Resilience is often associated with extreme trauma or overcoming extraordinary odds. This way of thinking about resilience leaves most of the ontogenetic picture a mystery. In the following review we put forth the Everyday Stress Resilience Hypothesis where resilience is analyzed from a systems perspective and seen as a process of regulating everyday life stressors. Successful regulation accumulates into regulatory resilience which emerges during early development from successful coping with the inherent stress in typical interactions. These quotidian stressful events lead to activation of behavioral and physiologic systems. Stress that is effectively resolved in the short run and with reiteration over the long-term increases children’s as well as adults’ capacity to cope with more intense stressors. Infants, however, lack the regulatory capacities to take on this task by themselves. Therefore, through communicative and regulatory processes during infant–adult interactions, we demonstrate that the roots of regulatory resilience originate in infants’ relationship with their caregiver and that maternal sensitivity can help or hinder the growth of resilience.

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highly aroused but affectively positive states 13% of the time with an average duration of 4 min. Even when playing with their mothers in face-to-face interactions, infants expressed sad or negative affect about 3% of the time, fussy vocalizations about 3% of the time and distress indicators (e.g., spitting up) about 1% (Weinberg et al., 1999). Research findings, however, are hardly needed to demonstrate the ubiquity of infants’ experiencing distress. Supporting evidence is everywhere from infants crying for a bottle, fussing because they are wet or because they cannot reach an object, crying in protest when their mother leaves them alone, or for no apparent reason (i.e., the mythical gas). Infants also get highly aroused while playing a too exciting game such as peek-a-boo where over- arousal transforms laughter into tears or spitting up. These common bouts of distress, however, are limited in duration by the infants’ self-regulation of the distress (e.g., thumb sucking, attending to an interesting object) or by a caretaker’s intervention (e.g., picking the infant up). Although these observations may seem boringly quotidian, they are not because it is not only coping that is at stake. Development depends on infants’ active engagement with the world of people and things.

As infants, the capacity to effectively deal with stressors is not entirely in their hands. Although infants may be able to turn away from a bright light or an intrusive face, there are obvious physical and emotional limitations that infringe on infants’ regulatory capacities. In turn infants come to depend on their main caregiver, typically the mother, to intervene when necessary. The mother’s ability to attend to her infant’s signals and to respond appropriately is instrumental to the development of stress regulation and of resilience.4 But perfect contingency between mother and infant is not implied for optimal growth. Rather, we propose that it is the missteps in communication with their attendant stress and their resolution – the mismatches of intentions and affect and their re-coordination – between the mother and infant that lead to resilience. Recognizing that even in typical development perfect matching (or perfect contingency) is in and of itself impossible, if it were to exist it would prohibit any occurrence of a mismatch thus leading the infant to never experience stress. However experience with stress is not sufficient to build the infant’s developing capacity for resilience. Specifically, missteps in communication within the dyad may be followed by a reparatory process, a dyadic coping mechanism that focuses on the process of transforming stressful mismatching states into non-stressful states (Gianino and Tronick, 1988; Tronick, 2006; Tronick and Beeghly, 2011). On the one hand, when reparation is successful the infants’ stress level decreases and matching returns and the reiteration of successful reparation builds the infant’s capacity for resilience. On the other hand, dysregulation occurs when reparation fails and dysregulation precludes infants’ engagement with the animate and inanimate world. Moreover, when engagement is chronically disrupted negative cascading processes have the potential to disrupt development in a number of different domains, including biological, relational, and behavioral realms. Thus stress regulation is critical to typical development.

Recognizing the centrality of stress regulation leads to a number of questions. In the following review we present a reconceptualization of the concept of resilience by framing its development using a systems perspective. Specifically we address the importance of the mother–infant dyad and how the environment within the dyad can prevent infants from being chronically overwhelmed by stress and can help foster the growth of their regulatory capacities.

