ANNUAL REVIEWS

Annual Review of Clinical Psychology

Social Behavior as a Transdiagnostic Marker of Resilience

Ruth Feldman[1,2]

[1]Center for Developmental Social Neuroscience, Interdisciplinary Center Herzliya, Herzliya 4601010, Israel; email: feldman.ruth@gmail.com

[2]Child Study Center, Yale University, New Haven, Connecticut 06520, USA

Annu. Rev. Clin. Psychol. 2021. 17:153–80

First published as a Review in Advance on January 12, 2021

The *Annual Review of Clinical Psychology* is online at clinpsy.annualreviews.org

https://doi.org/10.1146/annurev-clinpsy-081219-102046

Keywords

resilience, social behavior, reciprocity, oxytocin, affiliative neuroscience, Coding Interactive Behavior, CIB

Abstract

The recent shift from psychopathology to resilience and from diagnosis to functioning requires the construction of transdiagnostic markers of adaptation. This review describes a model of resilience that is based on the neurobiology of affiliation and the initial condition of mammals that mature in the context of the mother's body and social behavior. The model proposes three tenets of resilience—plasticity, sociality, and meaning—and argues that coordinated social behavior stands at the core sustaining resilience. Two lines in the maturation of coordinated social behavior are charted, across animal evolution and throughout human development, culminating in the mature human reciprocity of empathy, mutuality, and perspective-taking. Cumulative evidence across ages and clinical conditions and based on our behavioral coding system demonstrates that social reciprocity, defined by plasticity at the individual, dyadic, and group levels, denotes resilience, whereas the two poles of disengagement/avoidance and intrusion/rigidity characterize specific psychopathologies, each with a distinct behavioral signature. Attention to developmentally sensitive markers and to the dimension of meaning in human sociality may open new, behavior-based pathways to resilience.

Contents

INTRODUCTION

The use of social behavior as a transdiagnostic marker of resilience implicates a specific viewpoint: one that adopts three assumptions about the nature of resilience (Feldman 2020). First, it contends that resilience has a positive definition that is not built on the negation (absence of symptoms following trauma or hardship) or ex post facto assessment (resilience is observed only after the trauma has passed and some individuals remain symptom-free) (Kalisch et al. 2019). Second, it requires a conceptualization of resilience that is evolutionary and bottom-up—a model suggesting that resilience emerges over time both phylogenetically (across animal evolution) and ontogenetically (throughout the lives of individuals). Such a perspective necessitates the incorporation of "development" into the model as an indispensable feature and suggests that resilience may be expressed differently at various developmental nodes (Rutter 2013). Third, it maintains that resilience is essentially social and that social behavior provides a window into its manifestations. Across animal evolution, the coordination of behavior into collaborative processes has been a key attribute of survival, adaptation, and endurance, and species that are more proficient in social coordination exhibit a survival advantage (Wilson 2012) culminating in humans, whose brain volume and connectivity expanded across primate evolution to enable both the coordination of social behavior and the reading of interactive intent (Dunbar & Shultz 2007). Biobehavioral synchrony, a human-specific process of social coordination, begins with an infant's first social interactions with parents; during these brief, repetitive-rhythmic exchanges, infants learn to give salience to

social cues, exercise flexibility of social response, and practice mutuality as a pathway to social life (Feldman 2016). This nonverbal coordinated exchange expands across development into a complex, verbal, and symbolic dialogue that retains the rhythms, turn-taking, and reciprocity of the original attachment. The emergence of resilience, therefore, is intertwined with the evolution of social behavior across species and in the lives of humans.

In this review, I describe social behavior as a window into the conceptualization, assessment, and treatment of risk and resilience. I begin by charting a conceptual model of resilience within the context of an emerging scientific field, affiliative neuroscience, and highlight its ethological and philosophical foundations. The model builds on the neurobiological foundations of affiliative neuroscience to describe three tenets of resilience that give the construct a positive definition (i.e., not built on negation): plasticity, sociality, and meaning. The plasticity component applies to all living matter, from bacteria to humans, and taps the ability to flexibly adapt to changing environmental conditions, which Darwin (1859) considered key to species survival and thriving. The sociality aspect addresses bonding-based social group living, a core feature of adaptation in mammals that mature in the context of the mother–infant bond from which they develop the neurobiological substrates of sociality (Rosenblatt 2003). The layer of meaning marks a human-specific aspect of resilience that enables people to endure, even thrive, in the face of trauma through cultural meaning systems, acts of kindness, and collective narratives that transcend the lives of individuals and give meaning to trauma by connecting the distant past and the projected future (Feldman 2020). I contend that coordinated social behavior stands at the core integrating all three tenets while providing context for the daily practice of plasticity, sociality, and meaning during one-on-one, family, or group interactions within multilayered attachments with kin, friends, and community members to enhance resilience (**Figure 1**).

To describe the critical role of social behavior in resilience, I chart two lines in the development of coordinated action leading to mature human reciprocity, which is marked by intimacy, perspective-taking, empathy, mentalization, and an overall give-and-receive approach to social life. Such mature reciprocity is built on the synchrony of nonverbal social cues learned in infancy and incorporates, like expanding ripples, the child's emerging cognitive, emotional, self-regulatory, and symbolic abilities into the dialogue. The first line charts the origins of coordinated social behavior across animal evolution, from ants to humans, and the development of flexibility, complexity, and plasticity within social groups and affiliative bonds (**Figure 2**). The second line describes the maturation of humans' biobehavioral synchrony, from birth to adulthood, culminating in adult–adult reciprocity (**Figure 3**). Finally, I describe a scientific system for in-depth assessment of social behavior, the Coding Interactive Behavior (CIB) (Feldman 1998), which has been used across development from newborns to adults among many cultures and multiple high-risk conditions. The CIB provides coordinates for the assessment of social interaction among any two humans; since the system includes multiple scales tapping parent, child, and dyadic behaviors, it can pinpoint the behavioral signature of various risks and define age-specific and condition-specific features of resilience. The overall model is shown in **Figure 1**.

AFFILIATIVE NEUROSCIENCE PERSPECTIVE ON RESILIENCE

Neurobiological Substrates of Affiliation

The neurobiology of affiliation is an emerging scientific field targeting the neurobiological systems and behavioral processes that sustain human social affiliations. The model described in this review draws on the initial condition of mammals; a mammal's brain is immature at birth and requires proximity to the mother's body and well-adapted caregiving to tune the environment-dependent neurobiological systems to the specific ecology and its hardships. Early parental

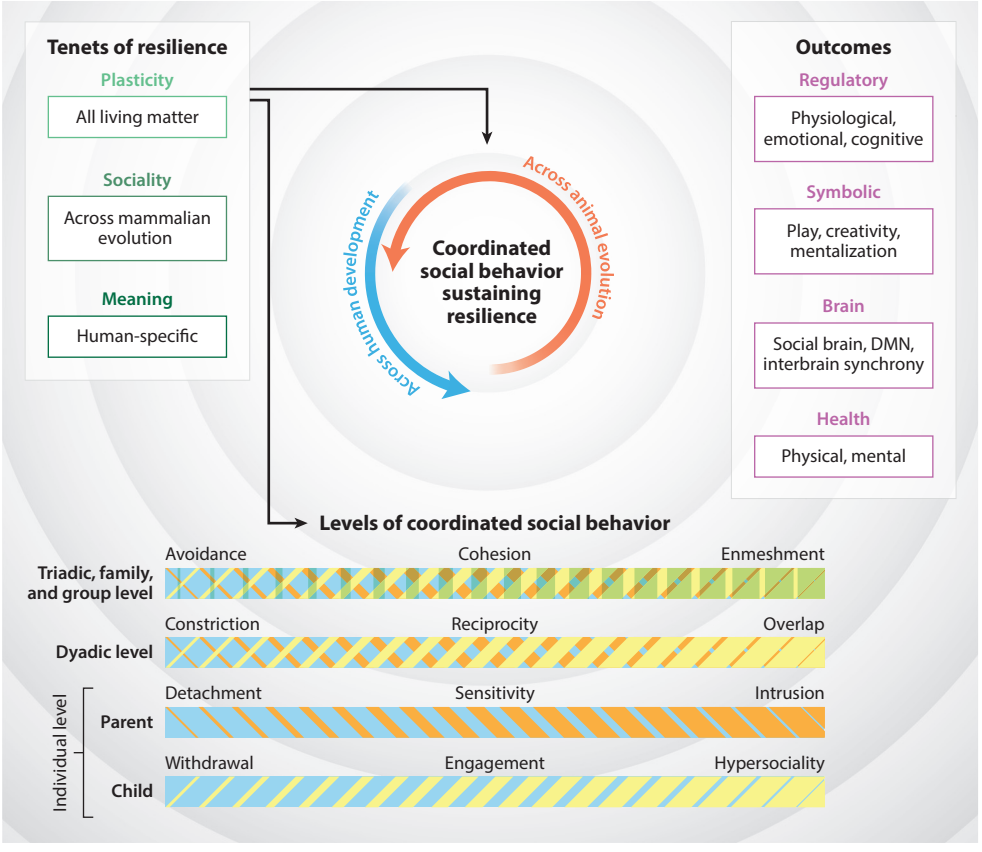

Figure 1

Conceptual model: coordinated social behavior as the foundation of resilience. The model proposes that coordinated social behavior stands at the core that sustains resilience by integrating the three tenets of resilience—plasticity, sociality, and meaning—into a living human social dialogue and by facilitating the maturation of developmental outcomes in the regulatory, symbolic, brain, and health domains. Social behavior is described at three levels: individual, dyadic, and group. At each level, the resilience-promoting social behavior is defined by plasticity (sensitivity, engagement, reciprocity, cohesion) and stands at a flexible midpoint between the end of withdrawal (detachment, constriction, avoidance) and the end of intrusion (hypersociality, overlap, enmeshment). Abbreviation: DMN, default mode network.

provisions not only translate to other affiliative bonds throughout life but also underpin the skills required to navigate the social world; hence, the systems that support mammalian bonding are also those that underpin group living (Feldman 2017). Three foundations of the neurobiology of affiliation are highlighted here: the oxytocin system, the "affiliative brain" (the interconnected neural networks that sustain human attachments), and biobehavioral synchrony (the process by which the parent's mature brain externally regulates the infant's immature brain and tunes it to social life).

The oxytocin system is implicated in plasticity at the cellular, molecular, neuronal population, and network assembly levels; it affords an integrative interface through cross talk with the stress, reward, and immune systems and provides the neurobiological substrate for parental care, pair bonding, and consolidation of organisms into social groups (Anacker & Beery 2013, Feldman 2012a, Gimpl & Fahrenholz 2001, Grinevich & Neumann 2020). The affiliative brain

