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Cooperative Development of EFE Hunter-Gatherer Infants and Toddlers

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[−] Abstract and Keywords

The social landscape and development of Efe infants and toddlers are described. For the Efe, survival depends on sharing and cooperation with others beyond the immediate family that is built on a history of trustworthy experiences. Efe infancy is intensely social. Infants and toddlers are in near constant physical and/or social contact with people for much of their waking time. These young children are very successful at obtaining resources from other members of the forager band, as well as visitors. With increasing growth and mobility, toddlers play a more active role in determining with whom they spend time, and their networks grow and diversify, most likely, as a result.

4.15.06: Eleven-month-old Uese sits wide-eyed in her aunt's lap as men, women, boys, and girls stream from the forest into the bright light of the freshly cleared camp. Cheerful greetings and song meet the newcomers as they are helped to ease baskets and infants to the ground. Babies are cuddled by people they do not know or do not remember; with a bit of humored coaxing, toddlers are directed to shake hands, and older children bring water to the travelers. In time, they sit and share news, and voices blend with the sound of bees circling above.

First one and then several men untie bundles of honey, and pieces of dripping comb make their way across camp. It is difficult to keep track of the flow—honey received from one person is then shared with another, and in minutes all are eating, seemingly content with their share.

Uese is amazed by the rich sweetness in her mouth. As her mother opens a roasted yam, she steps unsteadily to her side. Her mother breaks off a small warm piece and says a few quiet words to Uese, placing it into her waiting hand. Uese toddles to a young girl, newly arrived, and breaks off a piece, offering an equal morsel in outstretched hand. Smiling, the girl accepts, and together they watch the animated storytelling of men nearby. A boy grins at Uese and breaks from the group, scooping her onto his hip. Her brow knits, uncertain how to respond to her cousin, not remembering their last camp together. Sensing her concern, he distracts her with a flowering vine and carries her about camp. Uese's mother disappears into the forest to retrieve fresh antelope from her husband's unmarried nephew, in recognition of meals the family has shared with him in the past. Uese's cousin sets her down beside her sister, who is weaving a basket for tomorrow's foray.

*The day fades as women shingle last leaves on new huts; others return from the forest with bedding and firewood. A neighbor beckons Uese to come see the baby she nurses— a newborn whose mother has not yet returned from gathering. Uese perches on her thigh and fingers the baby's tiny hands. When her own mother returns to the hearth, Uese feels very hungry and fusses, reaching for her breast. Saying nothing, **(p.70)** her mother kneels next to the fire and blows on the fading embers. As they burst into flames, her mother sits, and Uese climbs into her lap and begins to nurse hungrily. Water begins to boil for the rest of the family's meal.*

Abruptly, an angry voice complains from across the camp, and all are reminded of the dispute that once split the group. Voices soften, and the gentle rhythm from a finger piano eases the tension. When Uese's sucking slows with sleepiness, she is laid into the arms of an old relative, whose own children have long since died. Draped there also is a small orphaned boy, now in the woman's care. Uese's mother and sister join a group of women on the other side of camp.

Darkness sets in, and a drum beats to the laughter of girls, a decade's span in age, sitting arms entwined. Men rub aching feet and store their bows and arrows in the

rafters of huts; women confer about the search for food. Many will go to "kilima ya njala"—hill of hunger—a forest patch dense with yams where innumerable generations have foraged when other foods are scarce. Tomorrow, though, they will go because it is close; and happily, as the abundant honey affirms that many weeks of poor returns are, for now, finally behind them.

This vignette describes experiences typical of the Efe of the Ituri Forest, who over generations have hunted and foraged a broad stretch of tropical forest on the northeastern edge of the vast Congo River Basin. It exemplifies the pace of the continuously shifting social and physical landscape of hunter-gatherer child experience, as well as the influence of multiple cooperative relationships on Efe children's ability to secure resources. Honey season is a celebratory time, and even more so when game is plentiful. Sharing abounds, moods are raised as families and friends reconnect after months apart, and vestiges of past conflicts are forgotten. Other times are challenging for the Efe. When rains are heavy, foraging becomes difficult and food scarce. Smaller camps lie fragmented across the high ground between swollen rivers, and poor returns are guarded from exchange obligations by the rain that forces hearths inside.

The unpredictability of resources is a part of Efe life across the life span, influencing wellness and behavior. But its effects can be especially profound for babies as they leave a niche buffered by breast milk and continuous contact. These children are increasingly heavy and energetically costly to carry, but they are not able to independently follow their mothers when they gather food. And they are not as good as their older and more skilled social players at competing for resources.

The Efe adapt to shifts in resource availability by changing residency and camp location, and by sharing unpredictable returns in flexible social networks calibrated to individual and cooperative needs. These interpersonal networks develop over a lifetime of association with family, clan, and other Efe. Efe babies are centered within social networks from birth, and they access food and other interests by active social participation. Through these early experiences, and from observation, imitation, and instruction in valued patterns of behavior, Efe babies develop crucial cooperative competencies to strategically garner resources from others. Over time, **(p.71)** they develop the more complex skills required to be economically and reproductively successful partners in social networks that they will depend on throughout their lives.

Chapter Background and Overview

More than 25 years have passed since Tronick et al. first reported the significant breadth and intensity of cooperation in Efe infant care now known to characterize their social landscape from birth into early childhood (Ivey, 2000; Morelli and Tronick, 1987; Tronick, Morelli, and Ivey Henry, 1992; Tronick, Morelli, and Winn, 1987). At the time, the highly social nature of Efe infancy was viewed as an extreme, even odd, outlier to the canonical expectation that human infants develop primarily under the sole care of mothers, graduating into the broader community later in childhood. This premise privileged the patterns of care and social interaction characteristic of middle-class communities in the United States and Western Europe (Arnett, 2008) and continues to retain special

influence as *the* human evolutionary legacy (Morelli and Ivey Henry, in press). Now, however, a sea change has occurred in hunter-gatherer research demonstrating both the prevalence of shared developmental assistance and the universal energetic need of human mothers for it (Hewlett and Lamb, 2005; Hrdy, 2005; Kramer and Ellison, 2010). This progress has been critical to the vibrant synthesis of work to understand the ecological conditions that favor human cooperative solutions to inherent genetic evolutionary conflicts. The emergence of human cooperation from behavioral flexibility, shared risks, and shared genes established the reliable patterns of resource and information exchange from which human life history, and culture, developed (Alvard, 2009; Gurven, 2004; Hill et al., 2011; Kaplan, Hill, Lancaster, and Hurtado, 2012).

We return to research on Efe babies with these theoretical advancements as backdrop to examine Efe life history and ecological circumstances, past and present, that favor the cooperative patterns of babies' relationships and their developing capacity to participate in them to secure resources. We describe the nutritional, physical, and social ecology of Ituri Forest life to frame more clearly the uncertainties and tradeoffs of Efe child growth and development and the behavioral adaptations that characterize Efe relationships. Then we examine babies' social networks and resource acquisition from infancy through the toddler period.

Efe Adaptive Landscape

The Efe are one of the oldest and most genetically diverse extant lineage of modern humans (Hammer, Woerner, Mendez, Watkins, and Wall, 2011; Patin et al., 2009), and one of the few remaining traditional African pygmy groups inhabiting the Congo Basin of sub-Saharan Africa (Bailey and DeVore, 1989). African **(p.72)** pygmies were long considered fragments of a homogeneous population, but ancestral pygmies diverged into two distinct clusters during climactic retraction of the Congo forest about 27 thousand years ago. Since then, there has been little gene flow between the western (Aka, Baka, Bakola, Biaka) and eastern (Efe, Mbuti, Asua, Batwa, Babinga) clusters, and variable cultural and genetic assimilation with neighboring populations (Bahuchet, 2012; Hewlett, 1996). The Efe remain distinct in their lack of genetic admixture (perhaps accounting for the lowest average stature of any human population), their primary subsistence use of bow and arrow, and only sporadic engagement in market economies. Efe subsistence and social ecology closely mirror that in which human biology—and social dependence— evolved, providing a rare window into the ontogeny of cooperative dexterity demanded by foraging life. The ancestry of Efe pygmies, together with evidence of wetter and highly variable ecosystems during the period of human evolutionary emergence (Magill, Ashley, and Freeman, 2013a, 2013b), reframes their place in the central story of human social and biological evolution.