2. The Everyday Stress Resilience Hypothesis

Our approach to questions about the emergence of a resilient, biobehavioral phenotype during the first years of life is formulated in the Everyday Stress Resilience Hypothesis. The hypothesis states that coping with everyday stressors influences infants’ regulatory capacities for these typical stressors and prepares them to cope with later, more taxing stressors. In short, everyday coping experiences develop regulatory capability and capacity or a ‘regulatory resilience’. Furthermore, based on human and animal research, we also argue that successful regulation of stress and the growth of regulatory resilience is not solely dependent on infants’ internal self-organized regulatory capacities (Calkins and Hill, 2007; Hofer, 1987, 2006; Kopp, 1989; Tronick, 2006). Rather stress regulation and its potential growth toward resilience is critically dependent on the quality of the infant-caregiver relationship. Although theories have emphasized the importance of the caregiver’s regulatory role (e.g., Hofer, 2006; Field, 1994), the unique contribution of the Everyday Stress Resilience Hypothesis further this notion by contextualizing the early development of resilience in the typical, everyday process of dyadic regulation. In particular of critical importance is the infant–caregiver dyad’s capacity for continual, mutually coordinated regulation of infants’ psychobiological states of stress – quotidian and intense – into non-stressful states. Thus, elaboration of the Everyday Stress Resilience Hypothesis requires placing it in a broader context of typical macro-development (changes in capacity in ontogenetic time such as babbling to speech or immobility to running) and real-time everyday activities (e.g., caretaking), the stress that travels with both, and the mutual regulatory interactive processes that regulate the stress. Critically, we will elucidate how mutual regulatory processes in-and-of-themselves generate micro-stressors. It is the regulation of these micro-stressors, through a process of reparation, that is critical for building resilience. The process of reparation within the dyad depends on many factors including context and individual differences in reactivity and regulation.

But first an analogy for the Everyday Stress Resilience Hypothesis: training for a marathon. Runners do not run marathon distances to train for a marathon. Instead they run a specific distance each day and increase that distance over the course of weeks. However, it is not until they actually run the marathon that they complete the full distance. Training within capacity does not lead to improvement rather progressive training develops the runner’s stamina, or coping capacities. Progressive training leads to a bit-by-bit accumulation of capacity culminating in the capacity to go the full distance. The increase in capacity is not related to a singular change but to changes in many different metabolic and muscular characteristics. Effective training is specifically aimed at processes that relate to running the marathon. Training does not prepare one for a triathlon or long distance skiing. Of course, without the training, had runners tried to go the full daunting distance they would surely fail: the stress would exceed their capacity. Or had they over-trained their capacity would actually diminish because different systems would not have been able to recover from the inherent stress of training. Their capacity also diminishes when training is ended. Thus a progressive increase of training and reiterated chronic training is needed to maintain and grow capacity; with it one becomes resilient and without it resilience is lost. This analogy is similar to the inoculation analogy for stress (Parker et al., 2006) but differs in that it is not an all-or-none model but an ontogenetic model. It allows for a consideration of the loss of capacity and the need for recovery, or reparation.
3. Stress at the macro-developmental level and the micro real-time processes that regulate it.

We frame our understanding of the development of resilience using a dynamic systems perspective. Dynamic self-organizing biological systems have a hierarchical organization operating at multiple levels and temporal scales. They are information-rich with specific, intense and continuous dynamic interactions with local contexts. Complex systems exhibit emergent properties at different levels. Self-organizing processes generate these emergent properties and lead to an increase in the complexity and coherence of the system. Prigogine (Prigogine and Stengers, 1984) states that a primary principle governing the activities of open biological systems is that they must acquire energy and information from the environment to maintain and increase their coherence and complexity. The developing infant is just such a system. Its impressive features of very rapid development of emergent capacities, striking increases in complexity, and almost continuous informational exchanges with the external environment are reflections of continuously active powerful self-organizing capacities.

Critically it is necessary to recognize that ontogenetic change requires disorganization and reorganization. Stress travels with this process. Despite the smooth, step-by-step characterization of development seen in graphs charting developmental milestones, development does not proceed so smoothly. Development proceeds in an irregularly serrated pattern. Periods of stability (sometimes thought of as periods of practicing) in developmental domains are followed by periods of dismantling an already organized capacity and reorganizing it into a more complex and coherent form of organization. The transitions between periods of stability (attractor states) are inherently stressful not only because they are energetically demanding but because the transitions are unstable. During transitions the infant may actually lose complexity and coherence until the new organization emerges. Crawling, for example, needs to be dismantled to allow for the self-organized emergence of walking (Trevarthen, 1982; van de Rijt-Plooij and Plooij, 1992). Or how infants who learn how to crawl across a risky slope must then relearn how to cross the same slope while maintaining homeostasis and are more likely to become fatigued, over-aroused and distressed. A primary feature of the model, however, is that disorganization is part of the process. Disorganization is necessary for the emergence of something new and for an increase in complexity and coherence; it is the wellspring of change and the new. By contrast, fixed systems do not develop. Nonetheless for all of its benefits, the process of macro-development is costly and stressful.

