specific emotional profiles. Rather, maternal sensitivity is evident in the match to cultural expectations (Friedlmeier & Trommsdorff, 1999). For example, German mothers focus on the cause of an emotion to scaffold independent and instrumental responses, while Japanese mothers often target the child’s emotional display in order to mold emotion expressions that support harmony within the social group.

Although infants typically express a fairly standard array of emotional signals early in life, variation is initially introduced with the emergence of temperament-linked profiles of emotion and emotion regulation (Rothbart, 2011). Quickly, however, we see culture-specific transformations of these expressions into socially embedded communicative signs (Holodynski & Friedlmeier, 2006). For children whose initial temperament does not match the cultural ideal, there is an additional pull on emerging regulatory mechanisms to align the individual with social partners. Thus, an open question in the developmental literature centers on the extent to which parents mirror the emotions of their children and then engage in culturally informed regulation

of their emotions. Important, as well, is to ask how early in development cultural differences in emotion shaping emerge.

### 26.13 Policy Implications and Conclusions

Decades of research has puzzled with how to best define the emergence and evolution of emotion in infancy. In tandem, the literature has strived to find the best way to capture variation in emotion and the growing influence of personally directed emotion-regulation strategies. Much of this work has focused on outlining theoretical and empirical operations of emotion and emotion regulation, striving to describe universal axioms (Pérez-Edgar & Hastings, 2018). However, temperament-linked variation is patently evident in the first months of life. Adding another layer of complexity is the fact that outside forces, often parents, act as external regulators of the child, shaping emotion and behavior to reflect both individual characteristics and cultural norms. Hence, it is not surprising that we are only now scratching the surface of these complex networks of constructs, contexts, and mechanisms.

Puzzling through these complexities is important, as maladaptive emotion and emotion-regulation processes are implicated in long-term profiles of socio-emotional and cognitive functioning, influencing social, academic, and mental health outcomes. Given the pervasiveness of emotional processes in everyday life, we need to better understand and identify points of risk. With this knowledge, early interventions can target mechanisms that shape the individual, the context, and the *interactive* relation between the individual and the environment. To roughly organize research and intervention, there are four factors that should be examined together in order to generate a three-dimensional view of emotional development in infancy: person, timing, experience, and context (Pérez-Edgar, 2019).

With respect to person, we need to assess individual variation across multiple levels of functioning. This involves the expression of emotion, the contextual forces that trigger emotion, biological correlates, and cognitive profiles. Each source of information is unique and is likely not wholly overlapping with any other source of information. As such, bringing together these channels of emotion will provide additional information.

Within and beyond the person, new analytic approaches can capture the timing of emotion over time, helping extract regulatory mechanisms and eventual socioemotional outcomes. As such, we can now speak to micro-longitudinal methods that examine shifts in emotion markers within the course of a single episode (Cole & Hollenstein, 2018). These micro-trajectories are then embedded within longer-scale trajectories typically examined in developmental research. This work may help capture the mechanisms that underlie our largely descriptive representations of emotional development over time.

The next broad goal is to couple the timing of personal responses with specific experiences. At a small-scale level, this can encompass exposure to constrained triggers that are designed to elicit variation in emotional displays – the LAB Tab, for example, is designed for this purpose. At a larger scale, variation in sociocultural, sociohistorical, and socioeconomic forces will determine the rhythm of exposure to events that can support or hinder adaptive functioning. For example, children exposed to traumatic events, such as family separation, will not have the typical scaffolding experiences provided by parents.

This brings us to the question of context. Oddly enough, although this is the most overarching component of interest in our work, we often ignore or overlook its influence. That is, we constrain experimental studies, or narrowly define more descriptive studies, in order to boost our ability to detect a core construct and its associated mechanisms. Yet outcomes are often discussed using language with an implicit nod to universality. Qualifying language outlining restrictions to specific persons, reacting to experiences across time, in a defined context is often thought to diminish the importance of a finding. However, in striving to remove context from the equation, we have effectively limited our understanding of the breadth of variation in emotion that can emerge over the course of development. As an example, some cultures value exposing children to emotion-eliciting events in order to shape the child's response (Holodynski & Friedlmeier, 2006). In contrast, other cultures will preemptively remove potential emotional elicitors in order to engender a more even-keeled emotional state. One can imagine that the pattern of emotions to the environment, the strategies employed for emotion regulation, and the broader relation between emotion and functioning, may look quite different across cultures.

Complexity is not a limitation. Rather it is a conduit to identifying active mechanisms that shape observed emotional profiles – the very profiles that motivate us to engage in research. A broad literature base has noted individual differences in the presentation and regulation of emotion, often linked to individual differences in temperament. These presentations are then acted upon by socialization agents, typically in the form of parents, who scaffold regulation and modulate emotion in light of both their own traits and the broader sociocultural ideals. Better understanding the intersection of the individual and the context they are embedded in is crucial for building effective policies that enhance infant development, help parents scaffold and support children, and build environments that enhance both individual and community development.

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