The Ituri Forest, ancestral home of the Efe, lies along the northeastern rim of the Congo Basin and was once part of a large forest archipelago providing rare ecological continuity during the period of hominid evolution (Mercader, 2002). The Efe maintain a predominantly foraging lifestyle. Men hunt and gather in groups and solitarily; women gather, mostly in groups and often with children. In some years, the Efe journey to the

forest-savanna margins in search of food. The diverse and verdant nature of African tropical forests, however, belies significant temporal and spatial unpredictability of preferred foods (Foerster, Cords, and Montfort, 2012; Wilkie, 1987), risks for micronutrient deficiency and food toxicity (Davies, 2013), marked leanness of most protein sources (Siren and Machoa, 2008), and a scarcity of carbohydrates (Hladik, 1993).

Like hunter-gatherers elsewhere, Efe gained access to new resource patches through contact with horticulturalists (Kelly, 1995) believed to have migrated into the Ituri Forest about 2 thousand years ago with the introduction of bananas (Vansina, 1990). Their descendants, including the Lese, live in villages that dot the road transecting the forest. The clan-based, interpersonal exchange system of Efe forager and Lese farmer men has been described as symbiotic, but may be better characterized as a mixture of cooperation, conflict, interdependence, and mistrust (Wilkie and Curran, 1993). The formalized but flexible pattern of reciprocity offers advantages to Lese in the form of Efe labor, especially during short-duration high-need periods of clearing, planting, and harvesting of crops. In return, Efe are given limited access to garden yields, but are expected to share highly valued resources of meat and honey. In recent decades, the alliance has grown fragile as Lese gardens and villages retracted with the disrepair of roads and dwindling markets across the Ituri. Even with fewer Lese partners and more meager harvests, the Efe, unlike a number of other foragers (Dounias and Froment, 2011), have not adopted farming.

(p.73)   In addition to the unpredictability of food, the Congo is rife with pathogens and trauma hazards (Dounias and Froment, 2011). Strong positive selection on immune-related genes in pygmy populations, for example, bears evidence of a long history of exposure to disease-producing agents (Lachance et al., 2012). High exposure to pathogens through activities strongly associated with zoonotic infections and infectious disease is a significant cause of death among foragers (Gurven and Kaplan, 2007), including the Efe (Bailey, 1991a). Young children are at special risk for harm, given their small size, immature immune systems, and precarious skills.

Adaptation to Ecological Uncertainty

Nutritional Uncertainty

The Efe, like all pygmies, share a suite of biological and social adaptations in response to nutritional uncertainty common in rainforest environments. Nutritional pressure is a central hypothesis of pygmy stature (Perry et al., 2007) because small body size reduces caloric demands of cell growth and maintenance (Kuzawa, 2007; Stearns, 1992). Along with slower growth rates from early childhood (Bailey, 1991a) through puberty, a long history of adaptation to limited nutritional resources (Becker, Verdu, Hewlett, and Pavard, 2010) is evidenced in selection pressure on growth hormone sensitivity, bone cell turnover, breast milk lipid composition, and starch metabolism (Lachance et al., 2012; Perry et al., 2007). Micronutrient deficiencies and food toxicities also pose unique challenges for reproduction and growth during infancy, a time of significant sensitivity to

variation in nutritional access and quality (Kuzawa and Bragg, 2012; Spencer and Palmer, 2012). Iodine, for example, is scarce in tropical forests but crucial to both successful pregnancy and child growth and survival (Branca and Ferrari, 2002; Davies, 2013). Improved iodine uptake is evident among Efe and other pygmies (Dormitzer and Ellison, 1989; Herraez et al., 2009), and although it is contained in breast milk, it cannot be banked for future use (Zimmermann, 2011).

Efe babies are very small at birth, averaging only 2.4 kg, but are exceptionally fat for their size (Tronick and Winn, 1992), suggesting critical resource pressures very early in Efe infancy. Although human young are protected from nutritional variation in maternal milk supply by the adaptive insurance of fat deposits in the first half-year of life (Dettwyler 1992), this safeguard weakens as growth outpaces milk production at about 6 to 9 months of age and babies require additional foods to maintain growth and health (Kuzawa, 1998). By their first birthday, babies come into increasing competition with siblings over food resources that parents and other cooperative producers bring to the hearth (Gurven, Stieglitz, Hooper, Gomes, and Kaplan, 2012). The synergies of small size and immature systems heighten disease risks in the first year, and the Efe infant mortality rate of 22% in our study is similar **(p.74)** to that reported for the Aka of the Central African Republic and Twa in Uganda (Ohenjo et al., 2006) and the 23% average for hunter-gatherers (Marlowe, 2005).

The transition from infancy into childhood is one of the most critical windows of selection pressure in human development (Bogin, 1999; Kuzawa, 2007). Human young are weaned into a buffered, energetic environment where they continue to be provisioned. They also grow for an extended period before reaching puberty, a derived pattern of human childhood This longer period of slow physical growth affords greater cognitive capacities, including the development of complex foraging skills to extract resources in ecologically unpredictable environments (Kaplan, Lancaster, and Robson, 2003) and the honing of social skills for coalitional relationships on which they will depend (Flinn, Quinlan, Coe, and Ward, 2008). As for a number of forager populations (Blurton Jones, 1993; Bock, 2005; Draper, 1976; Kaplan and Dove, 1987), Efe children are highly constrained in their ability to secure adequate food for themselves until young adulthood, placing strong demands on skills to secure resources from their social environment. The extent and duration of constraint across Efe childhood and vulnerability of early growth to perturbation are evident in the differential growth achieved in early childhood as a majority of the adult variance in Efe size is attained in the first 5 years (Bailey, 1991a).

Across the life span, forager social adaptations characterized by sharing and cooperative efforts reduce individual variance in access to energetic resources (Gurven, 2004). The high daily variability of Efe subsistence returns (Bailey and Peacock, 1988) strengthens the value of relationships through which children and adults can secure more predicable flows of resources. For example, Efe men more often hunt cooperatively, achieving lower individual return rates, but increasing the chance of returning from a hunt with some food to share (Bailey, 1991b). And, the specialized economic efforts of Efe wives and husbands smooth otherwise highly variable returns consumed at the hearth, consistent

with evolutionarily arguments for the human pairbond (Bailey and Aunger, 1989).

The Efe increase the probability of successful returns in other ways by reducing search costs of patchily distributed resources (Hein and McKinley, 2012) and by averting the risk for conflict with others (Wolf and McNamara, 2013). They scan the forest constantly as they travel, stopping to peer into the canopy, kick over logs, and probe cavities for resources and information predicting when fruit will ripen, a nesting animal will return, or new bee colony will be formed. They scan social resources in this way as well, testing for reciprocity of prior exchanges and offering new ones. The Efe travel between camps to learn about the movements of others, and check in at villages to catch the wind of possible exchange opportunities, all while avoiding long intrusions that wear out welcomes and test conflicting interests. The information that Efe obtain as they interact in their physical and social world is critical to resource providers, and information foraging across a broad niche increases the flow of opportunities for interaction within social networks.

(p.75) Social Uncertainty

Although Efe life is densely social, children may not have reliable access to those who may be most likely to invest in their welfare by the tether of close kinship. The high prevalence of parasites, infectious diseases, and injury increases the likelihood that, at times, caregivers will not be well enough to care for children or may die. Estimates of mortality for most African pygmy populations are relatively high, and we expect the same for the Efe. The death of an adult was often a close personal loss, and nearly 20% of all children up to 17 years of age had lost a mother or a father. Although children who lose a parent are quickly absorbed into another family of close kin, the social and psychological salience of loss and resulting shift in the demands of children's dependency radiate through the community. A unique and sensitive study of mortality experience of Aka pygmy adolescents found that they remembered an average of 24 deaths and could recount very intimate and frightening details of most. They experienced the strongest sense of grief with the loss of biological kin who were a source of comfort, safety, and security (Hewlett and Lamb, 2005).

Ecologically-specific energetic, morbidity and mortality risks are likely a continuous factor shaping Efe biology and behavior. Chisholm (1996) argues that environments of high mortality risk present children with important cues regarding the precariousness of social resources on which they depend, and poor resource access may accentuate the ill effects of this uncertainty even further (Ellis, Boyce, Belsky, Bakermans-Kranenburg, and van Ijzendoorn, 2011; Griskevicius, Delton, Robertson, and Tybur, 2011). Living with chronic social uncertainty has immediate and long-term impacts on development (Flinn, Nepomnaschy, Muehlenbein, and Ponzi, 2011) and can produce response strategies that are risk aversive and geared to minimizing variance across opportunities rather than avoiding social contact altogether (Nettle, 2009). For example, Efe children's uncertain access to important sources of care may promote broad solicitation of relationships during childhood. After the death of a parent and a period of mourning, Efe children often go away to live with a relative for some time in an effort to help them to move on from the experience. As in cases of fostering and migraton, children must manage new caregivers,

camps, and circumstances often without others with whom they have established relationships. Migration, morbidity, and mortality are salient and recurring social landscapes of Efe interdependency across the lifespan that both increase and ameliorate social variation.