Of course it is not only the process of development that is stressful for the infant. There are everyday internal stressors, such as hunger, fatigue, metabolic processes, lack of diurnal regulation, and a myriad of others. There are common external forces that stress the infant: a wet diaper, too bright a light, or a loud noise. Furthermore there are also quotidian stressful interchanges with the environment such as desiring an out of reach object, not getting a caretaker’s attention, and playing with a frustrating toy. In essence there is a veritable ubiquitousness of stressors which can amplify each other and cumulate to create cascades of stress which in turn make the infant more vulnerable. Thus one can only wonder how the infant is able to regulate stress in the face of such demands?

4. Dyadic regulatory systems

Our view is that to overcome the ubiquitous stressor problem humans evolved an exceptional, though hardly unique, method for regulating this stress. Humans form a dyadic regulatory system in which the infant’s regulatory capacity is supplemented, or scaffolded, by an external regulator – a caretaker, typically the mother. The dyadic regulatory process is referred to as the Mutual Regulation Model (Beebe et al., 2010; Brazelton et al., 1974; Hofer, 1994; Stern, 1976; Tronick, 1989; see also Fogel’s theory of co-regulation, Fogel, 1993). The Mutual Regulation Model stipulates that mothers and infants are linked sub-systems that form a larger, more integrated dyadic regulatory system responsible for regulating infants’ biobehavioral organization, including stress.
The regulatory functioning of the infant–caregiver dyadic system is guided by communicative processes (Fogel, 1993; Trevarthen and Aitken, 2001; Trevarthen et al., 2006; Tronick, 1989). Communicative signals convey the infants’ biobehavioral status to a receptive caregiver. However, the communication within even typical mother–infant dyads is far from perfect. As seen in Fig. 1, in typical interactions the dyad oscillates between states of matching (synchronous) to mismatched states (asynchronous) and back to matched states through the process of reparation (Tronick and Beeghly, 2011; Tronick and Gianino, 1986). When the regulatory function of the dyad operates successfully there is a fittness of maternal regulatory input to infants’ signaled regulatory needs. For example, a maternal smile in response to her infant’s attentional bid or a empathic frown when her infant is distressed.

As a consequence of successful matching, the infant becomes more coherently organized than they could on their own. On the one hand, dysregulation can be overcome when, for example, a caretaker in real time uses a crooning voice and gentle patting with a crying infant who is coping with the stress of dismantling of crawling in the service of eventual walking. The mother’s compassionate intervention helps transform the infant’s distressed state into a calmer, organized alert state leading to reparatory success. On the other hand, continual mismatching of regulatory input and infant needs results in reparatory failure. For example, giving a hungry infant an object will not repair their distressed state whereas if the dysregulated hunger state is instead repaired with maternal nursing then the infant is likely to progress into a non-stressful state. In the moment when the caretaker appropriately scaffolds the infant’s regulatory capacity, the infant’s stress is reduced and homeostatic balance is restored. Consequently, the infant can continue to engage the world and its challenges. A caretaker who ignores the distress or mistakenly interprets the distress creates a mismatch between the infant’s regulatory demands and the regulatory resources available. The stressful state continues and engagement is precluded.

Paradoxically, mutual regulation in real time is in-and-of itself stressful (Tronick, 2006; Tronick and Cohn, 1989). The stressors that occur during real-time mutual regulatory processes are micro-stressors, mismatches between external input and infant needs. These micro-stressors occur at rates measured as fast as tenths of seconds. They occur because regulation in real-time cannot be perfect. When regulation is even briefly disrupted, stress and negative affect are generated (Tronick, 2006). Micro-stress emerges from host of factors that make mismatches inevitable: (i) the speed at which signals are emitted – as fast as 0.25 s (Trevarthen and Schogler, 2005); (ii) the demands on infants’ and caregivers’ abilities to detect and decode such fast signals; (iii) the response time demanded – on the order of tenths of a second (Beebe et al., 2010; Condon and Sander, 1974; Trevarthen et al., 2006); (iv) non-perfect signaling – the occurrence of misuses; (v) the likelihood of missed signals given their rate of occurrence; (vi) the mismatching of intentions between the interactants and unpredictable changes in their intentions; (vii) rapidly changing regulatory demands as affected by their ongoing interactive state; (viii) changes in biobehavioral state; and (ix) dynamic changes resulting from preceding regulations and states affecting current states (Cohn and Elmore, 1988; Cohn and Tronick, 1987, 1988; Tronick et al., 1986).