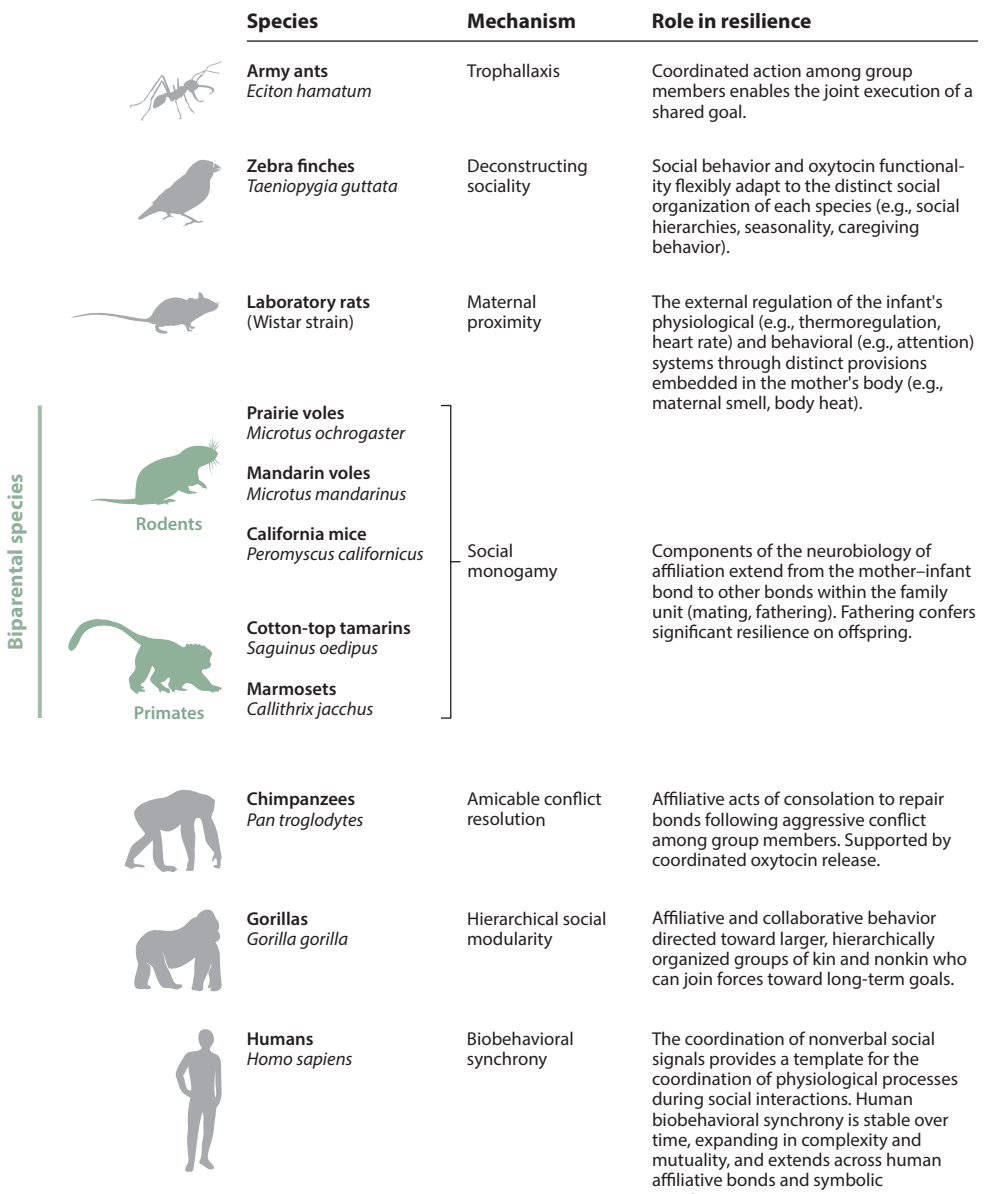

Figure 2

Mechanisms by which coordinated social behaviors sustain resilience across animal evolution, leading to humans' biobehavioral synchrony. These mechanisms were selected with a focus on behavior: social behavior in groups in nonmammalian species and within social bonds in mammals, including rodents, nonhuman primates, and humans. Mechanisms of coordinated action in mammals expands from the mother–infant bond to other affiliative bonds within the family unit (social monogamy in selected rodent and primate species), social bonds with larger groups of nonkin (social modularity in primates), and multidimensional attachments to kin, nonkin, social groups, and abstract ideas (humans).

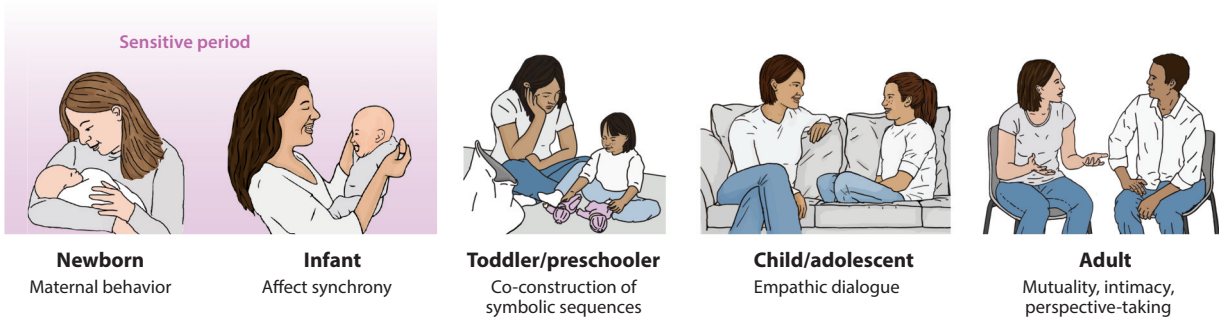

Figure 3

Mother–child reciprocity, which is individually stable from the newborn to adult stages, entails a mechanism by which the dyadic relationship incorporates the child's expanding social, cognitive, and symbolic abilities across development into its stable rhythms and flow. Mother–child reciprocity expands to the child's later attachments with close friends, romantic partners, abstract commitments, and, eventually, his/her own children.

defines the neural network that underpins human attachments, including parental, pair, and filial attachments, and integrates the subcortical mammalian-general structures sustaining maternal care with higher-order cortical systems implicated in embodiment, mentalization, and emotion regulation (Feldman 2015a, Kim et al. 2016, Numan 2020, Walum & Young 2018). Biobehavioral synchrony, an ancient mechanism that enables small creatures to survive harsh conditions through coordinated action, evolved into humans' coordination of physiology and behavior during social contact (Feldman 2016, 2017). These components shape the environment-dependent envelope that charts the line from the intimacy of the mother–infant bond to life within social groups that require complex social skills. The protracted maturity of the human brain, spanning nearly three decades (Sowell et al. 2003), marks the systems that participate in tuning the brain to the social world and managing its hardships. These are the very systems that support adaptation, endurance, and plasticity, and therefore the parent–infant interface is the foundation of resilience.

The initial dependence of mammalian young on their caregivers also makes affiliative bonds the arena for acquiring broader social skills required for navigating the social hierarchy of their species, as seen in both gregarious and solitary, uniparental or biparental species (Feldman et al. 2019, Lukas & Clutton-Brock 2013). Because mammals learned to manage hardships through relationships, bonding-related systems evolved to support stress management, relief, and reparation following trauma (Hostinar et al. 2014). Processes of viviparity necessitate immense plasticity, and the period surrounding childbirth exhibits the greatest plasticity in the adult brain (Froemke & Carcea 2017, Leuner et al. 2010). The evolution of mammals repurposed ancient neurobiological systems implicated in life-sustaining functions, such as the oxytocin molecule, in the service of reproduction (Feldman et al. 2016), generating heightened plasticity in affiliative contexts. Plasticity, the first tenet of resilience in the model described here, implies the capacity to consider multitude, perceive shades of gray, search for novel solutions, and bounce back from trauma—in short, the ability to persist tempered by the capacity to recalibrate. In the search for social behaviors that index resilience, the degree of plasticity in partners' adaptations to each other is therefore a key behavioral marker. As seen across the three levels of behavior—individual, dyadic, and family/group—various manifestations of inflexibility, whether over- or underfitted to partner and social context, index distinct developmental and clinical risk and are differentially expressed at various developmental stages.

Conceptual Foundations of Affiliative Neuroscience

Affiliative neuroscience draws on two lines of twentieth-century thought, both of which are essential for a social-behavioral, bottom-up perspective on resilience.

Ethology. The first foundation considers Konrad Lorenz's (1935) discovery of social bonding, which triggered extant research in animal ethology (Tinbergen 1963) and human attachment (Bowlby 1969). These studies not only placed mother–infant bonding at the cornerstone of adaptive social life but also advocated a bottom-up, behavior-based approach to mammalian sociality; the authors argued that to understand bonding, one must go into the natural habitat and quantify behaviors that emerge or intensify during bond formation. Such behavior-based approaches are critical for affiliative neuroscience and, consistent with models such as "two-person neuroscience" (Schilbach et al. 2013) and the brain's "we mode" (Kilner et al. 2007), maintain that the social brain should be studied within the natural ecology during real-life social moments (Hari et al. 2015, Levy et al. 2020, Sonkusare et al. 2019). Notably, Bowlby's use of ethology as a distinct lens into human nature deviated from the two main approaches of his time, psychoanalysis and behaviorism, both of which took the solipsistic view that humans are compelled by drives or molded by behavior.

Phenomenology. The second foundation relates to philosophical perspectives formulated during the same period as ethology, which revolutionized understanding of the mind; shifted the focus from the abstract to the concrete, bodily, and behavioral; grounded the self in day-by-day living; and de-emphasized the mind–body dichotomy. Affiliative neuroscience is informed by Husserl's [1977 (1925)] phenomenology, which argues for the "aboutness" of knowledge, Merleau-Ponty's (1945) emphasis on lived experiences, and Santayana's (1904) writing on perceptual "essences" as the foundations for mental life. Also relevant are neurocognitive models: Edelman (2004) on the brain's "value systems," the person-specific reward networks formed by early experiences; Damasio (1999) on the self as grounded in the body [echoing Freud's "The Ego and the Id"; Freud 1961 (1923)], and Varela et al. (2016) on cognition as geared to resolve daily problems. These authors grounded mental life in the contextual and local, refuted models that emphasize abstract or metaphysical ideas (Plato, Descartes), and argued that human knowledge is eclipsed by the human body and its affordances and limitations. Such work triggered current models on interoception and its role in mental health.

Yet, while affiliative neuroscience adopts these embedded elements, there are also fundamental differences. Whereas these models are solipsistic and describe the single brain (or mind) vis-à-vis its environment, affiliative neuroscience taps the neurobiological processes that bind two brains into an interconnected entity. It focuses on the brain's situatedness with respect to other brains as opposed to its situatedness within the world (the focus of phenomenology), its potential for maturation only in the context of other brains, and the role of real-life social experiences in binding two humans into a coupled entity.

The inherently dyadic nature of affiliative neuroscience may enable one solution for the core dilemma of neuroscience, which has been called the "hard problem" (Chalmers 1996): the schism between mind and brain—between objective measurements of the brain's machinery and subjective experiences of the living, feeling human. I have previously suggested that by focusing on interbrain connectedness and behavioral synchrony, which are subjectively felt yet open to objective scrutiny, affiliative neuroscience can define a unique context for the integration of brain and mind (Feldman 2012a, 2015b, 2016). While philosophers and scientists have questioned the validity of our perception of reality, the mind's connectedness with other minds cannot be refuted,

and this fact can give an anchor point to our perception of the world. Using coordinated social behavior as a marker of resilience draws on its unique lens into the integration of brain and mind.

COORDINATED SOCIAL BEHAVIOR ACROSS ANIMAL EVOLUTION AS A MARKER OF RESILIENCE

To support the key proposition of the model discussed in this review—that resilience is social—I begin by observing the role of coordinated social behavior across animal evolution. Primitive mechanisms of behavioral synchrony are found in ants, fish, and birds, underpinned by the coordination of biology and behavior and variations in the vasotocin molecule. Seven mechanisms of resilience-sustaining sociality are described in species that range from ants to humans (**Figure 2**).

Trophallaxis and Social Insects

The famous entomologist William Morton Wheeler (1928), investigating how social insects maintain complex social organizations and accomplish collaborative goals, coined the term trophallaxis to denote the exchange of sensory signals among group members. Theodore Christian Schneirla, studying army ants, extended the term to include social stimuli—reciprocal, low-intensity, multisensory stimulation that elicits approach behavior—and suggested that parenting marks a form of trophallaxis (Schneirla & Rosenblatt 1961). Three resilience-promoting components are integrated from ants to humans: Positive social behavior must be of low intensity to enable approach; it must involve social reciprocity among the partners' sensory signals; and reciprocal behavior provides the basis for social organizations.

Deconstructing Sociality and Birds

On the basis of research in zebra finches (*Taeniopygia guttata*), Goodson (2013) suggested that what we call sociality evolved from loosely coupled "modules" that characterize social life within each species, such as flocking, monogamy, social hierarchies, seasonality, and single versus biparental rearing. Social behavior, including its peptidergic underpinnings, can therefore be understood only in relation to group norms and cultural organizations. Avian species mark the beginning of parenting behavior; only in mammals and some birds is parenting expressed via concrete caregiving behavior that carries fitness benefits. Hence, resilience must consider cultural meaning systems and their perceptions of what it means to be resilient (e.g., creative, respectful).