Uncertainty and Cooperative Relationships

The mobility and flexibility of cooperative hunter-gatherer residence and economic pursuits also hedge against unpredictable access to resources (Hill, Walker, et al. 2011; Kaplan, Schniter, Smith, and Wilson, 2012), and present new cooperative **(p.76)** opportunities for sharing the demands of child care between diverse members of the group (Sear and Mace, 2008). Efe mothers, like other foraging mothers, greatly rely on others for help, but caregiver characteristics do not predict the overall amount of time infants spend with caregivers (Ivey Henry, Morelli, and Tronick, 2005). Kin are usually among the first to help with infant care (Briga, Pen, and Wright, 2012; Hamilton, 1975), and cultures provide a rich environment to learn kinship delineations and expectations for interpersonal, familial, and group level investment and exchange (Alvard, 2003).

Cooperation goes well beyond kinship. Residence is a key element of forager social organization (Hill et al., 2011; Kramer and Greaves, 2011), and familiarity is an important cue in cooperative relationships signaling potential for future sharing and trust (Harrison, Sciberras, and James, 2011). Hunter-gatherer resident patterns, however, are transient, marked by frequent changes in camp size, location, and composition. Efe camps may be as small as a few families located close to Lese gardens or as large of 30 to 35 people grouped in patrilineally affiliated clans located deep in the forest. And camps may be as close as 10 minutes from each other, or many hours' walk apart. These shifts expand and contract Efe children's access to other, with new social encounters with the shifting demographics that may accompany residential flexibility.

The variable nature of resource access for human adults and children alike places high demands on the development of social skills. Children must develop flexible capacities to learn about, manage, and negotiate cooperative and competitive relationships; to navigate shifting social networks; to predict intentions and future behaviors; and to adapt accordingly (Flinn et al., 2011; Fonagy, Gergely, and Target, 2007). The ability to discern the trustworthiness of others is central to recognizing and developing favorable patterns of exchange while minimizing and eliminating unfavorable ones, and is necessary for the evolution of stable social networks (Fowler and Christakis, 2010). Trust develops from trustworthy experiences and underlies cooperative relationships built on social and resource exchange. For Efe children, over time, some of these relationships will develop into closer and more intimate ones.

Ecological uncertainty should pressure for early development of capacities for social capture of resources and cooperative exchange due to energetic constraints on mothers as well as on children. The biological and social dependency of human reproduction on cooperative investment by others (Lancaster and Kaplan, 2010) implies that the same is true for children's development. Children's active pursuit of investment through the relationships they develop should be considered cooperative development, and, similar

to adults, strategic and sensitive to ecological variation.

Research Objective

We explore the ontogeny of Efe social relationships across the first 2 years of life by examining infants' and toddlers' involvement in social networks and the **(p.77)** cooperative opportunities they provide that extend beyond the mother's care. Our interest is to describe transitions over time in Efe child sociality, with their increasing physical (e.g., locomotor) independence from caregivers and growing need for nutritional resources beyond breast milk. These features strongly determine child resource-seeking capacity as well as vulnerability to variation in food and protective resources. We follow two lines of inquiry in our analysis. The first asks about children's social networks. We examine children's physical and social contact with people and changes in their social landscape by considering partners in terms of number, kinship, time engaged, and consistency. The second asks about trustworthy experience. We examine solicitations for and offers of resources. For both lines of inquiry, we examine children's affective state.

Data Collection and Query

The Efe in our study area number about 500 people and form 18 hunter-gatherer bands scattered across an area of approximately 900 square kilometers. The information we report in this chapter comes from a 2-year study of the development and behavioral ecology of Efe children in 51 camps. In the observational piece of this study, we (Ivey Henry) observed 20, 4- to 21-month-olds using focal subject sampling technique. Observations took place in two blocks of time over 2 consecutive days, from the time the child left the hut until about noon, and from afternoon until sunset. In each block of time, each child was observed for four 15-minute sessions separated by 45 minutes. In total, 2 hours of data were collected on each child at each age group (eight sessions total). All observations were recorded in real time using a tablet computer. This allowed the recording of duration of each event accurate to the second and the duration and sequencing of co-occurring events. Among the events recorded were all child behaviors, maternal location and activity, activity of others engaged with the child, and proximity of others to the child. Behavioral codes were developed over many years of experience living and working with the Efe and talking with the people we studied (Morelli and Ivey Henry, 2004).

Infant and Toddler Age Groupings

Increasing physical independence from caregivers and growing nutritional need bring children into contact with resources—and resource holders—in new ways. At the same time, the child's size, ability to move through the landscape, and demand for food and transport have energetic and time allocation implications for caregivers and other social partners (Konner, 2005). Because these qualities are important to Efe child social experiences, they form the basis of our age groupings. Physical and nutritional changes occur along with changes in social, emotional, and cognitive competences, however, we do not rely on conventional age-dependent **(p.78)** developmental markers because they are increasingly questioned as cross-culturally appropriate characterizations of human variation (Broesch, Callaghan, Heinrich, Murphy, and Rochat, 2010; Super, Harkness,

Barry, and Zeitlin, 2011).

We examine the development of children's social experiences across four age periods: younger infants (4- to 6-month-olds; $N = 10$; mean age, 5 months), older infants (7- to 11-month- olds; $N = 14$; mean age, 9 months), younger toddlers (12- to 15-month-olds;$N = 16$; mean age, 14 months), and older toddlers (18- to 21-month-olds; $N = 7$; mean age, 20 months). *Younger infants* are physically very dependent on their caregivers. Although they may have experience of other foods, they receive almost all of their nutrition from breast milk. They are capable of sitting on their own, but are almost always in the laps of others and cannot stand or move about without help. *Older infants* still rely mostly on breast milk for nutrition, but require more nutrition than milk alone can provide (Kuzawa, 2007). They may eat with siblings, but mothers often preferentially feed them independent of family meals. They stand but generally depend on the support of others to bring people and resources in close range. *Younger toddlers* walk quite easily around camp, but are unsteady on the uneven ground of a forest trail. At this age they move with significant independence from caregivers in camp, but are not agile enough to quickly follow older children. *Older toddlers* continue to nurse, but share fully in meals served around the hearth. They more readily follow and join the activities of other children in camp, and mothers increasingly leave them in camp when foraging.

All efforts were made to observe children over the first 24 months of life. But longitudinal studies of hunter-gatherer children are challenged by all the rigors of data collection among traditional cultures with the added unpredictability of forager mobility. Given this, and the distribution of child age at the start of the study, four children were observed once, seven twice, and nine three times in the course of the study period.

Infant and Toddler Social Networks

We considered as partners all people engaged physically (e.g., holding, leaning directly against, carrying) and/or socially (e.g., talking, directing, playing) with a child. We grouped social partners into one of four partner category types based on kinship affiliation given the role of genetic relatedness in determining others' investment in dependent young and in cooperative exchanges across the lifespan. In descending order of estimated relatedness with the child are (1) *family*, including the child's nuclear family (except mothers) and extended family members at .125 shared genetic relatedness or greater (i.e., fathers, siblings, first cousins, aunts, uncles, grandparents, and great grandparents); (2) *clan*, including individuals sharing any known paternal or maternal genetic relatedness less than .125; (3) *unrelated Efe*, including individuals with no identified genetic kinship other than being Efe; and (4) *Lese* farmers. Demographic data were gathered as part **(p.79)** of a larger longitudinal study of the population and reconfirmed during each camp visit before data collection. Paternity is unknown but accepted as informed by camp members. Although Efe children are gregarious and may have multiple partners simultaneously, we consider concurrent engagements with a maximum of two partners because children at the ages studied rarely engaged with three or more partners.

Expected Infant and Toddler Pattern of Association

Efe family members are expected to be among the most trusted of caregivers, and mothers are likely to solicit child care assistance from those dependent on her for provisioning such as siblings and foster children. As an extension of greater experience with family members, infants and toddlers may approach them more often for resources. And given close kinship, family members are expected to respond more favorably in return, especially if caregiving demands are not high. More distal kin such as *clan members* are likely to reside in camp. A number of economic and social cooperative relationships are established through clan membership. And mothers are likely to regard clan members as an opportunity for future benefits for themselves or their offspring, especially as infants grow and demonstrate increasing vigor and independence.