Add to these reasons the fact that the infant has limited and immature regulatory, behavioral, and attentional capacities and the likelihood of mismatches becomes quite high. Mismatched states, or asynchronous/miscoordinated states, tend to be more the norm than the exception in face-to-face interactions, even with typical mother–infant samples. In our studies, we have found that periods of mismatching in mother–infant dyads can make up as much as 70–80% of face-to-face interactive exchanges (Tronick and Cohn, 1989). However, interactive disorganization is quickly repaired into a more organized state (i.e., distress becomes quiet alertness). For example, in studies of typical face-to-face interaction at 6 months of age, mismatches occur at a high rate and repairs occur at about once every 3–5 s. More than one third of the repairs are successful at the next step in the interaction (Tronick and Gianino, 1986). Observations by Beebe (Beebe and Lachmann, 1994) and Isabella and Belsky (1991) replicate these findings to support the hypothesis that the normal interaction is a process of matches changing to mismatches with quick reparation back to matches.

Although typical interactions fluctuate between instances of coordination and miscoordination, a key point is that reparations do occur. Missteps are corrected. Thinking in these terms expands our notion of stressors from intense, perhaps traumatic, stressors to everyday stressors to micro-stressors. Without reparation and regulation, even micro-stressors have the potential to accumulate and disrupt development. The process of mutual regulation, in particular stress and its reparation, has been most carefully studied using an experimental stress induction procedure, the Face-to-Face Still-Face paradigm (Harrison and Tronick, 2007; Mesman et al., 2009; Tronick et al., 1978). The Face-to-Face Still-Face paradigm highlights the match–mismatch–reparation process at a simulated macro-temporal level which allows for detailed measurement of infants’ and caregivers’ reactions (see Fig. 2A). The paradigm consists of three episodes: (1) an episode of typical infant–caregiver face-to-face play, (2) the still-face episode where the caregiver stops interacting with her infant and holds a still, expressionless face, and (3) a reunion episode where the caregiver resumes interacting with her infant.

Most infants enjoy and come to depend on the reciprocal nature of social interactions with their caregiver (e.g., reciprocal smiling, playful touching) and the violation of this expectation of reciprocity during the still-face is stressful. Affective and behavioral responses are striking and include decreases in positive affect, increases in negative affect, and infant behaviors that are aimed at chang-
ing the mothers’ behavior or reducing stress, such as increases in protest, gaze aversion and turning away, back arching and postural collapse (Adamson and Frick, 2003; Mesman et al., 2009). Infants also show signs of physiologic activation with increases in heart rate (Bazhenova et al., 2001; Moore and Calkins, 2004; Weinberg and Tronick, 1996) and skin conductance (Ham and Tronick, 2008), and a suppression of respiratory sinus arrhythmia (RSA) (Bazhenova et al., 2001; Ham and Tronick, 2006; Moore, 2009; Moore and Calkins, 2004; Weinberg and Tronick, 1996).

Hypothalamic–pituitary–adrenal (HPA) axis activation, as measured by increases in salivary cortisol, has also been observed in infants during the still-face (Feldman et al., 2010; Haley and Stansbury, 2003; Ham and Tronick, 2006; Montirosso et al., 2011). During the reparation of the reunion episode, the mother once again interacts with her infant and attempts to reestablish dyadic regulation. In return infants gaze more toward her and express more positive affect. Negative affect and stress-reduction behaviors also decrease though they may still express higher levels of anger (Weinberg and Tronick, 1996). Cardiac measures recover again interacts with her infant and attempts to reestablish dyadic regulation. In return infants gaze more toward her and express more positive affect. Negative affect and stress-reduction behaviors also decrease though they may still express higher levels of anger (Weinberg and Tronick, 1996). Cardiac measures recover.