Hidden Regulators and Rodents

Hofer's (1995) program in rodent mothers systematically tested the regulatory functions embedded in the mother's body and demonstrated how elements of the maternal presence, such as body heat, odor, lactation, movements, and touch, foster maturation of distinct life-sustaining systems. This research showed that the mother's body contains a set of resilience-promoting factors, termed hidden regulators, and inspired much further study regarding the effects of brief and extended maternal separation on stress management throughout life.

Social Monogamy: Biparental Rodents and Primate Species

Social monogamy defines the first extension of the mother–infant bond to mating and fathering, which marks the origin of family units given that direct paternal care is found mainly in socially

monogamous species (Kleiman 1977, Lukas & Clutton-Brock 2013). Fathering confers substantial resilience on mammalian young, and as paternal caregiving stabilized monogamous mating systems, it fostered the emergence of complex social behaviors (Opie et al. 2013). Mating and fathering repurposed the same neural networks and hormonal systems of maternal care, providing both consistency and diversity in the neurobiology of affiliation and ushering in the development of the human family (Feldman et al. 2019, Walum & Young 2018).

Complex Social Organizations and Conflict Resolution in Primates

Evidence in Western gorillas (*Gorilla gorilla*) demonstrates hierarchical social modularity, which is marked by complex reciprocity not only within extended groups of kin but also among nonkin groups that form seasonal coalitions in ways that mirror the social structure of small human villages (Morrison et al. 2019). Such behavior-based social organizations enable joint gathering of widely dispersed foods and protection from predators, enhancing resilience through nonkin reciprocity. Among group-living primates, such as chimpanzees (*Pan troglodytes verus*), postconflict reconciliation behaviors enable amicable resolution of conflict and increase urinary oxytocin (Preis et al. 2018). In marmosets (*Callithrix*), the greater the bonding among kin or nonkin social partners, the greater the synchrony of urinary oxytocin fluctuation (Finkenwirth & Burkart 2017)—a pattern that is reflected in humans' biobehavioral synchrony.

Biobehavioral Synchrony: Human-Specific Mechanism

Humans can influence each other's physiology through the reciprocal coordination of social behavior without physical touch—an ability not found in other mammals (Feldman 2016, 2017). Reciprocal behavior develops from birth to adulthood into increasingly complex human exchange that integrates the capacity to assume multiple perspectives and empathize with others' pain, emotions, and mental states.

MATURATION OF HUMANS' COORDINATED BEHAVIOR FROM BIRTH TO ADULTHOOD

Humans' coordinated behavior begins in utero with the mother's recognition of infant biological rhythms and culminates in mature adult–adult reciprocity (**Figure 3**). From the mother–child bond, reciprocity expands to relationships within families and communities and transcends to one's connection with nature, art, and sacred experiences, as described by Winnicott (1971) in *Playing and Reality*. Across development, reciprocal interactions increase in complexity, diversity, symbolization, and mutuality.

Continuity in Reciprocity Across Development

Studies using the CIB describe distinct stages in the maturation of reciprocity from birth to adulthood. Longitudinal follow-ups indicate that parent–infant reciprocity shapes reciprocity across childhood and up until young adulthood in mother–child and father–child interactions (Feldman 2010, Feldman et al. 2013a, Ulmer-Yaniv et al. 2020). Such continuity is among the key factors underpinning the long-term effects of maladaptive parenting and the transmission of trauma across generations.

Parent–infant reciprocity supports the development of multiple physiological, social-emotional, regulatory, and cognitive-symbolic outcomes and shapes maturation of the social brain.

Three pathways are proposed as mechanisms underlying continuity (Feldman 2007b, 2015c). First, since reciprocity is individually stable, its early expression sets the stage for more complex reciprocal relationships and the transfer of reciprocal behavior to other social bonds throughout life. Second, parent–child reciprocity from birth and across childhood shapes the child's emotion regulation at the next stage and vice versa, reflecting dynamic mutual influences between coregulation and self-regulation (Feldman 2015c). Finally, consistent with the "sensitive period" frame (Feldman 2015b), coordinated interactions are considered critical environmental inputs for the maturation of neurobiological systems that underpin sociality, without which brain development is impaired or significantly altered.

Neonatal Period: Well-Matched Parenting Behavior

Human mothers, like other mammalian mothers, express the species-specific repertoire immediately after birth; it is triggered by an oxytocin rush during labor. The human postpartum repertoire includes gazing at the infant's face and body, expression of positive affect, "motherese" high-pitched vocalizations, and affectionate touch. The special feature of human parenting is reciprocity; mothers adapt their behavioral intensity to the neonate's scant moments of alertness (Feldman & Eidelman 2003, 2007). Maternal postpartum behavior shapes children's symbolic competence, cognitive skills, and reduced externalizing and internalizing symptoms across childhood (Feldman & Eidelman 2009a, Feldman et al. 2004a). Maternal and paternal postpartum behavior links with parents' plasma oxytocin in parent-specific ways (Gordon et al. 2010) and affects children's social reciprocity with best friends in preschool (Feldman et al. 2013b), reflecting the continuity from parental to filial attachment.

Infancy: Nonverbal Reciprocity

The sensitive period for social coordination is between 3 and 9 months, from the time infants begin to take active part in social interactions. Parents and infants engage in interactive "dance," coordinating gaze, affect, covocalizations, and touch into dyad-specific patterns, which shapes the child's social, emotional, cognitive, and brain development (Feldman 2007c, 2012a). Mothers and fathers engage in parent-specific forms of synchrony—more rhythmic with mothers and environment-focused with fathers (Feldman 2003)—and reciprocity links with multiple parental hormones (Feldman 2019) and activation of the parental brain (Abraham et al. 2014). Patterns of reciprocity are culture-specific (Bornstein & Cote 2001, Feldman et al. 2001) and predict social competencies and reduced aggression in the peer group in culturally specific ways (Feldman & Masalha 2010, Feldman et al. 2010).

Toddler/Preschool: Symbolic Play and Imaginary Narratives

During the second and third years, children begin to engage in symbolic play and generate storylike sequences. The complexity of symbolic play is predicted by the degree of reciprocity experienced in infancy (Feldman 2007a, Feldman & Greenbaum 1997). As children move into the preschool years, play becomes the context for imaginary scenarios that envision alternative reality, fostering creativity and symbolic reciprocity. Reciprocal interactions in infancy support preschoolers' creative play (Feldman & Eidelman 2009a) and predict theory-of-mind and morality up until adolescence (Feldman 2007b).

Upon school entry, children show reciprocity similar to that of preschoolers when playing make-believe games with toys, but play sessions are longer and afford more complex shared

imaginary scenarios, particularly among girls. In comparison, boys begin to engage in reciprocal motor games and conventional sports. As children move toward later childhood, they gradually leave make-believe games for dialogue-based reciprocity, which characterizes the next stages.

Later Childhood/Adolescence: Empathic Dialogue

Beginning at around 9–10 years, children leave playing with their parents for engagement in verbal dialogue. Reciprocal dialogue is critical for practicing complex social skills: resolution of conflicts; exchange of information; and discussion of ideas, feelings, opinions, and future plans. The coordinated dialogue incorporates children's emerging capacities for behavioral, emotional, and cognitive empathy and the ability to plan ahead, elaborate, cooperate, show motivation, and see other points of view. Such social skills, particularly at this stage when attachment focus shifts from parents to friends, are crucial for well-being and link with resilience in the face of adversity and maturation of the social brain.

Adulthood: Mutuality, Intimacy, and Transcendence

If the parent–child reciprocity was "good enough" and followed its developmental course, the parent and adult child can face each other as two mature social partners who still maintain their roles of parent and child. While the mature dialogue retains echoes of their entire history, it establishes reciprocity that respects boundaries and grants autonomy. Such dependable dialogue allows individuals to enter other relationships with trust and builds a bridge to the next generation that transcends the parent's life through invoking the early reciprocity with the child's own children, creating meaning for parent and child.

Overall, reciprocal interactions gradually unfold and incorporate emerging social skills, mental abilities, perspective-taking, and empathy as children grow. Children learn to engage in reciprocal long-lasting friendships, have romantic attachments, and, eventually, parent their own children, charting the cross-generational transmission of human sociality. By defining notions of respect, self-restraint, and trust toward community members, parent–child reciprocity also influences how children engage in the wider social world of coworkers, neighbors, and strangers. Reciprocity integrates variability with order, diversity with familiarity, and creativity with stability, combining the biological substrates of sociality with individuality and personal meaning to enhance plasticity within individuals, families, and social groups.

SOCIAL BEHAVIOR AS A MARKER OF RISK AND RESILIENCE

The CIB system builds on the assumption that every social behavior among two humans can be quantified along the same coordinates and that each segment of behavior carries the partners' habitual mode of interaction, similar to how every cell in our body carries the entire DNA. The following sections describe the conceptual foundations, empirical findings, and unique signature of specific risk conditions. A full list of CIB publications appears in **Supplemental Table 1**.

Supplemental Material >

Social Behavior in Healthy Development

The CIB framework (Feldman 2012b) proposes that social behavior among two humans can be viewed from the perspective of each individual (e.g., maternal behavior and child behavior as separate contributors to the exchange) as well as from the perspective of the dyad as a whole; the latter entails a dynamic systems perspective (Fogel 1993, Thelen & Smith 1994), which views systems

as single functional units that dynamically organize from their discrete components into entities not reducible to their discrete constituents. The coding scheme, therefore, includes codes tapping parent behavior and child behavior as two individuals, but also codes that zoom out toward the dyadic level. The CIB also has separate codes for the tertiary level: interactions among triads, families, or groups that include only systemic codes.

The conceptualization of social behavior from a systemic perspective reflects the view that social systems comprise multiple levels of relationships that maintain interdependence among them. While families can be described from a whole-family perspective, the social behaviors of each individual and each dyad affect and are affected in turn by individual-to-individual, individual-to-dyadic, dyadic-to-dyadic, and dyadic-to-triadic influences (Cowan & Cowan 1992). Building resilience, therefore, may have various "ports of entry" (Stem 1995); interventions can target individuals, dyads, or the entire system, and the effects may reverberate in the other subsystems, gradually enhancing flexibility and resilience in the entire system.

The individual level: sensitivity and engagement. In the first three stages of reciprocity, when a parent serves as an external regulator and assumes greater responsibility for the interaction, parent behavior is characterized primarily along the dimension of sensitivity. Sensitivity according to the CIB is a multidimensional construct tapping the degree to which the parent adapts to the child's arousal dynamics and communicative signals, facilitates social competence and creativity, resourcefully uses opportunities for expansion, and creates a supportive presence for safety and growth. In countless studies and meta-analyses (De Wolff & van Ijzendoorn 1997), parent sensitivity has been shown to influence child outcomes, including secure attachment, social skills, emotion regulation, empathy, better physiological stress response, maturation of the oxytocin and immune systems, physical and mental health, and brain development (Levy et al. 2019a; Pratt et al. 2015, 2018, 2019; Ulmer-Yaniv et al. 2018a,b).

As to child behavior, the dimension of engagement is conceptualized as a central contributor to resilience. The focus is on the degree to which the child is involved, shows initiative, persists, maintains positive affect, exhibits emotion regulation, and, beginning in the toddler stage, uses play for creativity, competent use of objects, and symbolic play. The fact that child social engagement is individually stable from infancy to adolescence (Feldman 2010; Feldman & Eidelman 1998, 2009a; Feldman et al. 1997; Halevi et al. 2017) indicates that sociality gradually builds across childhood into a traitlike dimension of the individual.

However, beginning in late childhood, interactions between parents and children are based on conversations, not play, and from this stage onward the parent's and child's behaviors are assessed along the same dimensions because both are responsible for being sensitive and engaged. At the conversational stage, social coordination includes not only codes that tap plasticity (e.g., resourcefulness) and sociality (e.g., gaze to partner) but also those related to meaning along the maturation of children's perspective-taking abilities. The meaning aspect considers empathy, motivation, assertiveness in presenting one's personal and political opinions, and broadening of one's own and one's partner's ideas and feelings.

