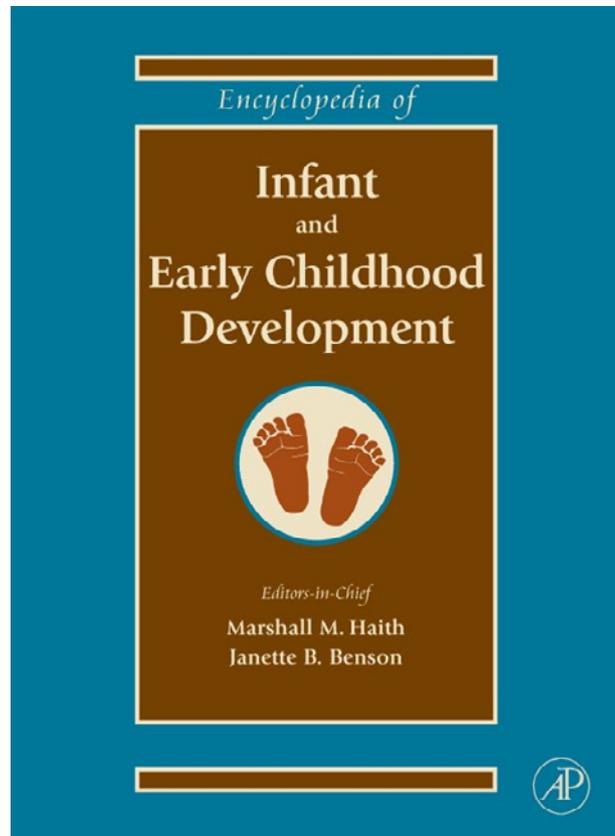


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emphasize the importance and complexity of early social and emotional development. In particular, we hope that this article highlighted the importance of focusing not only on the individual child, but on the child's broader ecology, with respect to caregiver relationships, family, and community risk and protective factors, and the larger cultural context that critically influences social and emotional development.

See also: Attachment; Birth Order; Discipline and Compliance; Emotion Regulation; Empathy and Prosocial Behavior; Fear and Wariness; Gender: Awareness, Identity, and Stereotyping; Humor; Play; Postpartum Depression, Effects on Infant; Risk and Resilience; Separation and Stranger Anxiety; Shyness; Social-Emotional Development Assessment; Socialization in Infancy and Childhood; Temperament; Vygotsky's Sociocultural Theory.

Suggested Readings

Briggs-Gowan MJ, Carter AS, Bosson-Heenan J, Guyer AE, and Horwitz SM (2006) Are infant-toddler social-emotional and behavioral problems transient? *Journal of the American Academy of Child and Adolescent Psychiatry* 45(7): 849–858.

- Carter AS, Briggs-Gowan MJ, and Davis NO (2004) Assessment of young children's social-emotional development and psychopathology: Recent advances and recommendations for practice. *Journal of Child Psychology and Psychiatry* 45(1): 109–134.
- Cole PM, Martin SE, and Dennis TA (2004) Emotion regulation as a scientific construct: Challenges and directions for child development research. *Child Development* 75: 317–333.
- Eaton W (1981) Demographic and social ecological risk factors for mental disorders. In: Regier D and Gordon A (eds.) *Risk-Factor Research in the Major Mental Disorders*, pp. 111–130. Washington, DC: US Government Printing Office.
- Lieberman A (1993) *The Emotional Life of the Toddler*. New York: Free Press.
- Malatesta CZ, Culver C, Tesman JR, and Shepard B (1989) The development of emotion expression during the first two years of life. *Monographs of the Society for Research in Child Development* 54: 1–2 Serial No. 219.
- Rothbart MK, Ahadi SA, Hershey KL, and Fisher P (2001) Investigations of temperament at three to seven years: The children's behavior questionnaire. *Child Development* 72: 1394–1408.
- Rothbart MK and Derryberry D (1981) Development of individual differences in temperament. In: Lamb ME and Brown AL (eds.) *Advances in Developmental Psychology*, vol. 1, pp. 37–86. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Rothbart MK and Putnam SP (2002) Temperament and emotion regulation. In: Pulkkinen L and Caspi A (eds.) *Paths to Successful Development: Personality in the life course*, pp. 19–45. New York: Cambridge University Press.
- Rutter M (1979) Protective factors in children's responses to stress and disadvantage. In: Kent MW and Rolf JE (eds.) *Primary Prevention of Psychopathology: Vol. 3. Social Competence in Children*, pp. 49–74. Hanover, NH: University Press of New England.
- Rutter M (1987) Psychosocial resilience and protective mechanisms. *American Journal of Orthopsychiatry* 57: 316–331.