Unrelated Efe are expected to be less engaged in direct contact with infants and toddlers than family or clan because more closely related young are likely to be the recipients of their attention and investment. However, cooperation among Efe includes many individuals other than kin, and genetic relatedness does not fully predict the care that infants receive (Ivey, 2000). Most unrelated Efe living in the camps studied were women (77%) who had married into the band (i.e., affines), comprising two and sometimes three generations of endogamy. An older woman may have known the baby's father as a child, and a younger woman may know the mother as a peer. Although adult Efe females in a camp are much less likely to be kin than are males, they spend much of their lives together or in nearby camps foraging, living as neighbors, and sharing deep friendships, often intergenerationally. Other unrelated members of camp include children who may or may not have parents in camp and visitors such as unmarried young men in search of a mate. Some of these, especially children, may rely on the good will of residents for food and protection, and kindness towards children (and usefulness to their mothers) may help secure them. A small number of unrelated camp members are transient passers-by.

Lese farmers' appearance in the social sphere of Efe infants and toddlers is highly transient and seasonal, and is associated with adult relationships. Such brief encounters occurred in villages or gardens, or when Efe joined in village celebrations. Yet, insofar as they are a part of the social scene, they contribute to the social demands children must learn to negotiate. As a result, Lese are included in analyses that examine social landscape complexity.

(p.80) Analytic Approach

We rely largely on descriptive statistics because our goal is to describe patterns of social experiences. Data for each child were averaged across the eight 15-minute observation sessions, and these averages were used to create age-group mean scores for the measures reported. For each measure involving partner types, only children involved with the partner type under consideration were included in the calculation. We report separately on mothers and exclude their data elsewhere, except where noted, because of our interest in care that extends beyond mothers. To increase the reliability of measures, for each child we include a partner category if it is made up of five or more individuals, and we include solicitations and requests when three or more were made.

Results and Discussion

Opening Scenes of Social Life

In previous research, we observed that the first to hold a newly born baby are the women and children in the mother's hut, who assist with the birth and provide emotional support to her. The newborn is passed tenderly from one person to the next, until all have seen and held him, then taken outside and placed into the hands of the people waiting to meet this new camp member (men, by custom, do not attend births but remain in camp). The mother is among the last to hold her baby, an hour or two after birth, and during the next few days, even though she nurses the baby, another lactating woman or two nurse the baby as well (Morelli and Tronick, 1987).

In the months that follow, Efe mothers largely determine the character of their babies' social connections by allowing the people they trust to take care of them (Hrdy, 2009). They influence their baby's exposure to and perspective of others by their own relationships, visiting with and working side by side others—baby in tow—and situating homes and hearths next to particular family and friends in cooperative and supportive relationships. But mothers alone do not determine the full extent of the early connections babies develop. Babies seek out others with smiles, sounds, and gestures; and others seek out babies to play, hold, and carry. Their social world also expands as they travel on the hips and backs of others in camp, on trails, to other camps or villages, and with mothers while they are working. Once toddling (about 9 to 10 months of age), babies are better able to contact others on their own, and over the following year they are increasingly physically independent of their mothers and other caregivers. The research on which we report strengthens the view that the social life of Efe infants and toddlers is dynamic and complex, and expands on it by examining other features of their social networks and their involvement in them.

(p.81) Infants' and Toddlers' Social Network

Social Network Structure

Prior research on Efe infancy demonstrated that the number of different people in physical or social contact with babies was high and increased with age (Tronick et al., 1992). Consistent with this work, we found that in a 2-hour period, younger infants (4- to 6-month-olds) were in contact, on average, with 9 different people, whereas older toddlers (18- to 21-month-olds) had 14 different partners, including mothers (Figure 4.1; Table 4.1).
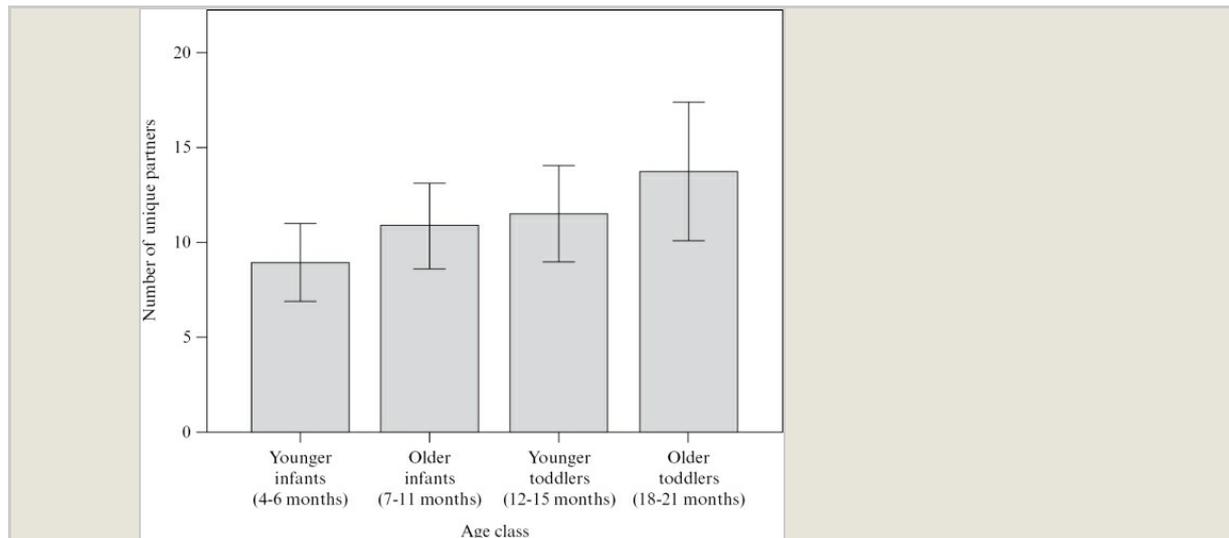
Figure 4.1 Mean (±95% CI) number of unique partners Efe babies were in social or physical contact with per 2-hour observation period.

Variation among babies was high; some were in contact with as many as 20 different social partners, and others with as few as 3. The 2 babies with the fewest social partners were observed in camps that were very small (5 and 7 members) and located near or in gardens during brief periods when camp members helped their Lese exchange partners with agricultural work. This is in line with previous research showing that group size and composition is an important determinant of the availability and diversity of Efe camp members, predicting the number of caregivers, but not the amount of time that babies received care (Ivey, 2000).

Table 4.1 Descriptive Measures of Social or Physical Contact

Measure	Partner Type[*]	Statistic	Younger Infants (4–6 mos)	Older Infants (7–11 mos)	Younger Toddlers (12–15 mos)	Older Toddlers (18–21 mos)
Number of unique partners per 2-hour period[*]	All partners	Mean ± SE	8.9 ± 0.9	10.9 ± 1	11.5 ± 1.2	13.7 ± 1.5
		Median	8.5	11	11	13
		95% CI	6.9–10.9	8.6–13.1	9–14.1	10.1–17.4
		N	10	14	16	7
Percentage of nonmaternal partners in category based on count of all partners[†]	Family	Mean ± SE	48.5 ± 8.9	46.3 ± 6.6	47.1 ± 5.4	34.3 ± 7.1
		Median	42.725	46.43	50	30
		95% CI	28.3–68.7	32.1–60.5	35.4–58.8	17–51.7
		N	10	14	15	7

	Clan	Mean ± SE	33 ± 5.8	35 ± 3.5	42.5 ± 6.3	40 ± 9
		Median	31.665	36.36	46.15	27.27
		95% CI	19.2–46.8	27.3–42.8	28.7–56.2	18.1–62
		N	8	11	13	7
	Unrelated Efe	Mean ± SE	27.3 ± 4.8	24 ± 3.1	14.9 ± 1.6	19.6 ± 6.6
		Median	18.18	25	15.48	14.29
		95% CI	15.4–39.2	17.1–30.8	11.4–18.4	1.3–37.8
		N	7	11	12	5
Percentage of observation time spent with different partner types	Family	Mean ± SE	33.3 ± 6.9	24.7 ± 4.6	32 ± 5	39.9 ± 7.6
		Median	22.29	23.47	29.44	34
		95% CI	17.8–48.8	14.7–34.6	21.3–42.6	21.2–58.6
		N	10	14	15	7
	Clan	Mean ± SE	10.6 ± 4.7	9.7 ± 2.9	13.1 ± 5.3	12.3 ± 4
		Median	4.66	5.07	4.07	5.54
		95% CI	−0.4–21.6	3.3–16.2	1.5–24.6	2.5–22
		N	8	11	13	7
	Unrelated Efe	Mean ± SE	12.7 ± 3.8	9.7 ± 2.4	9.4 ± 3.3	2.6 ± 0.7
		Median	7.63	12.07	4.82	2.49
		95% CI	3.3–22.1	4.4–15	2.2–16.6	0.7–4.5
		N	7	11	12	5

([*]) Family: partners other than the mother with a relatedness coefficient of 0.125 or more; clan: partners more distantly related, including patrilineal and matrilineal clan; unrelated Efe: partners not identified as kin of subject or of unknown relatedness.