In considering sensitivity and engagement as key social behaviors at the individual level, two points are emphasized. First, resilience-promoting sensitivity and engagement stand at a flexible midpoint between the end of detachment/withdrawal and the end of intrusion/hypersociality. Below, I consider maternal withdrawal as a marker of depression and maternal intrusion as a marker of anxiety and stress-related conditions. From the child's perspective, the withdrawal end may represent a response to maternal intrusion or a sign of neurodevelopmental disorders (e.g., autism spectrum disorder, velocardiofacial syndrome; see Hirschler-Guttenberg et al. 2015, Weisman et al. 2015), whereas the hypersociality end represents insecurity in the attachment relationship

and the mother's inability to provide a supportive presence that facilitates what Winnicott (1958) described as the capacity to be alone in the presence of someone. Such hypersociality does not enable flexible shifts between moments of match and episodes of mismatch and reparation inherent in any interaction. Individual social behavior indexing resilience is always flexible, is open to oscillations between states, is not extreme or rigid, enables dynamic responsivity to the partner, and is not driven by the need to keep one's tight defenses or to fully merge with the partner.

Second, a developmentally sensitive approach is required to describe changes in the expression of sensitivity and engagement over time and their salience for adaptive functioning. Sensitivity comprises somewhat different components at different ages, and mothers may have greater ease or difficulty expressing sensitivity at various stages. Whereas some mothers can engage sensitively with infants who are fully dependent, others may find such dependence overwhelming and be better at sensitively granting autonomy to teenagers. Although the optimally sensitive mother can adapt to growing social and cognitive needs, few studies have systematically tested outcomes of sensitivity experienced at some stages but not at others, and there are clinical descriptions of children who experienced sensitive mothering in infancy but little adaptation to separation needs as they developed.

Age-dependent effects are also noted in engagement. Social engagement builds on temperamental dispositions—in particular, negative and positive emotionality, sociality, emotion regulation, and a tendency toward anxiety in social contexts. These may expand or limit the child's joy and competence during social interactions or lead to a withdrawn or disruptive style. In early childhood, social engagement reflects these temperamental dispositions to a greater extent as well as the mother's sensitivity in handling them. As children grow, engagement, while still reflecting inborn dispositions, also draws on learned social skills and the opportunities they have had to engage in wider social circles of family, friends, and mentors. At this stage, social disparity and socioeconomic status (SES) begin to exert significant effects on social competencies, expanding or limiting children's future options. From late childhood, engagement is a distinct marker of resilience and carries its unique effects on well-being, charting a unique path independent of the maternal effects (Halevi et al. 2017, Ulmer-Yaniv et al. 2018b).

The dyadic level: reciprocity. Assessment at the dyadic level follows assessment at the individual level; a dyadic lens addresses the degree of concordance, mutual adaptation, and fluency in the interaction. The dyadic component is the most individually stable from infancy to adulthood (Ulmer-Yaniv et al. 2020), preserving the dyadic rhythms and giving each attachment a unique signature. An infant who experiences greater reciprocity with his/her parents can create reciprocal interactions with friends in preschool (Feldman et al. 2013b) and adolescence (Feldman et al. 2013a); hence, this dyadic component enables children to form new attachments that echo the infancy patterns.

Similar to the individual level, the resilience-promoting social patterns at the dyadic level stand at a flexible midpoint that combines autonomy with coordination and expansion of dyadic patterns from the contribution of both partners. The two inflexible ends reflect, on the one hand, constriction of dyadic richness, minimal connection, and an inability to form meaningful dialogue and, on the other hand, tense overlap driven by fear of separation.

The triadic, family, and group level: cohesion. System-level social mechanisms are found not only in dyadic but also in triadic, whole-family, and group interactions. The CIB employs special codes to assess triadic and group-level interactions through the use of system-level constructs, such as autonomy, cohesion, enmeshment, and disengagement, consistent with Minuchin's (1974) formulations on growth-promoting family systems. As with the individual and dyadic levels, the

flexible midpoint that denotes optimal functioning marks systems that are cohesive, autonomous, and positive without being rigid and enmeshed on the one hand or detached and avoidant on the other. Such a cohesive family process predicts children's well-being and development. Furthermore, the three levels of reciprocity are built upon each other, and greater sensitivity at the individual level is linked to greater reciprocity at the dyadic level and cohesion at the triadic level; thus, the flexible style cuts across levels (Feldman 2007a). Children growing up with sensitive parents who construct reciprocal interactions and create a cohesive and harmonious family atmosphere are more resilient and can face life's hardships with greater flexibility and endurance. Such findings apply across cultures including societies that adhere to individualistic worldviews as well as those with more collectivistic, extended-family settings (Feldman 2007a, Feldman & Masalha 2010, Vakrat et al. 2018a).

Cohesion is the key construct marking flexibility in larger systems that comprise multiple subsystems. It reflects the notion that resilience in larger social systems, from families to communities to nations, depends on some unity shared by all members, without which the system is meaningless and does not afford a sense of belonging or security in the face of threats. Still, to foster resilience, social unity must be loose (not rigid), enable freedom to individuals and subsystems, afford a multitude of expression and behavior, and foster a sense of shared goals without a tight regime of duties, commands, and obligatory social codes. The "enmeshed" end, a term borrowed from family therapy, reflects rigidity, intrusion, authoritarianism, and surveillance and is often accompanied by fear and anxiety; the "avoidant" end implies no collective belonging, carelessness about other group members, and inability to find meaning through actions that benefit the group. Such conceptualization of social systems and their behavioral underpinnings may assist in identifying healthy versus toxic families, schools, work environments, and groups regardless of the systems' expressed goals.

Social Behavior in High-Risk Conditions

Social behavior in high-risk conditions falls under the two aforementioned typologies, underengagement and overengagement, with some risk conditions exhibiting a consistent pattern while others show a unique mixture of the two. The model described here follows Belsky's (1984) model of the determinants of parenting and differentiates risk conditions originating from the mother (e.g., maternal depression, anxiety, personality disorders), those originating in the child (e.g., prematurity, genetic or neurodevelopmental disorders), and those stemming from high-risk contexts (e.g., poverty, domestic violence, immigration, mass trauma). Each condition has a unique signature that allows one to describe specific risks while pinpointing markers of resilience by which some children fare better than others. While mother-driven and child-driven conditions tap different risks, they both impair at the dyadic level, thereby compromising a key resilience-promoting provision embedded in social interactions.

Mother-related risk conditions.

Maternal depression. The most prevalent mother-related condition is postpartum depression; it affects 15–18% of women in industrial societies and approximately 30% in the developing world (Kessler 2006). Depression is associated with the underinvolved, withdrawn, and detached end of the behavioral continuum. Depressed mothers provide a minimal amount of the species-typical repertoire of gaze, positive affect, and warm vocalizations and/or speech, and no affectionate touch (Feldman et al. 2009). Depression compromises the mother's ability to engage sensitively, adapt to the child's changing states, be resourceful in using social opportunities, regulate the child's negative

moods, and expand interactions. Infants of depressed mothers are less social, are more fearful, and have a difficult time regulating negative emotions and positive moments (Granat et al. 2017).

Beginning in the toddler/preschool years, the depressed mother's lack of joy and involvement often includes negativity, overt criticism, and, at times, open hostility, particularly when depression co-occurs with anxiety (Apter-Levi et al. 2016, Pratt et al. 2015). Such a maternal style often leads to child withdrawal, avoidance of the mother, negative mood, and emotional lability, in addition to minimal engagement, creativity, and symbolic play. The depressed mother's insensitive, detached, and negative style also leads to alterations in the child's endocrine support systems, including flat cortisol curves (Apter-Levi et al. 2016, Ulmer-Yaniv et al. 2018a), diminished oxytocin response (Apter-Levy et al. 2013, Pratt et al. 2015, Priel et al. 2019), and impairments in immune system functioning (Ulmer-Yaniv et al. 2018a), which mirror the mother's disruptions in these systems.

However, in our 15-year follow-up of postnatally depressed mothers and their children, my colleagues and I also detected markers of resilience (Apter-Levy et al. 2013, Pratt et al. 2015). Biomarkers for the oxytocin system, including urinary and salivary oxytocin and genetic variability on the oxytocin receptor (*OXTR*) gene, predicted resilience, and children with greater functionality of the oxytocinergic system showed better mental health and social competencies (Apter-Levy et al. 2013, Pratt et al. 2015, Priel et al. 2019). Similarly, although depressed mothers exhibited significantly less reciprocity across the first decade, children who received some reciprocity showed better regulatory outcomes at 10 years including better executive functions and emotion understanding (Priel et al. 2020). Having a sensitive relationship with the father increased children's social engagement and family-level cohesion (Vakrat et al. 2018a), and sensitive fathering increased resilience; while exposure to chronic maternal depression markedly increased rates of child psychiatric disorders, sensitive fathering reduced these rates by half (Vakrat et al. 2018b).

Benevolent, nondepressed adults in the child's environment are critical in the context of maternal depression. Following Israeli and Palestinian dual-earner middle-class families across the first years of parenting, we found that maternal depression had a greater impact on children's social competencies and mental health in the Israeli families, who live in nuclear-family settings, compared with Palestinian families, who live in extended-family settings where children are exposed to multiple adult relatives (Feldman & Masalha 2007).

Maternal depression affects maturation of the social brain in adolescence. Among children exposed to maternal depression throughout early childhood, the neural empathic response was aborted midway as measured by magnetoencephalography; however, when the mother was less intrusive, the child's neural development was more typical (Pratt et al. 2017). Similarly, in testing the brain basis of attachment in these adolescents, we found decreased neural activation to attachment stimuli and no differential response between own mother–child interaction and unfamiliar interaction, indicating no neural internalization of the attachment relationship. However, this aberrant response was found only in children who developed affective disorder themselves (Pratt et al. 2019).

Notably, cultures display wide variability in the amount of engagement that mothers present during naturalistic interactions. Whereas some cultures encourage open positive emotions and affectionate behaviors, others support more subdued parent–child relationships and place little emphasis on special moments of play. Yet, it is easy to differentiate cultural variability from the depressed mother's detached style; sensitive mothers across cultures are attuned to their children and provide a supportive presence for the children's security and growth.

Maternal anxiety. Anxiety represents the other end of the sensitivity continuum. Anxious mothers express high amounts of the maternal repertoire; they look intently at the infant, covocalize throughout play, display high positive arousal, and touch the infant frequently (Beebe et al. 2011,

Granat et al. 2017). However, these maternal behaviors bombard the child and do not respect signals for rest or boundaries. Anxious mothers are often intrusive and forceful, the interaction follows the parents' agenda, there is a sense of disquiet and overactivity, and such mothers provide little supportive presence for security and growth. Like sensitivity and engagement, the intrusive style is individually stable (Feldman 2010) and undermines the child's emotion regulation capacities (Granat et al. 2017). However, anxiety is a fluctuating condition, and when a mother's anxiety is reduced in the first months of parenting, the intrusive style decreases and the child's engagement increases in parallel (Feldman et al. 1997).

High maternal anxiety often co-occurs with other risk conditions. Maternal anxiety and depression show high comorbidity, anxiety often accompanies cases of personality disorders, and anxiety is associated with high contextual stress, such as poverty, single parenting, war exposure, and natural disasters (Meltzer-Brody et al. 2018). In such cases, features of the anxious, inconsistent, intrusive, negative, and dysregulating style are observed, either throughout the interaction or in unpredictable spurts that the child has no control over.

Maternal personality disorders. While our lab has not conducted studies of maternal personality disorders, studies of parents with severe personality problems using the CIB have been conducted in other centers (Fonagy et al. 2016, Strover & Coates 2016, Suchman et al. 2017). Mothers with borderline personality disorder tend to display a highly intrusive style combined with inconsistencies. Two features characterize the interaction of mothers with borderline personality disorder and their children. The first is frightening behavior, when a mother, seriously or jokingly, engages in dangerous or frightening behavior and the child shows clear signs of fear. This feature is diagnostic and does not appear in clinically depressed or clinically anxious mothers. The second feature is a stonelike facial expression that involves a total lack of responsivity and disengagement, which is harsher than that observed in postpartum depression and leads to heightened child distress.