Social Interaction

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Glossary

Developmental disorganization – A normal developmental process in which one well-organized behavior, capacity, or state of consciousness is disassembled in order to reorganize it in a more complex and coherent form.

Mutual regulation model – The bidirectional process of communicating and responding to the relational intentions and meanings of the other during social interactions.

Reparation – the process of changing mismatching affects and intentions to matching affects and intentions.

Resilience – The individual's ability to resist and regulate stress. Individual differences in resilience in part emerge from differences in interactive reparatory experience.

Still-face – An experimental manipulation during interactions in which one partner is instructed not to respond to communicative displays of the other.

States of consciousness – The psychobiological organization of one's self in relation to the world. It is one's sense of self in the world. It does not imply awareness.

Introduction

Infants' and young children's social engagement with other people, along with genetic and other experiential processes, is a fundamental process shaping a child's normal as well as abnormal development. Normal social interaction leads to positive emotions, curiosity about the world of things, the capacity to cope with stress, and

the development of close relationships during infancy and in adulthood. An infant experiencing abnormal social interactions becomes sad or angry, hesitant and withdrawn, anxious and vigilant, unengaged with people, the relationships they do have lack emotional closeness, have a limited emotional range and may lack empathy. They are likely to disengage from acting on the world of inanimate things. Whether the interactions are normal or abnormal, social experience not only becomes part of the content of the brain, but may actually sculpt the brain. Though interactions the infant makes meaning about the nature of him or her self and his or her relation to other people and the world.

Infants must be seen as a component of a dyadic – a two part – communicative system in which the infant and adult mutually regulate and scaffold their engagements with each other and with the world of things. In interactions, they communicate their individual needs and intentions and respond to each others needs and intentions. They exchange their private meaning of themselves and the world and they create new meanings. The infant has capacities to express their intentions and sense of the world and capacities to respond to the expressed needs and intentions of the other person. Of course, the other person has to have the same capacities.

Macro-Development

Though the classic milestone charts make the sequence of development appear like a smooth progression, normal development is neither smooth nor steady. Development actually is characterized by periods of stable organization in one domain followed by periods of disorganization in which the old organization is disassembled followed by a period of reorganization out of which a new more complex organization emerges. Crawling is an effective way of getting around in the world but it is disassembled to allow for the emergence of walking. Crawling allows the hands to be used only when sitting and stationary, whereas walking frees up the hands to be used while being mobile. Yet taking apart crawling in order to put together walking is energetically costly. The process is also emotionally costly because intentions cannot be fulfilled. Crawling has become less effective but walking is not yet in place such that achieving goals is difficult and frustrating.

The sequence of organization, disorganization (sometimes referred to incorrectly as regressions, because the infant does not go back to an old form but rather takes apart the old), and reorganization into a more complex and coherent form of functioning characterizes the development of all systems (see [Figure 1](#)). Periods of disorganization are an 'inherent' characteristic of self-organizing systems which grow and develop greater levels of complexity. Adding to this complexity and costliness, the

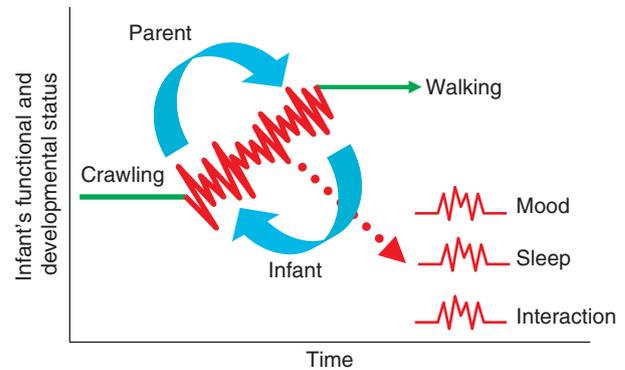


Figure 1 Normal development is not a smooth process but one characterized by organization, followed by disorganization and then reorganization. Disorganization in one system can disorganize other systems. The disorganization is regulated by a dyadic system made up of the infant and an adult.

disorganization of one domain can disorganize other domains. For example, the infant who is beginning to change from crawling to walking not only becomes disorganized motorically, but also is likely to become emotionally and diurnally disorganized. The regulation of this disorganization falls to the internal self-organizing resources of the infant. These resources are not trivial and include for instance brain processes that control the limbs and posture (motor cortex, vestibular mechanisms), and other areas that control wake-activity cycles (reticular formation). Yet some of the time for all developmental changes the infant's internal resources are inadequate to the task of controlling the disorganization. To overcome this limitation we have evolved a system to externally supplement the infant's internal resources – caretaking, or more formally a system of mutual regulation in which the infant is part of a larger dyadic system that includes an external regulator, an adult.