Reparation is a dyadic process of matching regulatory input to regulatory need in order to provide the scaffolding for infants’ intrinsic regulatory capacities. The Everyday Stress Resilience Hypothesis sees reparation as central to the development of regulatory capacities. As already noted, with development the regulatory task becomes increasingly self-organized and new ways of regulating distress (e.g., speech, executive functioning, inhibitory control, and emotion display rules) begin to emerge. However, it is not until later in childhood that these capacities begin to take their mature form (Carlson and Wang, 2007; Casey, 1993; Cole et al., 2004; Eisenberg et al., 2007; Saarni, 1979; Saarni et al., 1998; Stegge and Meerum Terwogt, 2007; Thompson, 1994). Although emerging regulatory capacities are internalized by the infant, their development is critically dependent on the successful provision of external regulation by the caregiver (Bernier et al., 2010; for review see Calkins and Hill, 2007; Kopp, 1989). External regulation serves to foster the development of infants’ self-regulatory capacities to cope with everyday stressors and it is this development that propels and boosts their resilience when under greater duress. When deprived of regulatory support, infants, as well as the young of other species, show deficits in their regulatory capacities (Blandon et al., 2008; Champagne and Curley, 2009; Fogel, 1993, 2006; Meaney, 2010; Tronick and Reck, 2009; Weaver et al., 2004). They are chronically dysregulated and constantly recruit their resources to self-regulate which, in turn, undermines and disrupts their engagement with the world (see Fig. 2B). Consequently, the quality and form of the mutual regulation relationship between the infant and mother, often referred to as ‘maternal sensitivity’, is important to infants’ development regulatory capacity, as well as overall development (Ainsworth et al., 1974; Beebe et al., 2010; Beehly et al., in press).

5. ‘Reparatory sensitivity’

Sensitivity has and is an omnipresent concept in psychology with developmental effects that are viewed as wide reaching. From Freud (1974) to Bowlby (1980), the quality of maternal sensitivity has been seen as influencing the infants’ development of relationships with others over the lifespan. Higher levels of maternal sensitivity in infancy are associated with regulation including physiological regulation (Calkins et al., 1998; Conradt and Ablow, 2010; Moore et al., 2009) and stress management (Blunt Bugental et al., 1993; Conway and McDonough, 2006; Waters et al., 2010). Higher levels of maternal sensitivity are also associated with later secure attachment (Ainsworth et al., 1978; Bigelow et al., 2010; Isabella et al., 1989), sociability (Hobson et al., 2004), temperament (McElwain and Booth-Laforce, 2006), lower levels of aggression (Crockenberg et al., 2008; Leerkes et al., 2009), and gains in both cognitive (Bernier et al., 2010; Tamis-Lemonda et al., 1996) and socio-emotional development (Leerkes et al., 2009).

However, at face value maternal sensitivity is a multidimensional, complex psychological construct that can be measured in many different ways under many different circumstances. It can be measured by observing synchrony within the dyad or the matching of affect during times of distress, non-distress, or both, as well as during heightened states of positive arousal. When thinking about the mother’s regulatory role within the dyad, we think it is more fitting to tease apart the construct of ‘maternal sensitivity’ and limit our consideration to what we define as ‘reparatory sensitivity’. Reparatory sensitivity refers to the quality and form of the mutual regulation relationship between the infant and mother during times when infants’ regulatory strategies are overtaxed and they cannot self-regulate their states, be the states negative or positive. Reparatory sensitivity occurs at multiple stress levels including the micro-temporal level where the mother provides regulatory scaffolding that leads to interactive reparation of the micro-stress that travels short-lived rapidly occurring mismatches.

The idea of reparatory sensitivity can be conceptualized in terms of Hans Selye’s (1936) classic General Adaptation Syndrome to stress theory. Selye stated that depending upon the individuals’ regulatory resilience in the face of a stressor, they may progress through three biobehavioral states – the alarm state, the resistance state, and the exhaustion state. The alarm state prepares the individual for the stressor which then is followed by the resistance state where the individual may use emotion regulation or stress-behavior modification techniques to self-regulate. If those attempts fail, the individual succumbs to the stressor and moves into the exhaustion state where they are now vulnerable to stress related diseases.

In Selye’s model, how the individual adapts during the resilience stage is central to any understanding of how they cope with stress, but more recent thinking points to factors not considered in the model. Selye’s original model did not consider development and the changes that occur in the regulatory systems ontogenetically. He also did not consider the phenomena of plasticity, sensitivity-periods, and how experience can modify development through learning and changes in gene expression as researched in the emerging field of epigenetics (Barry et al., 2008; Champagne, 2010; Champagne and Curley, 2009; Meaney, 2010; Weaver et al., 2004). Importantly in this context, Selye saw adaptations as intrinsic to the individual organism, rather than considering the idea we are advancing that successful regulation for the infant is a dyadic process and that dyadic failure leads to stress. For example, mismatched affect within the dyad is a key factor for behavioral and physiological disorganization in infants (Tronick et al., 1986).