Following substance-abusing mothers and their infants at 3 and 6 months (Mayes et al. 1997), we found a highly inconsistent style in which mothers switched between extreme withdrawal/flatness and forceful, overbearing behavior. This maternal style worsened with age, and maternal behavior has been observed to deteriorate in studies with drug-addicted and highly stressed mothers across the globe. It appears that when mothers with very limited resources must adapt to their children's growing social and cognitive needs, their behavior worsens and the children become more challenging. With age, such children often exhibit high defiance and conduct problems or inhibited and disengaged sociality, at times shifting between the two within a single session.

Finally, several studies used the CIB for mother-related physical health conditions, including mothers with cerebral palsy or movement restriction, deaf mothers, blind mothers, and physically ill mothers (D. Cohen et al., unpublished data). Looking at these tapes during the training seminar, it is amazing to see how, when parenting is not altered by mood disorders or contextual stress, mothers find multiple ways to compensate for their limitations and are able to create a reciprocal relationship with the infant even when they cannot see, hear, or move. We often see in such conditions that the child's level of engagement is comparable to that in healthy dyads and that the level of reciprocity is adequate. This finding, again, highlights the resilience embedded in coordinated interactions that can transcend the here-and-now and imbue life with meaning and purpose.

Interventions. Intervention studies using the CIB are currently being conducted across several sites, and cumulative evidence suggests that each method improves different features of the interaction at the individual or dyadic level. For instance, Dollberg et al. (2013) tested mothers before, after, and then at 1-year follow-up after mother–infant psychodynamic psychotherapy and

found that whereas maternal sensitivity increased following treatment, at the 1-year follow-up the improvement was curtailed. However, gains to child engagement showed a linear increase from pretreatment to posttreatment to 1-year follow-up, and this change led to stable increases in dyadic reciprocity. Steele et al. (2019) applied a group attachment-based intervention for high-risk low-SES mothers and showed that high levels of hostility and mothers' inability to provide a supportive presence were improved by the intervention. Much further research is needed to specify intervention effects across cultures, conditions, and treatments. As data are gathering, it appears that different factors are affected by different interventions, and this effect may reverberate in other dimensions of the relationship.

Child risk conditions. When a child is born prematurely, suffers a physical or neurodevelopmental disorder, or presents psychiatric symptoms, social interactions are more challenging to the parent and are often compromised. Specific child conditions exhibit distinct profiles, although the reciprocity component is typically disrupted.

Prematurity. Approximately 11% of infants are born prematurely, amounting to millions of premature babies each year, and medical advances have enabled the survival of increasingly smaller infants (Vogel et al. 2018). Numerous studies have described interactions between mothers and premature infants (for review, see Korja et al. 2012), and cohort studies have followed long-term outcomes of premature birth (van der Pal et al. 2020); however, very few studies have observed social interactions between parents and prematurely born children beyond infancy.

Two components influence the interactions between mothers and premature infants. Mothers are anxious after premature birth: The infant's situation is precarious, birth has often been traumatic, and the child's developmental course is unknown. Familiarity with the infant, which provides key inputs for reciprocity, is significantly impaired. The mother is separated from the child (sometimes for weeks or months), cannot engage in full bodily contact, and in many cases has missed the last trimester of pregnancy, during which she would have become familiar with the infant's rhythms and prepared for the maternal role (Spinelli et al. 2016). The anxiety and separation often lead to an intrusive maternal style, but one that is not accompanied by the hostility and inconsistency observed in postpartum depression or the frightening behavior observed in personality disorders when the attachment itself is a source of conflict. From the infant's end, prematurity is often linked with immature facial social signals, which can lead to difficulties interpreting the infant's needs and state (Yatziv et al. 2018), and brain immaturity can lead to inconsistent engagement. The combination of unfamiliarity, inconsistent child involvement, and heightened maternal anxiety leads to a style that is mother-led, didactic, anxious, and high-strung but also caring and consistently involved. This style remains suboptimal across the first years of life. However, there are individual variations related to risk and resilience that are specific to prematurity. Mother's style across the first years of parenting was found to be shaped by postnatal depressive symptoms and by the child's respiratory sinus arrhythmia (RSA), a biomarker of parasympathetic control (Feldman & Eidelman 2009a) that is suggested to be a component of resilience. Indeed, in multiple studies of infants, children, and adolescents, higher RSA has been associated with greater resilience and more optimal social behavior (Groh & Narayan 2019, Hamilton & Alloy 2016).

More than 20 years ago, my colleagues and I launched the Longitudinal Kangaroo Care Study (Feldman 2004). We randomly assigned mothers and neurologically intact premature infants to a Kangaroo Care (KC) group, which involved an hour of skin-to-skin contact daily for two consecutive weeks during the incubation period, or to a medically and demographically matched control group who received standard incubator care (SC). We followed mothers and children for two

decades and repeatedly observed social interactions as well as the children's cognitive, physiological, endocrine, and emotional factors. When the children reached young adulthood, they underwent functional magnetic resonance imaging scanning. Provision of mother–newborn contact during the critical postpartum period, when mammalian young require their mother's presence for growth and maturation, improved both mothers' moods and infant regulatory outcomes, including executive functions, stress reactivity, emotion regulation, RSA, focused attention, and frustration tolerance until age 10 years (Feldman & Eidelman 2003; Feldman et al. 2002a,b, 2014b). The enhanced reciprocity across seven time points from birth to 10 years functioned as a resilience component mediating the improved outcome.

When the child participants reached young adulthood, we conducted brain imaging and compared three groups: preterm infants who had received KC, preterm infants who had received standard care (SC), and a full-term cohort that also had been followed from birth to young adulthood (Ulmer-Yaniv et al. 2020). We tracked the development of mother–child reciprocity across development and found that whereas reciprocity increased for all children from infancy to adulthood, premature infants in the SC group and their mothers exhibited consistently lower levels of reciprocity across development and did not show catchup even by adulthood, lending support to the "sensitive period" perspective. In comparison, neonates who received KC showed higher reciprocity already in infancy, which was higher than that of the SC infants but lower than that of the full-term group. However, by the adolescent transition, the degree of reciprocity between KC children and their mothers, when interactions were becoming conversation-based and required empathy and perspective-taking, showed full catchup and was comparable to that of the full-term group. The degree of reciprocity across development shaped the brain's empathic response to distinct emotions in young adulthood, an effect that demonstrates how mother–infant contact during early separation altered the biological basis of sociality in human adults (Ulmer-Yaniv et al. 2020). These findings corroborate how reciprocity is sensitive to birth conditions and carries lasting effects on the adult brain.

Multiple birth. Another birth condition that can compromise parent–infant bonding is multiple birth, when parents need to bond simultaneously with more than one infant. We followed 23 sets of triplets, which were medically and demographically matched for comparison with 23 twin sets and 23 singletons from birth to 5 years (Feldman & Eidelman 2009b). Triplet birth creates a unique ecology in which the number of infants exceeds that of the adults, altering the needs-to-resources ratio; parenting stress is high in infancy and improves over time.

The interactive style of mothers and fathers with triplets exhibited a unique mix. Parents provided adequate amounts of the human parental repertoire; they looked, smiled, touched, and vocalized similarly to parents of singletons. However, a core feature of human bonding is exclusivity, and the special match between parents' and children's rhythms was reduced. This reduction in reciprocity slowed the children's symbolic development (Feldman et al. 2004a), impinged the formation of attachment security, and led to higher internalizing and externalizing (Feldman & Eidelman 2004) and slower cognitive development across the first 2 years (Feldman & Eidelman 2005). By 5 years, parents learned to synchronize with each child, and most children showed catchup of cognitive development, executive functions, and mental health indices by that time (Feldman & Eidelman 2009b).

Findings for triplets pinpointed markers of risk and resilience. Among 62% of the triplet sets, one infant was born with intrauterine growth retardation (IUGR). Premature infants who show IUGR are at double risk, and their mothers display even more anxious-intrusive behavior (Feldman & Eidelman 2006). Compared with their siblings, infants with IUGR were more dysregulated, displayed less reciprocity with their mother, and did not exhibit catchup in cognitive

or behavior adaptation by 5 years (Feldman & Eidelman 2009b). These findings underscore the critical role of reciprocity in child development, particularly for infants born at increased risk.

Autism spectrum disorders. We observed mothers and fathers and their 3- to 6-year-old children with autism spectrum disorders (ASD) in several interactive and emotion-regulatory contexts compared with typically developing children matched for mental age. The parents showed high levels of sensitivity, low intrusiveness, and no disengagement during interactions, and their style was comparable to that of parents of typically developing children. However, children with ASD displayed minimal engagement and high withdrawal, and, consequently, the dyadic reciprocity was compromised, with little fluency and greater constriction (Hirschler-Guttenberg et al. 2015). Interactions with both parents increased the children's deficient oxytocin production for the duration of the interaction, but levels returned to low baseline immediately after contact (Feldman et al. 2014a). Children with ASD were able to use their parents as external regulators to manage moments of heightened negative or positive arousal, but their strategies of regulating their emotions were immature (Ostfeld-Etzion et al. 2015). These results highlight a condition in which the child's disengagement, due to deficient neurobiological support systems, does not affect the parent's behavior, although the dyadic level is compromised. Such findings are important for parental training in cases of ASD and can help parents specify their role in helping their children achieve coordinated social behavior.

Infant psychiatric disorders and feeding disorders. In several studies, we assessed interactions between mothers and infants who had been referred to an infant mental health clinic for problems with sleep, feeding, dysregulated behavior, disrupted mood, or relationship difficulties. We observed dyads in the home ecology in both play and feeding sessions to assess the provision of a basic life-sustaining function that increases maternal anxiety. Clinic-referred mothers displayed low sensitivity, and whether such insensitivity presented intrusive, inconsistent, or disengaged prototypes depended on maternal personality, history, and symptoms. Across infant psychiatric disorders and maternal psychopathologies, clinic-referred mothers exhibited worse parenting during the feeding interaction. This situation, which elicits tension in mothers, induced significantly more intrusive behavior across multiple codes, including physical forcing, overriding behavior, hostility, criticism, and disregard of the child's signals (Keren et al. 2001). Mothers' attachment narratives of their own parents were less coherent, and representations of the infant and maternal roles were less specific, lively, and multidimensional—attributes that correlated with lower sensitivity (Dollberg et al. 2010). Furthermore, while all infants tended to present withdrawn behavior, some with unpredictable shifts between fussiness and disengagement, a subgroup of infants presented extreme withdrawal, which is considered an early marker for depression, particularly in families with genetic susceptibility (Dollberg et al. 2006).

Mothers of young children with feeding disorders [nonorganic failure to thrive (NOFTT)] showed a unique feature related to physical proximity and touch (Feldman et al. 2004b). During free play, most mothers placed the child within arms' reach and touched him/her occasionally. Touch was more limited in the clinic-referred group in general, but mothers of children with NOFTT displayed no touch, whether affectionate, instrumental, or even accidental, and positioned the child outside of arms' reach. Young children with NOFTT (aged 9–36 months) mirrored the mothers' difficulties and showed no touch or proximity-seeking behaviors (Feldman et al. 2004b). Studies in animal models have shown that lack of maternal touch results in diminished infant body weight, and such a behavioral signature appears to function similarly in humans (Ardiel & Rankin 2010, Iwasaki et al. 2000).

Overall, child-related risks, for reasons of immaturity, neurodevelopmental disorders, or psychiatric disorders, limit the child's engagement component of the interaction, tilting it to the disengaged or inconsistent style and disrupting the development of age-related reciprocity. Because reciprocity is individually stable and influences emotional and physiological regulation, these early disruptions may have lifelong effects on resilience.

Context-related risk. High-risk contexts do not provide sufficient support for mothers to invest fully in infant care, and developmental risk stems from both direct exposure and its impact on maternal stress and inconsistent attention. Countless studies indicate that poverty, single parenting, dangerous neighborhoods, domestic violence, and war exposure can decrease the quality of parenting, particularly in terms of reciprocity, which requires maternal calm, effort, and attention. Studies in animal models show that inconsistent mothering exerts worse effects than consistently diminished caregiving, particularly on maturation of stress-management systems. The "variable foraging demands" paradigm in bonnet macaques induced unpredictable caregiving due to changes in food availability from an abundant food supply (low foraging demands) to minimal supply (high foraging demand) (Coplan et al. 1996). Compared with infants in high- and low-foraging settings, infants in a variable condition showed lower sociality and greater withdrawal as juveniles and alterations to stress physiology in adulthood, including low and flat cortisol reactivity and impaired glucose metabolism. Yuncai & Baram (2016) showed that fragmented caregiving can alter cellular, molecular, and neural processes in an infant's brain and thus lead to substantial cognitive and emotional impairments. Our human model for inconsistent caregiving involves families living in a small Israeli town near the Gaza border who were exposed to repeated, unpredictable attacks across the past two decades.