Under normal circumstances the combination of internal and external regulation is adequate and development moves forward. However, when the internal and external resources are inadequate development may be seriously disrupted. Disorganization increases and becomes long lasting, and in turn the development of new forms of organization fail or become compromised and coherence and complexity are lost. Note however, that a critical feature of the model is that disorganization is part of the 'normal' process. Disorganization is 'necessary' for development to move forward. It is only problematic when it exceeds the capacities of the dyad to regulate it.

Micro-Development: The Moment-by-Moment Process of Mutual Regulation

The infant is motivated to communicate with people, to establish intersubjective states, states in which there is mutual expression and knowing of the intentions and needs of oneself and of one's partner. This motivation is

assumed to be a biological characteristic of our species. The child also is inherently motivated to act on and make sense of their place in the world – reach for objects to know what he or she can do with it. The accomplishment of motivated action on the inanimate world, however, is often dependent in the infant and young child on the establishment of intersubjective relationships. As is the case for *Homo sapiens*, children can only create meanings in collaboration with others. Their understanding of the world of objects, no matter how primitive, is dependent on establishing intersubjective states with others and the mutual creation of meaning. Though we are impressed with our ability to manipulate the world of things and create new technology the primary context in which the understanding of the world emerges is when we are in social relationships. Thus the child who successfully accomplishes communication with others, develops normally. Their understanding of themselves, others and the world expands. A child who does not engage the world in a culturally appropriate manner does not develop normally no matter what causes the failure – chronic or acute illness, congenital malformations, poor parenting, toxic exposures, or parental psychopathology.

Success or failure in accomplishing intentions is dependent on at least three critical processes among others. The first is the integrity and capacity of the child's physiologic systems and central nervous system to organize and control the child's physiologic states and behavior. The second is the integrity of the infant's communicative system including the central nervous system centers that control and generate messages and meanings and the motor system that makes the messages manifest (e.g., gestures and facial expressions). The earliest and continuing function of the communicative system is to express the child's intention for action to the caregiver and to communicate the extent to which the infant is succeeding or failing in fulfilling his or her intentions or goals. The third process, reciprocal to the second, is the caretaker's capacity to appropriately read the child's communications and willingness to take appropriate action. Therefore successful engagement with the world of people and things depends on the status and the effectiveness of the child–caretaker communicative system in facilitating the child's motivated intentions. These processes make up the process of mutual regulation – the capacity of each interactant, child and adult, to express their motivated intentions, to appreciate the intentions of the partner, and to scaffold their partner's actions so that their partner can achieve their goals.

The Mutual Regulation of Infant–Mother and Other Adult Social Interactions

Infant social interactions and emotions are also regulated dyadically. The principal components are the infant's

central nervous system (e.g., primarily the limbic system) and the behaviors it controls (e.g., facial and vocal emotional displays) and the caregiver's regulatory input (e.g., facial expressions, gestures, vocalizations). Thus, the dyadic (collaborative) regulatory system is guided by communication between internal and external components, the infant and the caregiver (see Figure 2 for one such example).

The Normal Individual and Cultural Variation of Social Interactions

Interactions have been found to have enormous individual variation. In studies of normal mother–infant face-to-face interactions, expressions of positive affect by either the mother or the infant occur respectively about 42% for the mother and 15% for the infant. The standard deviation for positive affect for the mother varies from almost 0 to 80% or more. There is also variation between what mothers and fathers do with infants. Relative to mothers, fathers express positive affect with infants less often and spend a greater proportion of time in physical play with infants. During mother–infant interaction, infant arousal cycles between medium and low levels, and high positive affect appears gradually. In contrast, infants' arousal during father–infant interaction is high, sudden, and organized in multiple peaks that appear frequently as play progresses. For both mothers and fathers, positive affect predicted infants' positive affect at 6 months. Thus the 'what' and



Figure 2 In (a) the infant is pulling on the mother's hair and in (b) she tries to disengage herself. In (c) she makes an angry face because it hurt as she disengaged. The infant reacts immediately and in (d) he places his hands in front of his face to defend himself. In (e) they have reestablished contact.