Nonetheless these developmental and dyadic ideas can be readily incorporated into Selye’s stress theory where the mother acts as a constant external regulator, a fail-safe, not only knowing when her infant’s regulatory tolerance level has been exceeded and when to step in to intervene, but also when to let her infant self-regulate. With this organization of regulatory sensitivity the mother allows her infant to experience a certain amount of stress or discomfort, a level that she knows her infant can cope with. Furthermore, through her scaffolding during the process of dyadic mismatches, matches, and reparation, the mother helps her infant build a self-soothing repertoire. More specifically, we believe that reparatory sensitivity to typical interactive macro and micro-stressors leads to individual differences in infants’ regulatory capacities and, consequently, the growth of resilience.
This brings us back to the marathon example. The marathon runner runs a series of shorter, but progressively longer, less-traumatic distances in everyday order in order to prepare for the actual shock of the marathon. It is this practice that prepares the runner for the longer distance. Self-monitoring and monitoring by coaches and training mates prevents overtraining and damage that is not easily repaired, but at the same time allows for a level of training stress that can be repaired resulting in a growth of capacity. Similarly, the mother’s reparatory sensitivity to the match–mismatch process monitors infant’s stress within the dyad. The mother acts to prevent stress that would overwhelm the infant’s resources while allowing for appropriate levels of capacity increasing stress. Thus the infant does not necessarily need to be in a distressed state during a mismatch. Instead, mismatches can be small and occur quite frequently in everyday social encounters. What is important is how the infant copes during mismatches. This everyday coping, fostered by the mother’s reparatory sensitivity, is what leads to increased everyday resilience.

6. The effects of sensitivity on development

Research suggests that the quality of maternal sensitivity remains consistent across non-stressful and stressful contexts (Conradt and Ablow, 2010; Leerkes et al., 2009; McElwain and Booth-Laforce, 2006; Mills-Koonce et al., 2009; Moore et al., 2009). The stability of maternal sensitivity as broadly characterized in the literature, what we would prefer to see as ‘reparatory sensitivity’, fits well with the Everyday Stress Resilience Hypothesis with its emphasis on chronic on-going events; that is a chronic progressive exposure to reparable levels of stress. Infants of mothers who showed greater maternal sensitivity at 6-months were less likely to show externalizing and internalizing behavioral problems at 24- and 36-months, problems reflecting regulatory issues (Leerkes et al., 2009). Calkins and colleagues found that greater maternal sensitivity to toddler’s negative emotions coupled with a flexible parenting style increases young children’s physiologic regulation across multiple stressors (Calkins et al., 1998). Adding to this, recent epigenetics research emphasizes the protective nature of maternal sensitivity. Propper et al. (2008) found that infants with a genetic vulnerability for physiological dysregulation during stressors were likely to show signs of successful physiologic coping (e.g., RSA withdrawal) at 12-months if their mothers were rated as more sensitive at 3- and 6-months. Greater levels of maternal sensitivity at 12-months have also been associated with later gains in increased levels of distress and the need for the dyad to achieve synchrony in situations where reparation is necessary (Atkinson et al., 2009). This behavior has the potential to affect the timing and quality of the mother’s intervention thereby disrupting the level of trust within the dyad and the stability of the mother’s relationship with their developing infant.

Several additional studies highlight the important link between the timing and efficiency of reparation and infant recovery (Kogan and Carter, 1996; Leerkes et al., 2009; McElwain and Booth-Laforce, 2006; Moore and Calkins, 2004; Porter, 2003; Thompson, 1994). Timing and efficiency are often related to levels of synchrony within the dyad. Synchrony within the dyad is the result of infants’ increased levels of distress and the need for the dyad to achieve regulatory homeostasis (Tronick and Cohn, 1989). For example, in dyads who experienced more unilaterally patterns of communication during play, where only one part of the dyad is engaged in some sort of communication while the other member is inattentive (e.g., the infant is looking away), infants showed lower vagal tone, a cardiac marker for poor physiological regulation (Porter, 2003). Due to the lack of attention, infants had less of an opportunity to experience their mothers’ attempts to change their emotional state and to redirect their attention compared to infants who were part of more synchronous dyads. Additionally, in synchronous dyads infants exhibited more positive behaviors and greater vagal tone indicating greater physiological regulation. This suggests the important role of dyadic synchrony in situations where reparation is necessary (Porter, 2003).