War-related trauma. For 18 years, we followed children exposed to war-related trauma, in which the situation is chronic and is exacerbated unpredictably every few months; yet, the source of trauma is outside the family and, unlike conditions such as domestic violence, the family faces the trauma together (Feldman & Vengrober 2011; Feldman et al. 2013c, 2014c; Halevi et al. 2016, 2017; Levy et al. 2019a,b; Yirmiya et al. 2018, 2020). We found that a mother's ability to cope with the external danger and provide reciprocal parenting is critical for her children's mental health, stress management, immune response, emotion regulation, executive functions, and brain maturation.

In early childhood, mother–child reciprocity was associated with less maternal anxiety and depression and fewer posttraumatic symptoms (Feldman & Vengrober 2011); reciprocity was also associated with children's ability to use their mothers' proximity to manage moments of increased anxiety and with cortisol and salivary α-amylase flexibility (Feldman et al. 2013c). All of these findings point to the early role of reciprocity as a resilience marker. In middle childhood, reciprocity combined with a more functional oxytocin system, measured by cumulative risk on the *OXTR* gene in child, mother, and father, differentiated children with chronic posttraumatic stress disorder from those who remitted (Feldman et al. 2014c). Mother–child reciprocity was individually stable from early childhood to adolescence and affected maturation of child oxytocin and cortisol reactivity to social interactions and attachment reminders (Yirmiya et al. 2020).

During late childhood and early adolescence, children who had experienced more sensitive and reciprocal caregiving showed greater social engagement, which mediated the effects of trauma on maturation of the oxytocin, stress, and immune systems, rates of externalizing and internalizing symptoms, and anxiety disorders (Halevi et al. 2017, Ulmer-Yaniv et al. 2018b, Yirmiya et al. 2018). By middle childhood, social skills function as key resilience markers, which, although shaped by

mother–child reciprocity, chart a unique pathway to physical and mental health. Social skills should thus be highlighted as a focus for intervention at this age.

Early mother–child reciprocity carried long-term effects on resilience. It mediated the effects of war exposure on children's executive functions at the transition to adolescence (S. Motsan, K. Yirmiya & R. Feldman, unpublished manuscript) and buffered the effects of trauma on disruptions to default mode network connectivity in adolescence (Zeev-Wolf et al. 2019). Reciprocity experienced across childhood shaped maturation of the social brain, including the brain basis of empathy in children (Levy et al. 2019a) and mothers (Levy et al. 2019b) in response to others' physical pain and emotional distress and the degree of impairment to default mode network connectivity in mothers and children (Zeev-Wolf et al. 2019).

Overall, longitudinal and cross-sectional studies comprising thousands of parent–child interactions coded with the CIB and hundreds of adult–adult interactions of couples, friends, and strangers across cultures and high-risk conditions have accumulated into a unique library of evidence. Such evidence allows us to shift the focus from dichotomous diagnosis of psychiatric disorders to social behavior and its adaptiveness to partner, setting, environment, and culture as a transdiagnostic marker of adaptation. The CIB provides a clinically useful tool for observation of age-related risk and resilience and draws on extant evidence to suggest that the degree to which an individual can exercise plasticity, engagement, and coordination during interactions with other human(s) can index psychopathology and resilience. Such plasticity markers can be analyzed from 3-minute segments of behavior, provide a unique window into distinct mental health issues and personal difficulties, gauge age-related adaptive functioning, and provide a novel framework for intervention. This accumulating evidence also suggests that the time has come for a paradigm shift in our reliance on psychiatric categories as the sole basis for treatment.

Coda: resilience, meaning, and the "life worth living." Since the ancient Greeks, the search for well-being has been tied to guidelines for the "life worth living." Aristotle, writing on "eudaimonic happiness," asserted that happiness and thriving are built on harmony between abstract virtues and social action.

The core feature that differentiates science from other forms of knowledge is its openness to proof and falsifiability—its verifiability. As Gerald Edelman (1972) succinctly put it, "Science is imagination in the service of the verifiable truth." Verifiability, therefore, differentiates science from other forms of truth, such as heuristic truth, artistic truth, and religious truth. Verifiability originates from the Latin word *veritas* (evidence), which across the Middle Ages and Renaissance was defined as the marriage of truth and values. Notably, across cultures, "values" always refers to the moral code by which the individual organizes social conduct with others: within affiliative bonds, families of kin, or the broader social circle of neighbors, subordinates, and fellow citizens.

According to this view, the practice of science must involve the acquisition of knowledge that is relevant to one's social conduct and that aims to benefit society—the pursuit of knowledge that is relational, not solipsistic. To do science, to tie the horses of imagination in the service of verifiable truths, one must tie *veritas* to it. Verifiability, the origin of the human scientific project, is named after the Goddess Veritas, the daughter of Chronos and the mother of Virtus; while science originates in time, it breeds virtue. Only when science involves the "marriage of truth and values" and aims to create meaning through reciprocal, respectful, and mutual social action can it touch upon the knowledge that matters and the evidence that forms the foundation for resilience.

SUMMARY POINTS

1. Clinical theory and research should move from psychopathology to resilience and from diagnosis to adaptation as the basis of treatment. Toward this end, resilience must have a positive definition (i.e., not built on negation). The model described in this review defines three tenets of resilience: plasticity, sociality, and meaning.
2. The ability to coordinate social behavior within affiliative bonds and social groups is a key marker of resilience across evolution and in the lives of humans.
3. Resilience-promoting social behavior stands at a flexible midpoint between the end of detachment/withdrawal and the end of intrusion/enmeshment. It allows for order amid variability, repair following rupture, and multitude of expression within cultural meaning systems.
4. High-risk conditions have unique behavioral signatures. Various psychopathological conditions present unique forms of under- or overengagement or a distinct mixture of the two. A focus on social-behavioral impairments may chart avenues for treatment.
5. Resilience is expressed differently at various developmental nodes. Parents may have a harder time coordinating with children at different stages (e.g., infancy versus adolescence).
6. Interventions target distinct aspects of the individual's social repertoire. Because levels of social behavior are interrelated, this effect may reverberate in other levels of the interaction.

FUTURE ISSUES

1. Clinical diagnosis should include objective and scientific assessments of social behavior, the degree of its adaptation to partner and context, and the level of its sensitive engagement and social reciprocity. This approach requires a paradigm shift in clinical thought and much research to detail parallels between current psychiatric diagnoses and patterns of social behavior.
2. Longitudinal and cross-sectional studies are needed to detail, year by year, the development of social behavior in children, to pinpoint markers of sensitive engagement and social reciprocity, and to describe how these behaviors are uniquely expressed in a child's multiple affiliative bonds. We need to clearly detail social behavior in various psychopathologies to differentiate children on risk or resilient trajectories.
3. Cultural variability in concrete social behavior is understudied, particularly beyond infancy. As resilience can be understood only in relation to cultural norms, it is critical that we define social behavior across groups to differentiate cultural variability from indices of psychopathology.
4. The effect of various interventions on the individual's social behavior with attachment partners, peers, and coworkers is uncharted territory. The various schools of psychotherapy (psychodynamic, cognitive behavioral, humanistic) should formulate concrete gains to social behavior as an outcome of treatment.

DISCLOSURE STATEMENT

The author is not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

ACKNOWLEDGMENTS

Ruth Feldman is supported by a Chair from the Simms/Mann Family Foundation. She thanks Maayan Harel for the graphic art.

LITERATURE CITED

Abraham E, Hendler T, Shapira-Lichter I, Kanat-Maymon Y, Zagoory-Sharon O, Feldman R. 2014. Father's brain is sensitive to childcare experiences. *PNAS* 111(27):9792–97

Anacker AMJ, Beery AK. 2013. Life in groups: the roles of oxytocin in mammalian sociality. *Front. Behav. Neurosci.* 7:185

Apter-Levi Y, Pratt M, Vakart A, Feldman M, Zagoory-Sharon O, Feldman R. 2016. Maternal depression across the first years of life compromises child psychosocial adjustment; relations to child HPA-axis functioning. *Psychoneuroendocrinology* 64:47–56

Apter-Levy Y, Feldman M, Vakart A, Ebstein RP, Feldman R. 2013. Impact of maternal depression across the first 6 years of life on the child's mental health, social engagement, and empathy: the moderating role of oxytocin. *Am. J. Psychiatry* 170(10):1161–68

Ardiel EL, Rankin CH. 2010. The importance of touch in development. *Paediatr. Child Health* 15(3):153–56

Beebe B, Steele M, Jaffe J, Buck KA, Chen H, et al. 2011. Maternal anxiety symptoms and mother–infant self- and interactive contingency. *Infant Ment. Health J.* 32(2):174–206

Belsky J. 1984. The determinants of parenting: a process model. *Child Dev.* 55(1):83–96

Bornstein MH, Cote LR. 2001. Mother-infant interaction and acculturation: I. Behavioural comparisons in Japanese American and South American families. *Int. J. Behav. Dev.* 25(6):549–63

Bowlby J. 1969. *Attachment and Loss*, Vol. 1: *Attachment*. New York: Basic Books

Chalmers D. 1996. *The Conscious Mind: In Search of a Fundamental Theory*. New York: Oxford Univ. Press

Coplan JD, Andrews MW, Rosenblum LA, Owens MJ, Friedman S, et al. 1996. Persistent elevations of cerebrospinal fluid concentrations of corticotropin-releasing factor in adult nonhuman primates exposed to early-life stressors: implications for the pathophysiology of mood and anxiety disorders. *PNAS* 93(4):1619–23

Cowan CP, Cowan PA. 1992. *When Partners Become Parents: The Big Life Change for Couples*. New York: Basic Books

Damasio AR. 1999. *The Feeling of What Happens: Body and Emotion in the Making of Consciousness*. London: William Heinemann

Darwin C. 1859. *On the Origin of Species by Means of Natural Selection*. London: John Murray

De Wolff MS, van Ijzendoorn MH. 1997. Sensitivity and attachment: a meta-analysis on parental antecedents of infant attachment. *Child Dev.* 68(4):571–91

Dollberg D, Feldman R, Keren M. 2010. Maternal representations, infant psychiatric status, and mother–child relationship in clinic-referred and non-referred infants. *Eur. Child Adolesc. Psychiatry* 19(1):25

Dollberg D, Feldman R, Keren M, Guedeney A. 2006. Sustained withdrawal behavior in clinic-referred and nonreferred infants. *Infant Ment. Health J.* 27(3):292–309

Dollberg D, Feldman R, Tyano S, Keren M. 2013. Maternal representations and mother-infant relational behavior following parent-infant psychotherapy. *J. Infant Child Adolesc. Psychother.* 12(3):190–206

Dunbar RIM, Shultz S. 2007. Understanding primate brain evolution. *Philos. Trans. R. Soc. B* 362(1480):649–58. **https://doi.org/10.1098/rstb.2006.2001**

Edelman GM. 1972. *Banquet speech*. Presented at Nobel Banquet, Stockholm, Dec. 10. **https://www.nobelprize.org/prizes/medicine/1972/edelman/speech/**

Edelman GM. 2004. *Wider than the Sky: The Phenomenal Gift of Consciousness*. New Haven, CT: Yale Univ. Press