'how' of mothers and fathers interactions with their infants is different but neither is more optimal.

Another and particularly telling instance of normal variation are findings of gender differences in the affective and regulatory behaviors of normal 6-month-old infants as well as differences in interactive coherence between mothers and sons and mothers and daughters. Infant boys are more emotionally reactive than girls. They display more positive as well as more negative affect, focus more on the mother, and display more signals expressing change or stop, and demands for more contact than girls. Girls show more interest in objects, a greater constancy of interest, and better self-regulation of emotional states. Their message is more that they can do it on their own. Girls also evidence greater stability of sadness over time than boys. Sex differences in interactive coherence or matching have also been demonstrated with mother–son dyads evidencing more coherence than mother–daughter dyads. These gender differences reflect normal variants and highlight the range of affective expressiveness, regulatory behavior, and synchrony that occurs during normal interactions.

Cross-cultural findings further make the point that there is no single optimal form of interaction. Among the Gusii, an agricultural community in western Kenya, mothers turn away from their infants just as their infants become most affectively positive and excited. This maternal behavior presages the socialization of later restrictions on the expression of positive affect among different individuals (e.g., younger individuals do not look directly at older individuals especially when expressing strong affect). This looking away pattern is normative for the Gusii, but is quite different from that seen in the US. American middle income mothers respond to the infant's affective excitement with continued intense looking and heightened positive arousal. Looking away in a Gusii fashion by an American middle class mother would be seen as pathological. And in the US, it might be correct judgment, and it might also be correct that a American middle class gaze pattern by a Gusii mother might be pathological.

The Quechua of the altiplano of the Peruvian Andes have a pattern of child-care and interaction that if engaged in the US would be seen as bordering on neglect. Quechua mothers tightly swaddle and fully wrap their infants in blankets from head to toe and then carry them on their backs. There is no light inside the wrappings, sound is muffled, and the infants can hardly move because of how they are swaddled. In addition, though the infants are nursed, the duration between feedings may be several hours and it is done in a nurturing but perfunctory manner. Thus there is minimal nurturing interaction. According to some, this pattern would be 'abusive', because they argue it is necessary for the infant to experience affectively intense interactions to develop normally, yet somehow Quechua infants do develop normally, but of course

as Quechua. Another perhaps dramatic example is the child rearing pattern of the Efe foragers of the Ituri forest. In this community, infants are with their mothers less than half of the time in the first year and regularly interact with many different individuals per hour. Even when the mother is in proximity, a crying infant is as likely to be calmed by someone other than the mother as by the mother. Moreover, infants are regularly nursed by individuals other than their mothers. There are playful interactions, more often with individuals other than the mother, but much of the time the infant is held or carried in a sling. Despite the fact that the Efe are foragers and live in the purported niche of evolutionary adaptation, the Efe pattern of care does not conform to a universalist evolutionary model, such as attachment theory, that postulates an evolutionarily given constraint that infants 'need' to be taken care of by one individual, usually the mother, or at most only a very few individuals, and that they are only able to develop other relationships slowly over the first years of life. Certainly, the Efe infant will be different than singularly (sometimes double) reared infant in an American or European middle class family, but neither is inherently more optimal the other. And if these examples from technologically simple societies seem too distant, one need only consider that in Japan many individuals from birth to death never sleep alone, or that many Italian families' children do not have a bedtime, but stay up or fall asleep while the rest of the family is awake and only get put to bed when the family goes to bed.

These findings make it clear that there is no singular universal optimal form of mother–child interaction from which deviations are considered pathological, as implied by the attachment model. Interactions vary among cultural communities (and the individuals in those communities) in culturally meaningful ways. On a daily basis, infants repeatedly participate in a cultured but variable set of interactions which results in their internalization of culturally accepted social–emotional interactive practices. Cultured interactive ways of being can be thought of as having a narrative structure, even though it is a narrative of communicative action and not words. The child comes to 'know' that "this is what is happening; this is what will happen; and this is how it will feel." This meaning system is established long before the child can engage in a narrative of words.