([†]) For each measure involving partner types, only babies involved with the partner type under consideration were included in the calculation. Because each infant could have a different selection of partner types in a given age group (e.g., some interacted with cousins, some did not), averages calculated across infants do not add up to 100% across partner types.
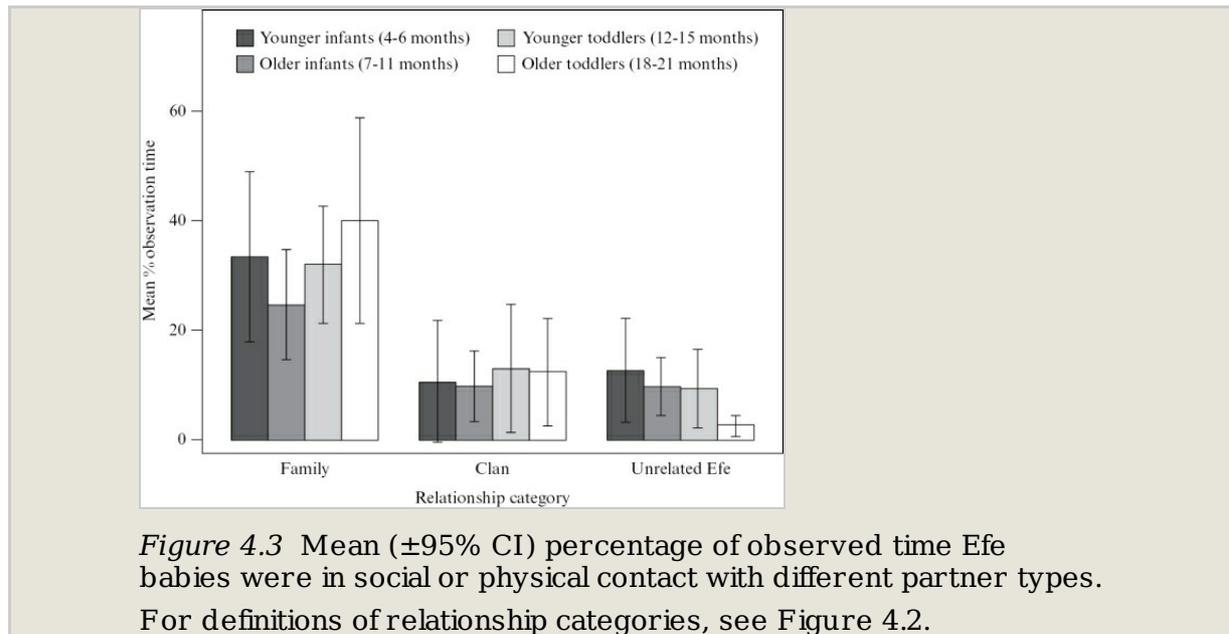
Family members were comparably represented in the social networks of infants and

younger toddlers, and as expected made up a greater proportion of partners than clan or unrelated Efe (Figure 4.2; see Table 4.1). As toddlers grew, their social **(p.82) (p.83) (p.84)** networks expanded to include clan; and for older toddlers, the proportion of social partners that were family or clan was similar across infants.

Figure 4.2 Distribution of partners in social or physical contact across different partner types. Plotted is the mean (±95% CI) percentage of all social partners accounted for by each partner category. Family: partners other than the mother with a relatedness coefficient of 0.125 or more; Clan: partners more distantly related, including patrilineal and matrilineal clan; Unrelated Efe: partners not identified as kin of subject or of unknown relatedness. Babies without a given partner type available were not considered in calculations.

Unrelated Efe representation in social networks of babies was highly variable, with no distinct age trend, but on average they accounted for a smaller proportion of social partners compared to clan members.

As anticipated, family members spent two to three times more time with infants and toddlers than did clan members or unrelated Efe, and the time family spent with them did not change dramatically with age (Figure 4.3; see Table 4.1). Clan members and unrelated Efe spent a similar proportion of time with infants and younger toddlers. For clan, the time they invested changed little for older toddlers; for unrelated Efe, time with older toddlers dropped considerably.

Figure 4.3 Mean (±95% CI) percentage of observed time Efe babies were in social or physical contact with different partner types. For definitions of relationship categories, see Figure 4.2.

The social world of Efe infants and toddlers is strongly influenced by the spatial patterning of associations determined by mother and trusted caregivers, and by their ability to navigate camp. Family members are likely to share a hearth or have one close to the baby's family, and mothers can easily put their babies in the laps of close-by family members while setting a fire or attending to another child. Dependents who are able to keep up with their mothers on foraging trips typically accompany them to help care for infants. But kinship alone does not determine **(p.85)** where adults locate hearth. Friendships are important, especially among women (Fisher, 1987), which may help explain baby contact beyond association by kinship. Women are the most frequent people not related to mothers in contact with babies, and they provide help when most needed for the smallest of babies, whose care is more physically demanding and requires strength and experience (Ivey, 2000). As babies become more independent and seek out company on their own, it appears that they choose a different set of social partners. They may visit with camp members, who take pleasure welcoming them, and they may be found at the edges of older children's play, or on the lap of a great uncle while he checks his hunting gear. The graduation of hunter-gatherer children from the toddler period into peer groups is well described (Draper, 1976), but indications of this transition are evident among the Efe much earlier than previously expected.

Social Network Consistency

We learned from prior research that very young Efe infants changed social partners often, with the rate of change increasing over the first 18 weeks of life. Three-week-olds, for example, were transferred to a person, on average, 3.7 times an hour; 18-week-olds 8.3 times an hour (Tronick et al., 1987). As partners change, babies are pressed to adjust to different interactional styles, and this likely facilitates **(p.86)** the social capabilities that allow babies to navigate complex and dense social landscapes (Stern, 1977; Tronick, 1980). We asked whether there were similar opportunities for babies as they grew up, and found that social movement from one partner to another continues at a rapid pace

throughout the first 2 years of life. Infants and toddlers, on average, experienced a change in social partners every 3 minutes regardless of age, and differences among them at each age group were small (Table 4.2). The average time from one partner to the next for younger infants (4- to 6-month olds) ranged from 2 to 4 minutes; for older toddlers (18- to 21-month-olds), it was 1 to 3 minutes. The regularity of this pattern under highly variable physical and social conditions of Efe life underscores the robustness of social turnover as a feature of Efe baby experience.

Table 4.2 Descriptive Measures of Social Consistency

Measure	Partner Type	Statistic	Younger Infants (4–6 mos)	Older Infants (7–11 mos)	Younger Toddlers (12–15 mos)	Older Toddlers (18–21 mos)
Interval (min) between partner change	All partners[*]	Mean ± SE	2.4 ± 0.2	1.7 ± 0.2	3.3 ± 0.4	2.3 ± 0.2
		Median	2.2	1.6	3.05	2.1
		95% CI	2.5–4.1	1.9–2.8	2–2.9	1.3–2.2
		N	16	7	10	14
Percentage of all unique partners across two consecutive age groups who appear in both groups	All nonmaternal partners	Mean ± SE		28.7 ± 3.9	32.1 ± 3.7	26.8 ± 3.7
		Median		33	29	28
		95% CI		19.7–37.6	23.5–40.7	16.5–37.1
		N		9	9	7
	Family	Mean ± SE		61.6 ± 7	65.1 ± 12.6	68.9 ± 9
		Median		60	67	60
		95% CI		45.5–77.6	36.1–94.1	46.9–90.8
		N		9	9	7
	Clan	Mean ± SE		0 ± 0	6.3 ± 3.3	12.1 ± 6.1
		Median		0	0	0
		95% CI			−1.2–13.9	−2.9–27.1
		N		9	9	7
	Unrelated Efe	Mean ± SE		10.3 ± 7.2	19.1 ± 12.4	4.7 ± 4.7
		Median		0	0	0

		95% CI	−6.3–26.9	−10.1–48.4	−6.8–16.3
		N	9	8	7
	Lese	Mean ± SE		7.4 ± 4.6	
		Median		0	
		95% CI		−5.3–20.1	
		N	4	5	4

(*) Mothers and Lese included in calculation

Efe mobility, camp fissions and fusions, and mortality and migration all serve as disruptors of social stability and are expected to present significant shifts in opportunities and constraints on babies' social networks and development of social relationships. When we considered babies who were observed in two consecutive age groups, we found that the consistency of infants' and toddlers' social networks (i.e., the same person in both age groups) was surprisingly low. On average, in a 2-hour period, only one out of every three individuals was observed in contact with babies across two consecutive age groups. There were differences, however, among social partner categories in partner consistency. Efe babies experienced more predictable access to the same family members over time. Mean consistency ranged from 62% to 69%, and exceeded 50% for the majority of babies (see Table 4.2). Most consistent partners were fathers and siblings; less so, cousins and grandparents; and least, aunts and uncles. By comparison, only 20% of clan members or unrelated Efe were the same in two consecutive age groups for infants and toddlers. For Efe babies, the significant departures and reunions in their emotional experience may not occur on a familial level as much as on a level of group residency. Social relationships with many others may be explored and enjoyed intensely, and then after some absence, renewed again.