Feldman R. 1998. *Coding Interactive Behavior (CIB) Manual*. Work. Pap., Bar-Ilan Univ., Ramat Gan, Isr.
Feldman R. 2003. Infant–mother and infant–father synchrony: the coregulation of positive arousal. *Infant Ment. Health J.* 24(1):1–23
Feldman R. 2004. Mother-infant skin-to-skin contact (Kangaroo Care): theoretical, clinical, and empirical aspects. *Infants Young Child.* 17(2):145–61
Feldman R. 2007a. Maternal versus child risk and the development of parent–child and family relationships in five high-risk populations. *Dev. Psychopathol.* 19(2):293–312
Feldman R. 2007b. Mother-infant synchrony and the development of moral orientation in childhood and adolescence: direct and indirect mechanisms of developmental continuity. *Am. J. Orthopsychiatry* 77(4):582–97
Feldman R. 2007c. Parent–infant synchrony: biological foundations and developmental outcomes. *Curr. Dir. Psychol. Sci.* 48(6):329–54
Feldman R. 2010. The relational basis of adolescent adjustment: trajectories of mother–child interactive behaviors from infancy to adolescence shape adolescents' adaptation. *Attach. Hum. Dev.* 12:173–92
Feldman R. 2012a. Oxytocin and social affiliation in humans. *Hormones Behav.* 61(3):380–91
Feldman R. 2012b. Parenting behavior as the environment where children grow. In *The Cambridge Handbook of Environment in Human Development*, ed. LC Mayes, M Lewis, pp. 535–67. New York: Cambridge Univ. Press
Feldman R. 2015a. The adaptive human parental brain: implications for children's social development. *Trends Neurosci.* 38:387–99
Feldman R. 2015b. Sensitive periods in human social development: new insights from research on oxytocin, synchrony, and high-risk parenting. *Dev. Psychopathol.* 27(2):369–95
Feldman R. 2015c. Mutual influences between child emotion regulation and parent–child reciprocity support development across the first decade of life: implications for developmental psychopathology. *Dev. Psychopathol.* 27:1007–23
Feldman R. 2016. The neurobiology of mammalian parenting and the biosocial context of human caregiving. *Horm. Behav.* 77:3–17
Feldman R. 2017. The neurobiology of human attachments. *Trends Cogn. Sci.* 21:80–99
Feldman R. 2019. The social neuroendocrinology of human parenting. In *Handbook of Parenting*, ed. MH Bornstein, pp. 220–49. London: Routledge
Feldman R. 2020. What is resilience? An affiliative neuroscience perspective. *World Psychiatry* 19:132–50
Feldman R, Bamberger E, Kanat-Maymon Y. 2013a. Parent-specific reciprocity from infancy to adolescence shapes children's social competence and dialogical skills. *Attach. Hum. Dev.* 15(4):407–23
Feldman R, Braun K, Champagne FA. 2019. The neural mechanisms and consequences of paternal caregiving. *Nat. Rev. Neurosci.* 20:205–24
Feldman R, Eidelman AI. 1998. Intervention programs for premature infants: How and do they affect development? *Clin. Perinatol.* 25(3):613–26
Feldman R, Eidelman AI. 2003. Skin-to-skin contact (Kangaroo Care) accelerates autonomic and neurobehavioural maturation in preterm infants. *Dev. Med. Child Neurol.* 45(4):274–81
Feldman R, Eidelman AI. 2004. Parent-infant synchrony and the social-emotional development of triplets. *Dev. Psychol.* 40(6):1133–47
Feldman R, Eidelman AI. 2005. Does a triplet birth pose a special risk for infant development? Assessing cognitive development in relation to intrauterine growth and mother-infant interaction across the first 2 years. *Pediatrics* 115(2):443–52
Feldman R, Eidelman AI. 2006. Neonatal state organization, neuromaturation, mother-infant interaction, and cognitive development in small-for-gestational-age premature infants. *Pediatrics* 118(3):e869–78
Feldman R, Eidelman AI. 2007. Maternal postpartum behavior and the emergence of infant–mother and infant–father synchrony in preterm and full-term infants: the role of neonatal vagal tone. *Dev. Psychobiol.* 49(3):290–302
Feldman R, Eidelman AI. 2009a. Biological and environmental initial conditions shape the trajectories of cognitive and social-emotional development across the first years of life. *Dev. Sci.* 12(1):194–200
Feldman R, Eidelman AI. 2009b. Triplets across the first 5 years: The discordant infant at birth remains at developmental risk. *Pediatrics* 124(1):316–23

Feldman R, Eidelman AI, Rotenberg N. 2004a. Parenting stress, infant emotion regulation, maternal sensitivity, and the cognitive development of triplets: a model for parent and child influences in a unique ecology. *Child Dev*. 75(6):1774–91

Feldman R, Eidelman AI, Sirota L, Weller A. 2002a. Comparison of skin-to-skin (kangaroo) and traditional care: parenting outcomes and preterm infant development. *Pediatrics* 110(1):16–26

Feldman R, Golan O, Hirschler-Guttenberg Y, Ostfeld-Etzion S, Zagoory-Sharon O. 2014a. Parent–child interaction and oxytocin production in pre-schoolers with autism spectrum disorder. *Br. J. Psychiatry* 205(2):107–12

Feldman R, Gordon I, Influs M, Gutbir T, Ebstein RP. 2013b. Parental oxytocin and early caregiving jointly shape children's oxytocin response and social reciprocity. *Neuropsychopharmacology* 38:1154–62

Feldman R, Granat A, Pariente C, Kanety H, Kuint J, Gilboa-Schechtman E. 2009. Maternal depression and anxiety across the postpartum year and infant social engagement, fear regulation, and stress reactivity. *J. Am. Acad. Child Adolesc. Psychiatry* 48(9):919–27

Feldman R, Greenbaum CW. 1997. Affect regulation and synchrony in mother–infant play as precursors to the development of symbolic competence. *Infant Ment. Health J.* 18(1):4–23

Feldman R, Greenbaum CW, Mayes LC, Erlich SH. 1997. Change in mother-infant interactive behavior: relations to change in the mother, the infant, and the social context. *Infant Behav. Dev.* 20(2):151–63

Feldman R, Keren M, Gross-Rozval O, Tyano S. 2004b. Mother–child touch patterns in infant feeding disorders: relation to maternal, child, and environmental factors. *J. Am. Acad. Child Adolesc. Psychiatry* 43:1089–97

Feldman R, Masalha S. 2007. The role of culture in moderating the links between early ecological risk and young children's adaptation. *Dev. Psychopathol.* 19(1):1–21

Feldman R, Masalha S. 2010. Parent–child and triadic antecedents of children's social competence: cultural specificity, shared process. *Dev. Psychol.* 46(2):455–67

Feldman R, Masalha S, Derdikman-Eiron R. 2010. Conflict resolution in the parent–child, marital, and peer contexts and children's aggression in the peer-group: a process oriented cultural perspective. *Dev. Psychol.* 46:310–25

Feldman R, Masalha S, Nadam R. 2001. Cultural perspective on work and family: dual-earner Israeli Jewish and Arab families at the transition to parenthood. *J. Fam. Psychol.* 15(3):492–509

Feldman R, Monakhov M, Pratt M, Ebstein RP. 2016. Oxytocin pathway genes: evolutionary ancient system impacting on human affiliation, sociality, and psychopathology. *Biol. Psychiatry* 79:174–84

Feldman R, Rosenthal Z, Eidelman AI. 2014b. Maternal-preterm skin-to-skin contact enhances child physiologic organization and cognitive control across the first 10 years of life. *Biol. Psychiatry* 75(1):56–64

Feldman R, Vengrober A. 2011. Posttraumatic stress disorder in infants and young children exposed to war-related trauma. *J. Am. Acad. Child Adolesc. Psychiatry* 50(7):645–58

Feldman R, Vengrober A, Ebstein RP. 2014c. Affiliation buffers stress: Cumulative genetic risk in oxytocin-vasopressin genes combines with early caregiving to predict PTSD in war-exposed young children. *Transl. Psychiatry* 4(3):e370

Feldman R, Vengrober A, Eidelman-Rothman M, Zagoory-Sharon O. 2013c. Stress reactivity in war-exposed young children with and without posttraumatic stress disorder: relations to maternal stress hormones, parenting, and child emotionality and regulation. *Dev. Psychopathol.* 25:943–55

Feldman R, Weller A, Sirota L, Eidelman AI. 2002b. Skin-to-skin contact (Kangaroo Care) promotes self-regulation in premature infants: sleep-wake cyclicity, arousal modulation, and sustained exploration. *Dev. Psychol.* 38:194–207

Finkenwirth C, Burkart JM. 2017. Long-term-stability of relationship structure in family groups of common marmosets, and its link to proactive prosociality. *Physiol. Behav.* 173:79–86

Fogel A. 1993. *Developing Through Relationships*. Chicago: Univ. Chicago Press

Fonagy P, Sleed M, Baradon T. 2016. Randomized controlled trial of parent–infant psychotherapy for parents with mental health problems and young infants. *Infant Ment. Health J.* 37:97–114

Freud S. 1961 (1923). *The Standard Edition of the Complete Psychological Works of Sigmund Freud*, Vol. 19*: The Ego and the Id and Other Works (1923–1925)*. London: Hogarth

Froemke RC, Carcea I. 2017. Oxytocin and brain plasticity. In *Principles of Gender-Specific Medicine*, ed. M Legato, pp. 161–82. Amsterdam: Academic. 3rd ed.

Gimpl G, Fahrenholz F. 2001. The oxytocin receptor system: structure, function, and regulation. *Physiol. Rev.* 81(2):629–83

Goodson JL. 2013. Deconstructing sociality, social evolution and relevant nonapeptide functions. *Psychoneuroendocrinology* 38(4):465–78

Gordon I, Zagoory-Sharon O, Leckman JF, Feldman R. 2010. Oxytocin and the development of parenting in humans. *Biol. Psychiatry* 68(4):377–82

Granat A, Gadassi R, Gilboa-Schechtman E, Feldman R. 2017. Maternal depression and anxiety, social synchrony, and infant regulation of negative and positive emotions. *Emotion* 17(1):11–27

Grinevich V, Neumann ID. 2020. Brain oxytocin: How puzzle stones from animal studies translate into psychiatry. *Mol. Psychiatry.* **https://doi.org/10.1038/s41380-020-0802-9**

Groh AM, Narayan AJ. 2019. Infant attachment insecurity and baseline physiological activity and physiological reactivity to interpersonal stress: a meta-analytic review. *Child Dev.* 90(3):679–93

Halevi G, Djalovski A, Kanat-Maymon Y, Yirmiya K, Zagoory-Sharon O, et al. 2017. The social transmission of risk: Maternal stress physiology, synchronous parenting, and well-being mediate the effects of war exposure on child psychopathology. *J. Abnorm. Psychol.* 126(8):1087–1103

Halevi G, Djalovski A, Vengrober A, Feldman R. 2016. Risk and resilience trajectories in war-exposed children across the first decade of life. *J. Child Psychol. Psychiatry* 57(10):1183–93

Hamilton JL, Alloy LB. 2016. Atypical reactivity of heart rate variability to stress and depression across development: systematic review of the literature and directions for future research. *Clin. Psychol. Rev.* 50:67–79

Hari R, Henriksson L, Malinen S, Parkkonen L. 2015. Centrality of social interaction in human brain function. *Neuron* 88(1):181–93

Hirschler-Guttenberg Y, Golan O, Ostfeld-Etzion S, Feldman R. 2015. Mothering, fathering, and the regulation of negative and positive emotions in high-functioning preschoolers with autism spectrum disorder. *J. Child Psychol. Psychiatry* 56(5):530–39

Hofer MA. 1995. Hidden regulators: implications for a new understanding of attachment, separation, and loss. In *Attachment Theory: Social, Developmental, and Clinical Perspectives*, ed. S Goldberg, R Muir, J Kerr, pp. 203–30. Hillsdale, NJ: Analytic

Hostinar CE, Sullivan RM, Gunnar MR. 2014. Psychobiological mechanisms underlying the social buffering of the hypothalamic-pituitary-adrenocortical axis: a review of animal models and human studies across development. *Psychol. Bull.* 140(1):256–82

Husserl E. 1977 (1925). *Phenomenological Psychology*, transl. J. Scanlon. The Hague, Neth.: Martinus Nijhoff

Iwasaki S, Inoue K, Kiriike N, Hikiji K. 2000. Effect of maternal separation on feeding behavior of rats in later life. *Physiol. Behav.* 70(5):551–56