Matching, Mismatching, and Reparation

The typical mother–infant interaction is one that moves from coordinated (or synchronous) to mis-coordinated states and back again over a wide affective range (see [Figure 3](#)). The mis-coordinated state is referred to as a normal interactive communicative error. It is a bit of interactive disorganization or messiness. The interactive

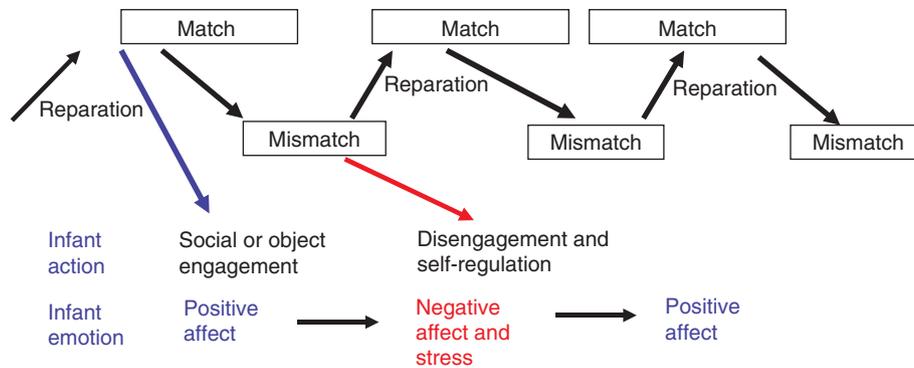


Figure 3 Normal interactions move between matching and mismatching states. Each state has different emotional consequences. The change from a mismatch to a match is a reparation.



Figure 4 Sequence of (a) mismatch, (b) match, (c) mismatch, and (d) match

transition from a mis-coordinated state to a coordinated state is referred to as interactive repair. The process of reparation, like the dynamics of regulating homeostatic states, is mutually regulated. The partners, both infant and adult, convey their evaluation of the state of the interaction through their affective configurations (Stop! Continue.). In turn, in response to their partner's expressed evaluation, each partner attempts to adjust his/her behavior to maintain a coordinated state or to repair an interactive error. Critically, successful reparations and the experience of coordinated states are associated with positive affective states whereas interactive errors generate negative affective states. Thus the infant's affective experience is determined by a dyadic regulatory process. **Figure 4** presents a sequence of matching and mismatching states.

Interactive mismatches have a high rate of occurrence but they are quickly repaired. In studies of face-to-face interaction at 6 months of age, repairs occur at a rate of once every 3–5 s and more than one-third of all repairs

occur by the next step in the interaction. Other studies using different analytic methods have found that maternal sensitivity in the mid-range, rather than at the low or high end, typify normal interactions. Mid-range sensitivity is characterized by errors and repairs as contrasted to interactions in which the mother is never sensitive, or always sensitive. In interactions characterized by normal rates of reparation, the infant learns which communicative and coping strategies are effective in producing reparation and when to use them. This experience leads to the elaboration of communicative and coping skills, and the development of an understanding of cultural interactive rules and conventions. Reparations are associated with positive affect and with the experiential accumulation of successful reparations and the attendant transformation of negative affect into positive affect, the infant establishes a positive affective core. This internal positive affective core is a resource that allows the infant to come to new situations feeling positive about him or herself and the unknown situation. The infant

also learns that he or she has control over social interactions. Specifically, the infant develops a representation of himself or herself as effective, of his or her interactions as positive and reparable, and of the caretaker as reliable and trustworthy. These representations are crucial for the development of a sense of self which has coherence, continuity, and agency and for the development of stable and secure relationships.

The functional consequences of reparation from the perspective of mutual regulation suggest that when there is a prolonged failure to repair communicative messiness, infants will initially attempt to reestablish the expected interaction, but when these reparatory efforts fail, they will experience negative affect. To evaluate this hypothesis mothers were asked to hold a still-face and remain unresponsive to the infant. Thus, the mother fails to engage in her normal interactive behavior, carry out her regulatory role, and does not allow for reparations. The effect on the infant is dramatic. Infants almost immediately detect the change and attempt to solicit the mother's attention. Failing to elicit a response, most infants turn away only to look back at the mother again (see [Figure 4\(a\)–4\(d\)](#)). This solicitation cycle may be repeated several times. In more intense reactions when an infant's attempts fail to repair the interaction he or she may lose postural control, withdraw and self-comfort. The disengagement is profound even with this short disruption of the mutual regulatory process and break of intersubjectivity.