Three probable factors that relate to the low consistency of partners are changes in camp mobility, composition, and labor allocation associated with high seasonality of resource availability. For example, of the consecutive age group comparisons made, 76% involved a change in camp size of 30% or more. In addition, there were significant changes in seasonal pursuits and camp distance from road across age group comparisons. These shifts dramatically influence the potential players in the social landscape for babies (and their mothers).

The quickness with which Efe babies' social partners changed moment to moment and the likelihood that people in contact with them would not be the same from one age group to the next provide opportunities for learning how to manage a fluid social scene of partners with diverse characteristics, permanency, and interests. The social knowledge gained from involvements with the many and varied people in contact with babies allow them to learn what they must do, and provide to others, to secure resources reliably. All of this

suggests that sophisticated capacities **(p.87) (p.88)** to develop social networks and negotiate conflict may be a much earlier feature of social development than appreciated, and the socially interdependent and uncertain life they live are likely similar to those in the human past.

Social Networks and the Child's Positive Affective Experience

Although it might be expected that a lack of continuity in individual social partners—and caregivers—would place high demands on infant capacity to regulate physiological and affective state, Efe babies appeared sanguine about their fast-paced and fluid social experiences, and they seemed to enjoy the exposure and learning that multiple partners provide. They were in good moods—smiling, laughing, bright eyed, and attentive—for most of the time observed, regardless of age (85% to 94% mean observation time). Moreover, their positive affective state varied little by partner type, even though stability of individual partners over time was low for all but family; and similarly aged babies varied little on this measure (Table 4.3). Their amiable and fun moods may make their engagement a pleasing experience, which likely encourages continued contact and sustained involvement with others (Sroufe, 2005), and as such, may be the means by which babies and partners learn about each other, commitments strengthen, and trust develops.

Table 4.3 Descriptive Measures of Positive Affect

Measure	Partner Type	Statistic	Younger Infants (4–6 mos)	Older Infants (7–11 mos)	Younger Toddlers (12–15 mos)	Older Toddlers (18–21 mos)
Percentage of observation time in positive affect	All nonmaternal partners	Mean ± SE	87.5 ± 1.5	85.9 ± 2.2	84.9 ± 4.1	94.1 ± 1.3
		Median	87.4	88.6	90.5	93.5
		95% CI	84.2–90.8	81.1–90.8	76.1–93.7	91–97.2
		N	10	14	16	7
Percentage of observation time with partner type that infants were in positive affect	Family	Mean ± SE	83.8 ± 2.9	82.3 ± 5.3	87.4 ± 2.2	94.3 ± 1.5
		Median	82.3	88.8	87.4	95.1
		95% CI	77.3–90.4	70.8–93.8	82.6–92.2	90.6–98.1
		N	10	14	14	7
	Clan	Mean ± SE	94.5 ± 2.2	79.1 ± 4.4	92.9 ± 4.4	95.9 ± 1.6
		Median	95.1	81.6	100.0	95.0
		95% CI	88.9–100.2	69.4–88.9	83.1–102.6	91.9–99.9

	N	6	11	12	7
Unrelated Efe	Mean ± SE	82.1 ± 5.6	87 ± 3	95.6 ± 1.8	100 ± 0
	Median	88.5	86.5	100	100
	95% CI	68.4–95.7	80.3–93.7	91.6–99.7	
	N	7	11	12	5

As Efe babies hone capabilities that allow them to move fluidly in and out of partnerships with others, they are likely to find negotiating their variable social landscapes difficult at times. The potential psychological cost of socially and emotionally demanding engagements may be lessened in at least two ways. One is by regularities in important aspects of care others provide. The public nature of Efe life makes examples of good care visible to all. Older children are counseled (by anyone) about appropriate caregiving, which improves their caregiving well before they are more fully responsible for care. Even less experienced adults are offered gentle advice. With constant watchfulness by many, partners are accountable in ways that they are not in other cultures, including Western cultures. All of this makes for more reliable social partners for babies, and more consistency in the care they receive even when the caregivers themselves are inconsistently available. With this may come feelings of familiarity and of safety and certainty that lie at the root of close relationships (Sroufe, 1979).

Moreover, the energetic and opportunity costs and psychological demands of infant caregiving are in part ameliorated by the distribution of work across caregivers and the elevated attention given to those who are engaged with Efe young. Caregivers are expected to be attentive or else not interact with babies, and dependents that compete for parental food and attention are expected to be tolerant and gentle. If a baby becomes overly challenging or the caregiver has a competing interest or demand at the time, there is no constraint on, or penalty for, passing the baby to someone more experienced at comforting or who is free of other tasks. The interdependency of Efe life nurtures intergenerational and intragenerational cooperation, enhancing infant experience of relationships by enhancing that of caregivers as well. Rather than a stand-alone child care system confined to the period of **(p.89) (p.90)** infant dependency, over the course of development, Efe infants' iterative experiences with the people who care for them—paused by departures and renewed in later seasons—become *relationships.*

Trustworthiness of Social Partners

The vulnerability of hunter-gatherer babies, intensified by ecological unpredictability, should favor early abilities to judge the safety and reliability of nutritional and social resources, especially given the competing interests of human parents with multiple young (Chisholm, 1996; Simpson and Belsky, 2008). From an early age, babies are able to assess the care they receive, judge others based on this and what they see, and act on these evaluations (Einav and Robinson, 2011; Hamlin and Wynn, 2011, 2012). Young babies may intuit as trustworthy care that meets their security/protective and biological

needs (e.g., Fonagy et al., 2007; Simpson and Belsky, 2008); but later their understanding of trustworthiness becomes more cultural in nature. Social partners, in turn, signal their interests in cooperative exchange by investments of time, energy, and kindness in infant care, providing to children information about their trustworthiness as social partners. This benevolence signals to the child shared social interests in their welfare and the availability and distribution of resources in the social environment (Szczesniak, Colaco, and Rondon, 2012).

Learning whom to trust is fundamental to developing and sustaining long-term cooperative relationships and to managing conflictual ones. Trust of others rests on trustworthy experiences of them (Yamagishi, 2011). There are many ways Efe babies directly experience the trustworthiness of others; being picked up caringly or played with gently are examples. What is more, the perceptions babies have of people through their direct involvement with them may be amplified by watching how they are with others. Here, we examine the people with whom infants and toddlers experience low levels of distress and from whom they receive resources as signs of their trustworthiness.

The Social Experience of Distress

Distress compromises babies' attentional and physiological processes (Morasch and Bell, 2011) and is energetically demanding (Wells and Davies, 1996). Because of this, the experience of prolonged periods of distress when with others may provide a strong signal to babies that their social partners are not adequate or reliable. And, as a result, babies' views of them as trustworthy may be undermined. The Efe respond rapidly to infant cries with calm attempts to quiet the child by meeting their immediate needs. They become very concerned when babies are distressed for no apparent reason and interpret it as a sign of poor health. Eighteen-week-olds who are difficult to console are returned more quickly to their mothers than are other babies, a wise choice given that mother's milk is most likely to comfort them and **(p.91)** help them recover from illness (Tronick et al., 1987; Winn, Morelli, and Tronick, 1990). At times, infant distress is tolerated for a little while in the course of care or brief competing tasks, knowing that the baby's unhappiness is temporary and not associated with harm.