All in all, in our terms parents who intervene both on-time and efficiently are high in reparatory sensitivity. They recognize
when their infant needs help and provide the appropriate level of attention and intervention. Intervening too soon may lead infants to seldom experience regulation on their own. As a consequence, when faced with a stressor in the absence of the caregiver, the infant may be unable to cope. Likewise intervening too late may result in an inconsolable infant who is unable to utilize the caregiver's soothing input. Observations by Beebe (Beebe and Lachmann, 1994) and Isabella and Belsky (1991) found that sensitivity in the mid-range, rather than at the low or high end, typify normal interactions. Given this work and work by Tronick and colleagues (e.g., Tronick and Gianino, 1986; Tronick and Cohn, 1998), it is hypothesized that mid-range sensitivity is also characterized by mismatches and repairs, yielding strong, but not perfect, behavioral measures of synchrony and matching. This is compared to interactions where the mother is never sensitive (i.e., high mismatch/low synchrony and no reparation) or always overly sensitive (i.e., low mismatch/low synchrony and no reparation).

Research suggests that a lack of sensitivity, as seen with frequent maternal emotional withdrawal, affects infants' later developing physiological stress responses. Specifically infants with emotionally absent mothers (e.g., mothers suffering from postpartum depression) were more likely to have elevated resting cortisol levels (Blunt Bugental et al., 2003) and Cohn et al., 1996). In effect the infant is left to regulate on their own and, when faced with higher levels of distress, are likely unable to regain homeostatic balance. Paradoxically too much sensitivity, where a child is rarely allowed to experience reparation, can also lead to negative consequences. A hypervigilant parent tries to buffer their child from experiencing any stress. Mothers who are over-involved or intrusive in interactions with their infant are less likely to have securely attached infants (Isabella and Belsky, 1991; Isabella et al., 1989). Over-involvement or intrusive styles of interaction both have the potential to limit the infant's regulatory growth due to fewer opportunities regulating stress. This ineffectiveness may result in a lack of confidence when faced with a stressor in the absence of their mother where the infant is likely to withdraw from the situation. In both cases of under and overly sensitive mothers, it is our hypothesis that the infant is at a disadvantage for developing coping mechanisms used to regulate their physiological, behavioral, and emotional reaction. Reparatory sensitivity is intertwined with the mother's ability to regulate her own psychological state in addition to her infant's. In sum the maternal sensitivity findings make it clear that the development of infants' resilience, as seen in the development of self-soothing and regulatory strategies, is both maintained and expanded by sensitive reductions in physiological arousal.

7. Conclusion

The concept of resilience is usually associated with coping and regulation under extreme amounts of stress. For that reason, examples of resilient behavior tend to focus more on the against-all-odds types of stories. The inner-city youth who grew up in poverty and lost both parents to violence or the physical abuse survivor, both of whom managed to become influential leaders in society. In this review, we put forth a hypothesis, the Everyday Stress Resilience Hypothesis, to present the argument that resilience can be thought of as a process of regulating and coping with everyday life stressors. The more experience one has successfully regulating everyday life stressors, the more prepared the individual is for greater challenges. For an infant, this can consist of coping with micro-stressors, the ubiquitous disruptions in the typical flow of communication within the mother–infant dyad. But infants' coping experience is not solely dependent on their own capacities. They are part of a larger dyadic regulatory system and their experience with the reparation of mismatches within the dyadic system is critical to successful regulation of stress in the short run and to the enhancement of the infants' regulatory resilience in the long run (Leerkes et al., 2009; McElwain and Booth-LaForce, 2006; Thompson, 1994). Thus it is the quality of behavioral and biological synchrony within the mother–infant dyad that serves as a protective regulatory function and as a function of preparing, expanding and developing the infant's regulatory capacity. The positive feedback loop within the dyad creates a greater propensity to regulate and makes mutual regulation easier.