Reparatory Failure and Pathology

To examine the process of reparatory failure in natural settings the interactions of depressed mothers and their infants have been studied. It was hypothesized that maternal depression, like the still-face, disrupts the mutual regulatory process and constitutes a break in intersubjectivity. The break is brought about by the effects of depression on maternal affect and responsiveness. Depression compromises the mother's, and eventually the dyad's capacity to mutually regulate the interaction. Overall, depressed mothers look away more and express more negative, angry and sad affect than do nondepressed mothers. They engage in less play and use less motherese (exaggerated intonations in adult speech to infant). The infants of depressed mothers look away more, self-comfort more, and express more sad affect than do infants of nondepressed mothers. Depressed mothers and their infants share more negative dyadic states more often and positive behavior states less often than nondepressed mothers and their infants.

Depressed mothers with similar levels of depressive symptoms do not engage in the same interactive style. There are at least two interactive patterns (intrusive and withdrawal) and each disrupts the regulatory process. Importantly, in terms of the argument that development is shaped by social-relational experience each form has a different effect on the infant. One way depressed mothers act is to be 'intrusive'. These mothers engaged in rough handling, spoke in an angry tone of voice, poked at their



Figure 5 In the still-face (a) the infant greets the mother as usual but in (b) almost immediately detect her lack of response the change, and attempt to solicit the mother's attention. In (c) he looks away and in (d) turns fully away. Typically, the infant will then try to elicit the mother, much as in (a) and then cycle through (b) through (a) repeatedly.

babies, and actively interfered with their infants' activities. Withdrawn mothers, by contrast, were disengaged, unresponsive, affectively flat, and did little to support their infants' activities.

As a striking demonstration of the sensitivity of the infant to these different maternal ways of being with their infants, infants of intrusive mothers (re)acted one way, whereas infants of withdrawn mothers (re)acted another way. Infants of intrusive mothers spent most of their time looking away from the mother, and seldom looked at objects. They infrequently cried. Infants of withdrawn mothers were more likely to protest and to be distressed than the infants of the intrusive mothers, suggesting that maternal withdrawal may be particularly aversive to young infants.

These differential infant reactions are expected. The infants are reacting to and acting on different kinds of external social input; the affective reality they are regulating is different. Infants of withdrawn mothers are failing to achieve social connectedness because of the mothers' lack of response and their inability to repair the interaction. Initially, they may become angry. However, since they are unable to successfully cope or self-regulate this heightened negative state, they become dysregulated, fuss, and cry. This dysregulation, similar to the dysregulation associated with homeostatic failures, compels them to devote much of their coping resources to controlling their dysregulated state. With chronic exposure moment-by-moment, day after day they develop a disengaged and self-directed regulatory style characterized by self-comforting, self-regulatory behaviors (looking away, sucking on their thumb), passivity, and withdrawal as a way of coping with their state. To the extent that this coping style is successful in stabilizing their affective state, it is deployed automatically and becomes defensive. This self-directed style of coping is used in an effort to preclude anticipated negative emotions even in situations in which negative affect may not occur. This interpretation explains findings that infants of depressed mothers have less engaged and more negative interactions with a friendly stranger than do infants of non-depressed mothers. The infants of the depressed mothers are utilizing this strategy automatically without evaluating whether or not it is warranted. Eventually with the reiteration and accumulation of failure, these infants develop a negative affective core primarily characterized by sadness and anger, a representation of their mother as untrustworthy and unresponsive, and of themselves as ineffective and helpless.

The infants of hostile intrusive mothers must cope with a different regulatory problem. The mother's behavior prevents reparation of the interaction because she consistently disrupts the infants' activities. These infants initially experience anger, turn away from the mother, push her away, or screen her out. However, unlike the failure experience of the infants of withdrawn mothers, these coping

behaviors are occasionally successful in limiting the mother's intrusiveness. Thus infants of intrusive mothers erratically experience reparation, such as a transformation of their anger into a more positive state. To the extent that these coping behaviors are successful in fending off the mother, these infants eventually internalize an angry and protective style of coping which is deployed defensively in anticipation of the mother's intrusiveness. These infants are easily angered when interacting not only with their mother but with others as well and are more easily frustrated when acting on objects.