Kalisch R, Cramer AOJ, Binder H, Fritz J, Leertouwer IJ, et al. 2019. Deconstructing and reconstructing resilience: a dynamic network approach. *Perspect. Psychol. Sci.* 14(5):765–77

Keren M, Feldman R, Tyano S. 2001. Diagnoses and interactive patterns of infants referred to a community-based infant mental health clinic. *J. Am. Acad. Child Adolesc. Psychiatry* 40(1):27–35

Kessler RC. 2006. The epidemiology of depression among women. In *Women and Depression: A Handbook for the Social, Behavioral, and Biomedical Sciences*, ed. CLM Keyes, SH Goodman, pp. 22–37. Cambridge, UK: Cambridge Univ. Press

Kilner JM, Friston KJ, Frith CD. 2007. Predictive coding: an account of the mirror neuron system. *Cogn. Proc.* 8(3):159–66

Kim P, Strathearn L, Swain JE. 2016. The maternal brain and its plasticity in humans. *Horm. Behav.* 77:113–23

Kleiman DG. 1977. Monogamy in mammals. *Q. Rev. Biol.* 52(1):39–69

Korja R, Latva R, Lehtonen L. 2012. The effects of preterm birth on mother–infant interaction and attachment during the infant's first two years. *Acta Obstet. Gynecol. Scand.* 91(2):164–73. **https://doi.org/10.1111/j.1600-0412.2011.01304.x**

Leuner B, Glasper ER, Gould E. 2010. Parenting and plasticity. *Trends Neurosci.* 33:465–73

Levy J, Goldstein A, Feldman R. 2019a. The neural development of empathy is sensitive to caregiving and early trauma. *Nat. Commun.* 10:1905. **https://doi.org/10.1038/s41467-019-09927-y**

Levy J, Lankinen K, Hakonen M, Feldman R. 2020. The integration of social and neural synchrony: a case for ecologically valid research using MEG neuroimaging. *Soc. Cogn. Affect. Neurosci.* **https://doi.org/10.1093/scan/nsaa061**

Levy J, Yirmiya K, Goldstein A, Feldman R. 2019b. Chronic trauma impairs the neural basis of empathy in mothers: relations to parenting and children's empathic abilities. *Dev. Cogn. Neurosci.* 38:100658
Lorenz K. 1935. Der Kumpan in der Umwelt des Vogels. Der Artgenosse als auslösendes Moment sozialer Verhaltensweisen. *J. Ornithol.* 83:137–215
Lukas D, Clutton-Brock TH. 2013. The evolution of social monogamy in mammals. *Science* 341(6145):526–30
Mayes LC, Feldman R, Granger RH, Haynes OM, Bornstein MH, Schottenfeld R. 1997. The effects of polydrug use with and without cocaine on mother-infant interaction at 3 and 6 months. *Infant Behav. Dev.* 20(4):489–502
Meltzer-Brody S, Howard LM, Bergink V, Vigod S, Jones I, et al. 2018. Postpartum psychiatric disorders. *Nat. Rev. Dis. Primers* 4:18022
Merleau-Ponty M. 1945. *Phénoménologie de la perception*. Paris: Gallimard
Minuchin S. 1974. *Families and Family Therapy*. London: Tavistock
Morrison RE, Groenenberg M, Breuer T, Manguette ML, Walsh PD. 2019. Hierarchical social modularity in gorillas. *Proc. R. Soc. B* 286(1906):20190681
Numan M. 2020. *The Parental Brain: Mechanisms, Development, and Evolution*. Oxford, UK: Oxford Univ. Press
Opie C, Atkinson QD, Dunbar RIM, Shultz S. 2013. Male infanticide leads to social monogamy in primates. *PNAS* 110(33):13328–32
Ostfeld-Etzion S, Golan O, Hirschler-Guttenberg Y, Zagoory-Sharon O, Feldman R. 2015. Neuroendocrine and behavioral response to social rupture and repair in preschoolers with autism spectrum disorders interacting with mother and father. *Mol. Autism* 6:11. **https://doi.org/10.1186/s13229-015-0007-2**
Pratt M, Apter-Levi Y, Vakart A, Feldman M, Fishman R, et al. 2015. Maternal depression and child oxytocin response; moderation by maternal oxytocin and relational behavior. *Depress. Anxiety* 32(9):635–46
Pratt M, Goldstein A, Feldman R. 2018. Child brain exhibits a multi-rhythmic response to attachment cues. *Soc. Cogn. Affect. Neurosci.* 13(9):957–66
Pratt M, Goldstein A, Levy J, Feldman R. 2017. Maternal depression across the first years of life impacts the neural basis of empathy in preadolescence. *J. Am. Acad. Child Adolesc. Psychiatry* 56(1):20–29.e3
Pratt M, Zeev-Wolf M, Goldstein A, Feldman R. 2019. Exposure to early and persistent maternal depression impairs the neural basis of attachment in preadolescence. *Prog. Neuro-Psychopharmacol. Biol. Psychiatry* 93:21–30
Preis A, Samuni L, Mielke A, Deschner T, Crockford C, Wittig RM. 2018. Urinary oxytocin levels in relation to post-conflict affiliations in wild male chimpanzees (*Pan troglodytes verus*). *Horm. Behav.* 105:28–40
Priel A, Djalovski A, Zagoory-Sharon O, Feldman R. 2019. Maternal depression impacts child psychopathology across the first decade of life: oxytocin and synchrony as markers of resilience. *J. Child Psychol. Psychiatry* 60(1):30–42
Priel A, Zeev-Wolf M, Djalovski A, Feldman R. 2020. Maternal depression impairs child emotion understanding and executive functions: the role of dysregulated maternal care across the first decade of life. *Emotion* 20(6):1042–58
Rosenblatt JS. 2003. Outline of the evolution of behavioral and nonbehavioral patterns of parental care among the vertebrates: critical characteristics of mammalian and avian parental behavior. *Scand. J. Psychol.* 44(3):265–71
Rutter M. 2013. Annual research review: resilience—clinical implications. *J. Child Psychol. Psychiatry* 54(4):474–87
Santayana G. 1904. What is aesthetics? *Philos. Rev.* 13:320–27
Schilbach L, Timmermans B, Reddy V, Costall A, Bente G, et al. 2013. Toward a second-person neuroscience. *Behav. Brain Sci.* 36(4):393–414
Schneirla TC, Rosenblatt JS. 1961. Animal research: panel, 1960: 1. Behavioral organization and genesis of the social bond in insects and mammals. *Am. J. Orthopsychiatry* 31(2):223–53
Sonkusare S, Breakspear M, Guo C. 2019. Naturalistic stimuli in neuroscience: critically acclaimed. *Trends Cogn. Sci.* 23(8):699–714
Sowell ER, Peterson BS, Thompson PM, Welcome SE, Henkenius AL, Toga AW. 2003. Mapping cortical change across the human life span. *Nat. Neurosci.* 6(3):309–15
Spinelli M, Frigerio A, Montali L, Fasolo M, Spada MS, Mangili G. 2016. 'I still have difficulties feeling like a mother': the transition to motherhood of preterm infants mothers. *Psychol. Health* 31(2):184–204

Steele H, Murphy A, Bonuck K, Meissner P, Steele M. 2019. Randomized control trial report on the effectiveness of Group Attachment-Based Intervention (GABI©): improvements in the parent–child relationship not seen in the control group. *Dev. Psychopathol.* 31(1):203–17
Stem D. 1995. *The Motherhood Constellation*. New York: Basic Books
Strover CS, Coates EE. 2016. The relationship of reflective functioning to parent child interactions in a sample of fathers with concurrent intimate partner violence perpetration and substance abuse problems. *J. Fam. Violence* 31:433–42
Suchman NE, DeCoste CL, McMahon TJ, Dalton R, Mayes LC, Borelli J. 2017. Mothering from the inside out: results of a second randomized clinical trial testing a mentalization-based intervention for mothers in addiction treatment. *Dev. Psychopathol.* 29:617–36
Thelen E, Smith LB. 1994. *A Dynamic Systems Approach to the Development of Cognition and Action*. Cambridge, MA: MIT Press
Tinbergen N. 1963. On aims and methods of ethology. *Z. Tierpsychol.* 20(4):410–33
Ulmer-Yaniv A, Djalovski A, Priel A, Zagoory-Sharon O, Feldman R. 2018a. Maternal depression alters stress and immune biomarkers in mother and child. *Depress. Anxiety* 35(12):1145–57
Ulmer-Yaniv A, Djalovski A, Yirmiya K, Halevi G, Zagoory-Sharon O, Feldman R. 2018b. Maternal immune and affiliative biomarkers and sensitive parenting mediate the effects of chronic early trauma on child anxiety. *Psychol. Med.* 48(6):1020–33
Ulmer-Yaniv A, Salomon R, Waidergoren S, Shimon-Raz O, Djalovski A, Feldman R. 2020. Synchronous caregiving from birth to adulthood tunes humans' social brain. bioRxiv 974659. **https://doi.org/10.1101/2020.03.09.974659**
Vakrat A, Apter-Levy Y, Feldman R. 2018a. Fathering moderates the effects of maternal depression on the family process. *Dev. Psychopathol.* 30(1):27–38
Vakrat A, Apter-Levy Y, Feldman R. 2018b. Sensitive fathering buffers the effects of chronic maternal depression on child psychopathology. *Child Psychiatry Hum. Dev.* 49(5):779–85
van der Pal S, Steinhof M, Grevinga M, Wolke D, Verrips G. 2020. Quality of life of adults born very preterm or very low birth weight: a systematic review. 109(10):1974–88
Varela FJ, Thompson E, Rosch E, Kabat-Zinn J. 2016. *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge, MA: MIT Press. Rev. ed.
Vogel JP, Chawanpaiboon S, Moller AB, Watananirun K, Bonet M, Lumbiganon P. 2018. The global epidemiology of preterm birth. *Best Pract. Res. Clin. Obstet. Gynaecol.* 52:3–12
Walum H, Young LJ. 2018. The neural mechanisms and circuitry of the pair bond. *Nat. Rev. Neurosci.* 19(11):643–54
Weisman O, Feldman R, Burg-Malki M, Keren M, Geva R, et al. 2015. Mother–child interaction as a window to a unique social phenotype in 22q11.2 deletion syndrome and in Williams syndrome. *J. Autism Dev. Disord.* 45(8):2567–77
Wheeler WM. 1928. *The Social Insects*. London: K. Paul
Wilson EO. 2012. *The Social Conquest of Earth*. London: Norton
Winnicott DW. 1958. The capacity to be alone. *Int. J. Psycho-Anal.* 39:416–20
Winnicott DW. 1971. *Playing and Reality*. London: Tavistock
Yatziv T, Kessler Y, Atzaba-Poria N. 2018. What's going on in my baby's mind? Mothers' executive functions contribute to individual differences in maternal mentalization during mother-infant interactions. *PLOS ONE* 13(11):e0207869
Yirmiya K, Djalovski A, Motsan S, Zagoory-Sharon O, Feldman R. 2018. Stress and immune biomarkers interact with parenting behavior to shape anxiety symptoms in trauma-exposed youth. *Psychoneuroendocrinology* 98:153–60
Yirmiya K, Motsan S, Zagoory-Sharon O, Feldman R. 2020. Human attachment triggers different social buffering mechanisms under high and low early life stress rearing. *Int. J. Psychophysiol.* 152:72–80
Yuncai C, Baram TZ. 2016. Toward understanding how early-life stress reprograms cognitive and emotional brain networks. *Neuropsychopharmacology* 41:197–206. **https://doi.org/10.1038/npp.2015.181**
Zeev-Wolf M, Levy J, Goldstein A, Zagoory-Sharon O, Feldman R. 2019. Chronic early stress impairs default mode network connectivity in preadolescents and their mothers. *Biol. Psychiatry Cogn. Neurosci. Neuroimaging* 4(1):72–80

Annual Review of
Clinical Psychology

Volume 17, 2021

Contents

Errata

An online log of corrections to *Annual Review of Clinical Psychology* articles may be found at http://www.annualreviews.org/errata/clinpsy