Human Nature
https://doi.org/10.1007/s12110-021-09393-w

Opportunities for Interaction

Natural Observations of Children's Social Behavior in Five Societies

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Accepted: 26 February 2021

Abstract
We examine the opportunities children have for interacting with others and the extent to which they are the focus of others' visual attention in five societies where extended family communities are the norm. We compiled six video-recorded datasets (two from one society) collected by a team of anthropologists and psychologists conducting long-term research in each society. The six datasets include video observations of children among the Yasawas (Fiji), Tanna (Vanuatu), Tsimane (Bolivia), Huatasani (Peru), and Aka (infants and children 4–12 years old; Central African Republic). Each dataset consists of a series of videos of children ranging in age from 2 months to 12 years in their everyday contexts. We coded 998 videos and identified with whom children had opportunities to interact (male and female adults and children) as well as the number of individuals and the proportion of observed time that children spent with these individuals. We also examined the proportion of time children received direct visual gaze (indicating attention to the child). Our results indicate that children less than 5 years old spend the majority of their observed time in the presence of one female adult. This is the case across the five societies. In the three societies from which we have older children (Aka, Yasawa, Peru), we find a clear shift around 5 years of age, with children spending the majority of their time with other children. We also coded the presence or absence of a primary caregiver and found that caregivers remained within 2 ft of target children until 7 years of age. When they were in the company of a primary caregiver, children older than seven spent the majority of their time more than 2 ft from the caregiver. We found a consistent trend across societies with decreasing focal attention on the child with increasing child age. These findings show (1) remarkable consistency across these societies in children's interaction opportunities and (2) that a developmental approach is needed to fully understand human development because the social context is dynamic across the lifespan. These data can serve as a springboard for future research examining social development in everyday contexts.

Keywords Childhood · Culture · Natural observations · Hunter-gatherers · Caregiving · Social development · Attachment · Infancy

Published online: 21 April 2021

Human childhood is unique among primates in that infants are born relatively helpless and remain dependent on others for care for more than a decade. This extended period of dependency is thought to support a longer period of time during which a child can spend time with and potentially learn from others. The early social relationships in a child's life are critical for survival and for healthy social-emotional development. There have been unstated assumptions in developmental psychology regarding (1) with whom children spend their time, (2) the primacy of the primary caregiver, and (3) the child's role in social interactions. We know very little about with whom children spend their time early in life and whether there are similar patterns of opportunities for interaction across diverse social contexts (but see Boyette & Hewlett, 2017; Demps et al., 2012; Kline et al., 2013; Lew-Levy et al., 2020). There is a debate surrounding the primacy of the mother (see Keller, 2013) as well as whether children spend more time with parents, other adults, or peers (Harris, 1995) and whether this is variable across age groups and cultural contexts. Knowing with whom children spend time has implications for developmental theories—for example, theories of attachment, social learning, language development, moral development, and prosociality. With whom children spend their time (and, of course, what they are doing together) has implications for many aspects of early development.

In the field of developmental psychology, researchers overwhelmingly study children living in urban contexts in the West, referred to as WEIRD societies (Western, educated, industrialized, rich, democratic) and therefore know surprisingly little about children beyond this limited subset (Henrich et al., 2010; Nielsen et al., 2017). Furthermore, our knowledge from the past 70 years has been focused on laboratory experiments, structured observations, and parental interviews (Broesch et al., 2020; Dahl, 2017). Therefore, there is a dearth of evidence examining and documenting how children spend their time and with whom they spend it in the early years of life (Kline et al., 2018). The result is a focused, methodologically bound snapshot of a child's life in one unrepresentative context. In the field of anthropology, however, researchers interested in children have primarily used ethnography, interviews, and mixed qualitative and quantitative observations which provide a macro overview (compared to micro-observational methods used by developmental psychologists) of the context—for example, comparing childrearing practices across and within contexts and cultures (Whiting, 1963; Whiting & Whiting, 1975). Qualitative ethnography in particular has provided us with contextual descriptions of children's social environment which suggest that the practice of caring for children may vary in important ways across societies, and that it changes over time (Chisholm, 1978; Whiting, 1963). Our understanding of child development is further limited by a lack of data across social categories of class and race within Western societies (see Hart & Risley, 1995). This suggests that the ecological context on which developmental psychologists focus may, in fact, be specific to WEIRD contexts and relatively recent times (Lancy, 2014).

Each approach (controlled experimental studies and qualitative ethnography) provides different *kinds* of information about the developing child and is located at extreme ends of a continuum. If we consider an analogy to a lens, one would be a microscopic focus (experimental studies) and the other would be a telescopic

focus (ethnography). Our goal here is to use a methodology that is somewhere in between these two—taking an observational approach, yet using video recordings to allow for microscopic and controlled measurements of behavior (e.g., visual gaze) and time allocation to understand whether the ecological context of development is similar or different across cultural contexts. This method has the advantage of being reproducible and possibly less subject to individual interpretation or perspective. This method builds on hybrid methodological approaches with systematic behavioral recordings of children, infants, and caregivers in everyday (not laboratory or experimental) settings (Barr et al., 1991; Hewlett et al., 1998). For example, Hewlett and co-authors examined infant and caregiver behaviors among the Ngandu and Aka in the Central African Republic. They used a systematic sampling technique to capture behaviors in everyday contexts (Hewlett, 1996; Hewlett et al., 1998). Konner's, (1976) work among the !Kung is also well known for the systematic recording of observable behaviors in an everyday context (Barr et al., 1991). Our work adds to this body of literature yet has three distinct components. First, we use video recordings which allow us to determine interrater reliability. Second, we are examining a wide age range (enabling a developmental approach). Third, we are examining and comparing behaviors from multiple contexts (similarities and differences).