More speculatively, these differences in infant reactions to maternal withdrawal and intrusiveness suggest an interpretation of differential effects associated with parental neglect and abuse. Infant failure to thrive, withdrawal and lack of motivation seen in situations of parental neglect, probably result in the lack of parental scaffolding leading to a constant demand on the infant to self-regulate. The infant is continuously required to control his or her own physiologic and affective states. This self-directed coping style compromises the infant's interchanges with the environment and motivation to engage with the world. By contrast, in the abusive situation, parental abuse leads to chronic physical defensiveness and anger as well as heightened vigilance, and fear.

These observations need to take into account gender differences in infant regulatory and affective styles. Boys are more affectively reactive and less able to self-regulate their affective states. This would make them particularly susceptible to the withdrawn style associated with depression because maternal withdrawal denies them the regulatory support that they need. On the other hand, girls, who are significantly more focused on objects and more able to maintain their own states than boys, may be more vulnerable to the intrusive style of depression which interferes with their self-organizing capacities. Combined with the findings that girls show more stability of sadness than boys, and boys show more stability of distancing and escape behaviors than girls, these gender differences in regulatory styles may be the first signs presaging the differential proportion of depression in girls and hyperactivity and aggressiveness in boys. Note, that it is not the case that girls are inherently depressed and boys inherently hyperactive. Each has different regulatory styles that in interaction with different caregiving styles make one or another outcome more likely.

This perspective also has implications for the higher rates of conduct and delinquency disorders in boys. We know from the literature on juvenile delinquency that boys commit many more crimes than girls. However, there is not a very good explanation for this phenomenon, but gender differences in infancy may already set the stage for this differential rate. The explanation, however, is not simply that boys are more aggressive than girls. Rather, it is that boys have greater difficulty controlling their

emotional reactions. Because of this difficulty they are more likely than girls to fail to accomplish their goals. This failure generates frustration and anger and may lead to aggression. This may be exacerbated in those situations where parenting behavior is also compromised by, for example, depression.

Other at-risk populations have been studied and reparatory failure is at the heart of the interactive problems observed. Mothers with borderline personality disorder (BPD) have major emotional regulation difficulties during the social interactions and during the still-face procedure. Mothers with BPD are more intrusive and affectively negative. The infants of mothers with BPD exhibited more emotion dysregulation such as more hiccupping and spitting up. Prenatal cocaine and opiate exposure are also thought to subtly compromise social and emotional development. Mothers of cocaine-exposed infants showed more negative engagement than mothers of unexposed infants and showed higher overall levels of mismatched engagement states than nonexposed dyads, including more negative engagement when the infants were in states of neutral engagement. Infants exposed to heavier levels of cocaine showed more passive/withdrawn negative engagement and were more likely to engage in negative affective matching with their mothers than other infants. Though the effects are relatively small, cocaine exposure in general and heavy cocaine exposure in particular were associated with subtle patterns of negative affective interchanges, which may have a cumulative impact on exposed infants' later development and the quality of their relationship with their mothers. Similar effects have been for other *in utero* drug exposure as well as medical conditions such as low birthweight, small size for gestational age, gestational age, and white matter disorders.

Mutual Regulation, Brain Psychophysiology, and Resilience

One way to think about the long run effects of these risk conditions is to consider the interface and interaction between the nervous system and behavior. It is well established that there is a mutual influence of brain and behavior. Mother–infant interaction in animals and humans has long-term effects on the regulation of fearful behavior and on the systems regulating stress. The stress system of the human child appears to exhibit plasticity during development, which is mediated at least in part by social factors. During the first half of the second year, an infant who has been attended by highly responsive, sensitive, loving adult will exhibit a period of low cortisol responsivity. This is hypothesized to protect structures of the brain that are developing during that time from the deleterious effects of high cortisol. Moreover, individual differences in temperament can affect the likelihood that children will show

increases in stress hormones as the quality of their care decreases. Children who exhibit more negative affect are more vulnerable to elevating cortisol as quality of care. In fact work with at-risk children has shown that the longer a child is neglected, the higher the degree of developmental delay. The longer a child experiences severe neglect, the less the hypothalamic, pituitary, adrenal (HPA) system recovers when conditions are improved.