There are several necessary pieces in order for the Everyday Stress Resilience Hypothesis to be valid. First the building blocks of self-regulation must be in place. Studies have demonstrated individual differences in behavioral and physiological reactivity early in infancy and these individual differences have been linked to difficulties in self-regulation and later emotion regulation capacities (Calkins, 1997; Hill-Soderlund and Braungart-Rieker, 2008; Kagan and Snidman, 2004; Kagan et al., 1992, 1998). For example, using typical measures of heart rate variability, infants who have less variability at rest and who showed greater suppression during challenges have less temperamental difficulties, show more regulatory behaviors, and are typically more attentive (Fox, 1989; Fox and Porges, 1985; Porges et al., 1973; Porges et al., 1994; Porter, 2003; Stifter and Corey, 2001; Stifter and Fox, 1990; Stifter and Jain, 1996). This is compared to infants who have greater heart rate variability at rest and who also showed less suppression during challenges. Infants who have this pattern of variability were more likely to have difficult temperament styles and, when under duress, took longer to recover (Bazhenova et al., 2001; Beauchaine, 2001; Field and Diego, 2008; Fox, 1989; Moore and Calkins, 2004; Porges et al., 1994; Stifter and Fox, 1990).

Second, the stressors experienced during infancy must be typical and not extreme or chronic. Numerous studies and reviews have demonstrated the toxic effect of chronic, high levels of stress on development (De Bellis et al., 1999a,b; Kalsas and Chrousos, 2007; Nelson and Carver, 1998). Adding to this, when mothers need to cope with chronic, intense stress their parenting and functioning is also compromised. They are inattentive and the timing and appropriateness of their responses are disrupted. As caregivers they have deficits in or lack regulatory sensitivity. Therefore, not only are the infants experiencing an extreme amount of stress but they also lack the external support or scaffolding needed to successfully regulate. Thinking back to Selye's model, these infants are more likely to progress to the exhaustion or disease state, a state that is a recipe for a developmental disaster (Selye, 1936). In a way, the condition is not unlike the marathon runner who continually over-trains and does not provide their body with an opportunity to recover. In the end, their body progressively weakens.

Finally, an implication of the Everyday Stress Resilience Hypothesis is that moderate levels of 'reparatory sensitivity' lead to the most successful regulatory development and, consequently, the greatest resilience. Following a classic inverted U-shaped distribution, both extremely low and extremely high levels of reparatory
sensitivity may contribute to suboptimal regulation skills, or vulnerabilities, in the developing infant. This idea is based on evidence associating moderate levels of maternal sensitivity and secure attachment (Beebe and Lachmann, 1994; Isabella and Belsky, 1991).

Future research is needed on many of the implications related to our hypothesis. A primary area of interest involves stress as a factor inducing regulatory capacity. How much stress is appropriate; how much is too little or too much? What markers can we develop to evaluate and predict outcomes? Are there sensitive periods when stress is required and does the stress have to be of specific type to induce a positive effect? If there are sensitive periods can they be overcome later in development? To explore these questions, more research involving microanalytic coding methods should be conducted at various ages in order to determine the dynamics of the interplay of behavior and physiology including their effects on reparation. Another area of research involves children who do not fit the hypothesis because they function well despite the extremes of chronic, toxic stress and trauma. Are these children at the extreme of the continuum of individual differences in regulatory capacity? Do they have deficits that go unnoticed? Even under situations of extreme stress where there is slim possibility that the child comes out unscathed, they may show deficits in some areas of functioning compared to others. Was there some fail-safe in their daily experience that protected them and allowed for normal development? The Everyday Stress Resilience Hypothesis represents a critical first step in building a more comprehensive theory of resilience. The hypothesis demands a detailed knowing of an individual’s experience, in particular the details of their relational experience, rather than a global characterization of events in their lives. Finally, how do differences in types of stress and types of infants fit into the picture? Is regulatory capacity specialized to the context and stimulus or is it unbounded? Does a sense of regulatory capacity extend to all domains (e.g., social, cognitive, and executive functioning)? Do temperamental differences predetermine infants’ regulatory capacity regardless of the mothers’ reparatory sensitivity? Carefully modifying these variables in future studies opens the door to understanding the scope of everyday resiliency.

Small stressors are ubiquitous in everyday experience, even for infants. Unfortunately, traumatic, chronic stress is also far too common. As argued here, it is our view that understanding resilience in the face of extreme stress requires broadening our perspective and focusing on the developmental processes that lead to resilience – the reparation of the stress of simply being in and engaging the world.

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