This responsive and patient caregiving may be why Efe babies rarely showed signs of distress, as measured by fussing, crying, and fretting. Infants and younger toddlers overall spent an average of 7% to 9% of time distressed, older toddlers about half of this time (Table 4.4). When with family, clan, and unrelated Efe, the percentage of time in distress was similar and low for each age group and declined noticeably for older toddlers (from 9% to 12%, to 4% to 6%). Although abilities and demands change dramatically over the first 2 years of life, average distress bouts were consistently brief —averages ranged from only 11 to 20 seconds.

Table 4.4 Descriptive Measures of Distress

Measure	Partner Type	Statistic	Younger Infants (4–6 mos)	Older Infants (7–11 mos)	Younger Toddlers (12–15 mos)	Older Toddlers (18–21 mos)
Percentage of observation time in distress	All nonmaternal partners	Mean ± SE	8.4 ± 1	9.1 ± 0.7	7.4 ± 0.9	3.6 ± 0.8
		Median	9.3	9.6	6.7	3.9
		95% CI	6.1–10.7	7.5–10.7	5.5–9.3	1.7–5.6
		N	10	14	16	7
Percentage of observation time with partner type that infant was in distress	Family	Mean ± SE	13.7 ± 2.3	15 ± 4.9	10 ± 1.6	4 ± 1
		Median	15.7	10.0	9.6	4.1
		95% CI	8.5–18.8	4.3–25.6	6.5–13.5	1.6–6.3
		N	10	14	14	7
	Clan	Mean ± SE	6.3 ± 2.2	19.2 ± 3.3	12.1 ± 4.5	
		Median	5.3	17.7	10.8	
		95% CI	0.3–12.3	11.8–26.6	−0.5–24.7	
		N	5	10	5	4
	Unrelated Efe	Mean ± SE	15.2 ± 5.8	16.3 ± 2.6	9.2 ± 2.1	
		Median	8.5	13.5	9.3	
		95% CI	1–29.3	10–22.5	3.5–15	
		N	7	8	5	0
Mean distress bout duration (seconds) with partner type	Family	Mean ± SE	15.6 ± 2	13.1 ± 1.3	16.1 ± 1.9	13 ± 1.5
		Median	16.6	12.0	14.5	14.3
		95% CI	11.1–20.1	10.3–15.8	11.9–20.2	9.3–16.6
		N	10	14	14	7
	Clan	Mean ± SE		18 ± 2.3	19 ± 4.8	
		Median		16.4	14.1	
		95% CI		12.9–23.1	5.7–32.3	
		N	4	10	5	4

Unrelated Efe	Mean ± SE	20.3 ± 6.1	15.7 ± 1.4	12.3 ± 1.9	
	Median	11.5	14.7	12.5	
	95% CI	5.4–35.3	12.4–19.1	7–17.5	
	N	7	8	5	0

Reliability of Resources

Infants' and toddlers' perceptions of social partners as dependable rests in part on receipt of resources asked for and offered. Successful requests may strengthen perceptions, deepen social connections, and affect future asking. They may also provide opportunities to enter into new exchange partnerships. Offers made in the absence of requests may be one way others demonstrate good will towards babies and shape the contours of their social matrices. Willing partners in the exchange are likely to act preferentially towards one another over time, which is what 3-year-olds did by directing altruistic acts to those likely to reciprocate (Olson and Spelke, 2008). This ask-and-offer, give-and-take process is core to early reciprocity and later cooperation.

Requests to Others for Resources

Efe infants require others to meet almost every need. They ask for food and protection, help with walking or dressing, transport, shared communications, and attention to someone or something. And most times, they get what they ask for (Table 4.5). About three out of every four requests made by Efe infants and toddlers were responded to favorably (on average, 70% to 75% success). The exception was younger infants, who experienced a low success rate of 47%. Many refusals were for objects that were not appropriate for infants to have, such as a sharp tool, or uncooked food.

Table 4.5 Descriptive Measures of Requests for and Offers of Goods and Services with Different Partner Types

Measure	Partner Type	Statistic	Younger Infants (4–6 mos)	Older Infants (7–11 mos)	Younger Toddlers (12–15 mos)	Older Toddlers (18–21 mos)
Percentage success of all requests made to different partner types	All nonmaternal partners	Mean ± SE	47.3 ± 4.7	69.5 ± 3	74.7 ± 3.2	73.1 ± 2.8
		Median	42.9	69.0	76.3	71.4
		95% CI	36.8–57.9	63.1–76	68–81.4	66.2–80
		N	10	14	16	7
	Family	Mean ± SE	45.7 ± 5.9	62.9 ± 4.7	69.1 ± 6.2	64.5 ± 7.7
		Median	45.0	58.3	71.4	69.7

		95% CI	31.8–59.7	52.6–73.3	55.6–82.7	45.6–83.4
		N	8	12	12	7
	Clan	Mean ± SE	49.3 ± 12.5	72.2 ± 11.7	73.2 ± 9.9	
		Median	37.5	77.8	73.1	
		95% CI	14.6–84	42.1–102.2	47.7–98.6	
		N	5	6	6	3
	Unrelated Efe	Mean ± SE		65.9 ± 8.9		
		Median		65.3		
		95% CI		43.1–88.7		
		N	4	6	3	1
Percentage of all offers received that were made by different partner types	Family	Mean ± SE	34.9 ± 6.6	28.1 ± 3.1	34 ± 7.4	30.5 ± 5
		Median	33.7	26.3	25.0	26.6
		95% CI	20–49.8	21.3–34.9	18.1–49.8	18.2–42.8
		N	10	14	15	7
	Clan	Mean ± SE	25 ± 7.4	16.6 ± 4.3	15.5 ± 3.6	18.4 ± 5.6
		Median	20.2	10.3	10.0	13.9
		95% CI	5.9–44	7–26.1	7.4–23.7	4.8–32.1
		N	6	11	11	7
	Unrelated Efe	Mean ± SE	23.3 ± 5.7	14.8 ± 4	17.9 ± 4	
		Median	19.1	9.6	15.4	
		95% CI	8.8–37.8	5.8–23.7	8.7–27.1	
		N	6	10	9	3

Remarkably, whom Efe babies asked did not appear to determine the success they enjoyed. The percentage of successful requests, on average, did not differ by kinship of the sharing partner; this was true at each age group and across age groups (see Table 4.5). Efe babies may enjoy such consistency of success across partners independent of shared kinship interests because favors requested are not usually costly—a steady hand to help negotiate steps around the fire, a call for another to watch other children at play, or a piece of food. Physically demanding activities such as carrying a baby require more

effort but are often of short duration and only brief energetic costs to others. Widely shared displays of cooperation may produce **(p.92) (p.93) (p.94)** benefits for all Efe social partners, given significant interdependencies across the life span, a shared ecology of uncertainty, and the public nature of most social interactions. For infants and toddlers, these trustworthy experiences may inspire a sense of safety and certainty that extend to family, clan, and unrelated Efe and lay ground for judgments about whom to trust, and whom parents trust with the child.

Offers of Resources From Others

What babies asked for were mirrored in what others offered, suggesting that Efe babies learn about the availability of resources in the social environment through requests. Although the percentage of offers made by family, clan, and unrelated Efe changed little with the age of the child, family members accounted for more of the offers made to older infants and toddlers, on average, compared with clan and unrelated Efe, who did not differ from one another (see Table 4.5). The proximity of family members, and therefore their ability to anticipate needs in advance of requests, may in part explain differences between kin in offers. Many offers included resources and activities near the hearth, such as eating, dressing, washing, and comforting a baby. Moreover, the social cost of not initiating engagement in the first place may be very different from not responding to a baby's request. The differences among partner types in their response to requests and offers suggests that the complex and perhaps conflicting signals of care and cooperative intent make for especially complex social environments in which infants must strategically navigate.