Innovative research looking at the psychophysiology of relationships has made major advances and demonstrates that mutual regulatory processes not only regulate affect and behavior but physiology as well. Simultaneous recordings of cardiac responses and skin conductance have been carried out with infants aged 6 months and their mothers during normal interactions and in the still-face. The cardiac measure, heart rate and respiratory sinus arrhythmia index the parasympathetic nervous system which has an important function in downregulating arousal. Skin conductance, a measure that has been difficult to use with infants because of movement artifacts, measure the sympathetic nervous system that has a primary role in arousal. Findings suggest that maternal behavior and psychophysiology and infant behavior and psychophysiology are mutually related. Parasympathetic and sympathetic activity between mothers and their infants was found to be concordant as was infant negative engagement and parasympathetic and sympathetic activity. The finding on sympathetic activity may be of particular importance because sympathetic activity is related to the activity of the amygdala, a brain site intimately related to emotionality and reactivity. These results open up an area of relational psychophysiological research that may deepen our understanding of mutual regulation, the development of relationships and the development of infant emotion regulation.

Conclusion

Social–emotional development is a critical process affecting all developmental domains. It leads to both the sculpting of the brain as well as its experiential content. The infant as well as the adult are active participants in the interaction. It is regulated by mutual regulatory processes. The mutual regulation of the interaction however is not smooth, but rather it is a messy process characterized by the matching and mismatching of affect and intentions. Reparation of mismatching to matching states powerfully affects the development of infants' sense of self and the emotional quality of their relationship with their partner(s). However, there is not an optimal universal form of interactions, but only interactions that are culturally appropriate resulting in the development of an cultured sense of self, even in infants. Nonetheless, interactions that produce unrelenting mismatches and failure of reparatory processes lead to withdrawal and a sense of helplessness.

Humans are makers of meaning and in essence, interactions are about making meaning – meaning about the infant's and adult's way of being together and what they want to do together. Successful interactions lead to shared states of knowing – dyadic states of consciousness – about the infant's and the adult's relation to each other and to the world. Meaning making during interactions is a creative process in which the uniqueness of the infant and adult generate new meanings out of the inherent messiness of interactions. When new meanings emerge there is a growth and expansion of the complexity and coherence of the infant's state of consciousness and infants are all about growth and development.

See also: Attachment; Autism Spectrum Disorders; Breastfeeding; Child and Day Care, Effects of; Depression; Discipline and Compliance; Emotion Regulation; Empathy and Prosocial Behavior; Family Influences;

Feeding Development and Disorders; Friends and Peers; Gender: Awareness, Identity, and Stereotyping; Imagination and Fantasy; Independence/Dependence; Marital Relationship; Mental Health, Infant; Parenting Styles and their Effects; Play; Pragmatic Development; Self Knowledge; Semantic Development; Separation and Stranger Anxiety; Shyness; Siblings and Sibling Rivalry; Smiling; Socialization in Infancy and Childhood; Theory of Mind; Twins.

Suggested Readings

- Nadel J and Muir D (eds.) (2005) *Emotional Development*. Oxford: Oxford University Press.
 Tronick E (2007) *The Neurobehavioral and Social Emotional Development of the Infant*. New York City: Norton Press.
 Schore A (2003) *Affect Regulation and the Repair of the Self*. New York City: Norton Press.

Social-Emotional Development Assessment

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Glossary

Dimensional assessments – Type of assessment that characterizes social-emotional deficits, competencies, subthreshold manifestations of symptoms, and risk factors.

Emotion regulation – Refers to voluntary or automatic processes that help children control/manage their emotional reactions. For example, being able to sooth oneself by diverting attention away from distressing stimuli. The intensity and duration of emotional reactions can serve as indicators of emotion regulation abilities. Difficulties regulating negative emotions have been linked to social-emotional and behavioral problems.

Joint attention – When two individuals (e.g., parent and child) are focused on or engaged in the same activity or event.

Multigated or multistage screening procedures – A cost-effective, multistep screening process used to identify children exhibiting atypical behavior and psychopathology. Short, inexpensive screeners are first used to identify children at

elevated risk for behavior problems from a larger pool of children and identified children are then referred for more comprehensive assessments.

Semistructured observational diagnostic tools – Specialized laboratory paradigms used to assess behaviors symptomatic of particular disorders. These assessments involve a variety of 'presses' designed to elicit behaviors relevant to a particular diagnosis that might not be commonly observed in an evaluation session.

Sensitivity – Proportion of a sample found to fall within a diagnostic category or the proportion of true positives.

Sensory sensitivity and reactivity – Hypersensitivity to sensory stimuli and difficulty regulating reactions to sensory stimulation. Oversensitive and overly reactive to sensory stimuli.

Social referencing – A form of emotional communication that helps young children learn about their environment through the emotional reactions of others. Children can use the emotional responses of adults to gauge their own affective responses in unfamiliar situations.