Predicting Infant Success Securing Resources

The rate at which babies encounter new partners is a less well-studied feature of social networks, and it is remarkably high in Efe infants and toddlers. Given this, we looked more closely at the role of encounter rate and success in securing resources from requests. We found that more rapid turnover of social partners was associated with greater success (Figure 4.4), underscoring the active role that Efe babies play in acquiring resources from highly variable social networks. Infants may trigger shifts in social partners behaviorally (reaching out) or affectively (smiling or fussing); toddlers may do so by moving on their own, from one partner to the next, and by verbalizing their interests.
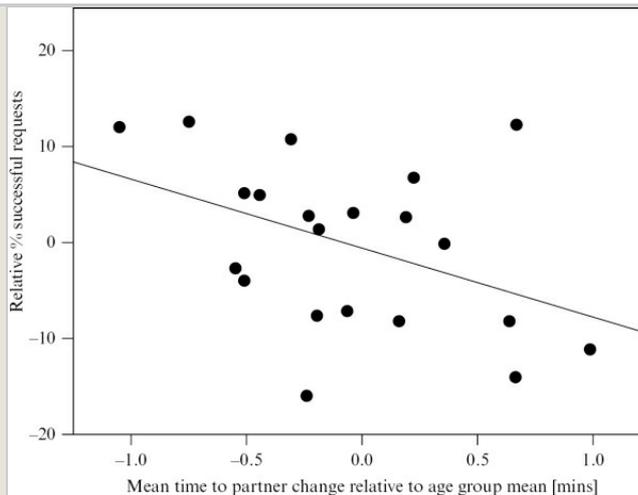
Figure 4.4 Relationship between mean interval between partner changes in minutes and mean percentage of Efe babies' requests that were successful. Both measures were first expressed relative to the mean across subjects in each age group by subtracting the mean across babies in a given age group from each individual score, and these centered values were then averaged across age groups for each baby to give an overall relative measure independent of age. Infants who encountered different partners more frequently per unit observation time (i.e., had shorter than average intervals between partner changes) had greater than average success in getting their needs met ($r = -0.43$, $P = 0.05$, $N = 21$ infant means).

Under conditions of high resource variance, the benefits of developing positive experiences and avoiding being burdensome in partner encounters may lay the ground for strategies to move more continuously through the social network, initiating broader and more rapid partner shifts. Changing partners at a fast pace, and the baby's ability to do so in a positive and socially productive way, distributes the cost of resource sharing with babies across many people and allows caregivers to return to activities that compete with child care with ease. There may be tradeoffs, however, such that gains of broad exposure to many partners must be balanced with the investment of time with particular partners to develop more intimate relationships.

Encounter rate is likely to be sensitive to camp size and composition, which change with ecological conditions. Camp size may relate negatively to encounter **(p.95)** rate, but camp composition may affect this relation. And resource-seeking strategies may be sensitive to both. Infants and toddlers may engage others in small camps that they may not engage in larger camps, where preferred partners are more likely available. We continue to explore predictors of success, including Efe infant strategy, and factors that may play a role in the relation.

Efe Mothers

Compared with other family members, Efe mothers spent more time observed with infants and younger toddlers. But this difference disappeared for older toddlers, with mothers and family spending about 35% (Table 4.6) and 39% (see Table 4.1; see Figure

4.3) of time with older toddlers, respectively.

Table 4.6 Descriptive Measures of Efe Mother Social or Physical Contact

Measure	Statistic	Younger Infants (4–6 mos)	Older Infants (7–11 mos)	Younger Toddlers (12–15 mos)	Older Toddlers (18–21 mos)
Percentage of all partner time in contact with mother	Mean ± SE	55.9 ± 6.8	60.3 ± 5.4	49.4 ± 4.2	35 ± 7.3
	Median	46.1	56.5	45.6	33.0
	95% CI	40.4–71.4	48.6–72	40.5–58.4	17–52.9
	N	10	14	16	7
Percentage of observation time with mother that infant was in positive affect	Mean ± SE	89.5 ± 2.2	86.5 ± 2	82.6 ± 4.4	91.1 ± 3.4
	Median	90.6	86.9	87.0	93.0
	95% CI	86.7–96.2	82.6–91.4	73.9–92.5	85–99.5
	N	10	14	16	7
Percentage of observation time with mother that infant was in negative affect	Mean ± SE	4.5 ± 0.9	7.1 ± 1.1	8.6 ± 1.4	5 ± 2
	Median	3.3	5.9	9.0	4.1
	95% CI	2.4–6.6	4.9–9.4	5.6–11.6	0.1–9.8
	N	10	14	16	7
Mean duration (seconds) of distress bouts while with mother	Mean ± SE	16.4 ± 1.7	13.6 ± 1.1	15.2 ± 1	13.9 ± 2.4
	Median	16.2	13.6	15.3	16.3
	95% CI	12.5–20.4	11.2–16	13–17.4	8.1–19.7
	N	10	14	16	7
Percentage of successful requests to mother	Mean ± SE	49.9 ± 5.7	71.8 ± 3.8	77.9 ± 2.9	71.8 ± 8.7
	Median	57.1	73.8	79.9	85.7
	95% CI	37.1–62.7	63.6–80	71.6–84.2	50.6–93
	N	10	13	16	7
Percentage of offers made to infants accounted for by mother	Mean ± SE	25.6 +−5	26.5 ± 4.4	22.8 ±3.3	14.8 +−4.9
	Median	21.6	26.4	19.4	11.2
	95% CI	14.4–36.8	17–36	15.8–29.8	2.8–26.7

N	10	14	16	7

Mothers continue to spend similarly low percentages of time with 24-month-olds and 36-month-olds (Tronick et al., 1992). This decline might have to do with toddlers' abilities to engage others on their own and with the reduced availability of mothers because mothers were less likely to be within sight of toddlers than infants. **(p.96)** **(p.97)** All mothers were observed in contact with babies from one age to the next, yielding consistency scores of 1, compared with the lower consistency scores of close family (about 65%). Other than these, few differences were noted in the measures we reported between mothers, close family, clan, and unrelated Efe.

Reflections on Cooperative Care and Infant Development

Efe babies are born into an intensely social world made up of networks of cooperative relationships that are critical to the survival of all. They benefit from these relationships by the care they receive and other resources they gain, and by the opportunities social engagements present to learn about others and to develop social ties that increase the security of accessing resources in the future. To do this, infants and toddlers must be able to adapt to the many changes in social partners and to discern people worthy of trust. And they must act in ways that sustain others' involvement with and interest in them. Their health and survival hinge quite immediately on doing so.

We cast light on the genesis of cooperative relationships by examining babies' social networks in the first 2 years of life. With age, networks grew in size and diversified. Family member presence in infant networks was strong across age groups, and clan member presence strengthened as babies grew older. Family contact time was consistent across age groups, and infants and toddlers could count on being with the same family members, but not with the same clan member or unrelated Efe, as they moved from one age group to the next. Shifts in social landscape brought babies into contact with many people and allowed them to learn and practice complex behaviors for developing, sustaining, and renewing relationships. The facility with which they did this and the willingness of others to engage them even while they grew heavier and more dependent on others for food and protection (given their increased mobility) were aided by their overall good disposition, which made it pleasurable for others to be with them.

That Efe infants and toddlers experience such rapid change in partners is noteworthy because it is as yet an undescribed feature of care among foraging groups. Quick turnover in partners affords advantages to them, and it did not appear energetically costly when distress was considered. A fast paced, broad network may lead to skills that allow babies to adapt to a fluid social scene and to enter into relationships with people, kin, and others, familiar and not. All of this may open up different social options that let babies hedge their bets in the face of uncertainty. It does the same for social partners. With information garnered from engagements with babies, they are able to invest judiciously in those whom as dependents are in need of scarce and often fleeting resources and whom as adults may be future cooperative partners.

Efe infants and toddlers experience people beyond the family as trustworthy, and this may be bolstered by what they observe. With many people worthy of trust, **(p.98)** Efe babies are expected to feel safe and secure in the knowledge of certain resources in their presence and perhaps in their absence as well. Given the safety that their social world engenders, the freedom for them to try new associations, and the favorable experiences they commonly enjoy with people they have just met or do not remember, Efe babies may well perceive unfamiliar people as trustworthy. Because of this, they should be more likely to risk new engagements in the hope for new resources and new information.

We are not certain if the social engagements in which Efe babies were involved beyond the mother developed into attachment relationships. We expect many did. It is a challenge to narrow conceptions of attachment to mother alone when there are no hunter-gatherer mothers we know of solely responsible for infant care (see, e.g., Quinn and Mageo, in press). Aka babies, for example, direct attachment behaviors to a good portion of the people who care for them other than their mothers (Meehan and Hawks, in press). And these babies experience little distress on their mothers' return when these preferred caregivers are available to them. This led Meehan and Hawks to conclude that babies developed multiple attachment relationships, up to six for some infants.

The highly variable social and environmental conditions that selected for human cooperative reproduction and the tradeoffs experienced by forager parents in the coordination of economic productivity and care of multiple young imply that the same uncertainties selected for *cooperative attachment* of infants to others as well. Given the life-span dependence of humans on sharing and reciprocity, evolutionary pressures on development should favor much greater social potential than Western science and culture have expected from children (or adults). The remarkable specialization of human biology and behavior on cooperative resource captures requires a shift in our view from *social* development to *cooperative* development.

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