With this project, our aim was to gather information about the early social context of childhood, examining a cross-cultural sample of everyday situations to probe for similarities and differences across contexts. How infants and children spend their time, and who their interaction partners are, has implications for nearly every developmental theory. In this paper, we focus primarily on the implications of our data for developmental theories of attachment and social learning. We discuss each of these aspects of development below and revisit the implications of our results in the discussion section.

With Whom Are Children Spending Time?

Attachment Theory rests on the foundation that the infant develops an emotional bond to one primary caregiver in the first year of life (Bowlby, 2008). From this secure bond, infants rely on the caregiver as a secure base from which they explore the world. A review by Keller examining Attachment Theory beyond the "West" and empirical data by Tronick et al. (1987) paints a somewhat different picture of the attachment process. In her review, Keller (2013) argues that infants are often cared for by multiple individuals and not just one primary caregiver in the first few years of life. This observation of early childhood across cultures, she argues, questions the basic tenets of Attachment Theory, a foundational theory from which other theories of development branch off. The current work speaks to this debate as we examine with whom children are spending their time in the first few years of life, which has direct implications for Attachment Theory. By increasing our knowledge about whom children spend their time with, we are better situated to evaluate current developmental theories.

Our knowledge of the context of social learning across development largely rests on observations and experiments with children and families who also practice and

emphasize success with formalized education. Parenting is often synonymous with teaching in these sociocultural settings (Lancy, 2010). This is in stark contrast to reports of childhood in settings where parents focus on health, survival, and the basic needs of the child (LeVine, 1994; Whiting, 1963). However, qualitative ethnographic reports and quantitative cross-cultural data indicate that teaching is present in a variety of forms in non-Western societies, even if it is not the primary focus for all parents (Boyette & Hewlett, 2018; Kline, 2015). In fact, the explicit emphasis on parents-as-teachers may be a luxury of the urban and middle-class settings on which developmental psychologists have so far focused. The current, predominantly Western focus on formal education has shaped the cultural context of childhood in these societies in unusual ways (Lancy, 2010). Given that ethnographic work shows that the sociocultural context of childhood is variable across social contexts, theories embedded in developmental psychology and explanations of developmental processes may need revision to accommodate flexibility in contexts of childrearing.

Many developmental theories are built on the assumption that a child spends the majority of their time with more knowledgeable others, typically the mother, early in life and that the child receives direct attention from others and is not simply a passive observer of others' behavior. Very little is known regarding how socialization changes throughout the early years, but there is evidence to suggest that during early childhood (3–5 years old) children undergo a cognitive and social shift (Marvin et al., 2016). Around 5–7 years of age, children across cultural contexts become socialized to other peers through various means (Damon, 1984). Damon examined the transition to formal education and also peer socialization across cultures and found striking similarities in the developmental trajectory of this shift to peer emphasis, despite varying social goals and contexts in different societies. In a recent review of the cross-cultural ethnographic literature on learning in hunter-gatherer societies, Lew-Levy et al. (2017) found that opportunities for learning begin in infancy, with parents taking children along on hunting and gathering trips. They also found that the influence of parents changes in middle childhood as peers become consistently more central to a child's life. The authors report that the role of the parent as teacher becomes important once again in adolescence, with parents teaching more complex skills to adolescent children (Lew-Levy et al., 2017). Kline et al. (2013) found that, among Yasawan Fijians, low-skill tasks learned early in life are likely to be learned from parents, but high-skill tasks learned later in life are more likely to be learned from experts and others.

Infants may also learn through passive observation, and active participation may be a feature unique to specific societies (Cristia et al., 2019; Shneidman & Goldin-Meadow, 2012). Work by Cristia and colleagues challenges long-held assumptions about theories of language learning and the social context. They found that Tsimane infants are spoken to for less than one minute per hour, per day (also see Casillas et al., 2019). This research suggests that infants may be learning language as passive observers rather than active participants of their social environment. To address this, we examined whether children were included as potential interactive partners during interactions (assessed via visual gaze directed at the infant). Here, we examine children in their everyday environment in five societies to determine: (1) with whom children spend time; (2) whether children are cared for by one primary caregiver,

and (3) whether children are the focus of direct attention. We examined the proportion of observed time children spent with other individuals (male and female adults and children), with a primary caregiver, and as the recipient of direct visual attention. We brought together six datasets (from five societies) collected by a team of anthropologists and psychologists conducting long-term research in each society. Each dataset consists of a series of videos of children at various ages, in their everyday context. This paper provides a foundation or springboard from which we can begin to investigate the developing child in context.

Methods

The study site selection was opportunistic. The first author approached researchers with an interest and expertise in child development and the ontogeny of social learning, who were known to have video recordings of children in their daily life from their long-term study sites. Each researcher has carefully selected and invested in their site as a place to study these and related research questions. Furthermore, all the chosen societies share several theoretically relevant features, including fewer childcare institutions, less emphasis on the nuclear family, and less reliance on markets relative to subsistence practices than in WEIRD societies. Our general methods involved video-recording children participating in various activities during the course of daily life. We used a "focal follow" procedure. In each society, the primary investigator, a research assistant from the researcher's home country, or a trained local research assistant identified a target child, obtained consent from the family, and then video recorded the child at specific intervals throughout the field visit. The methods for each society varied slightly, yet the data were comparable in that the goal was to capture a representation of the child's awake daily life. Children and families were familiarized with this process before the start of data collection so as to capture behaviors that were unsolicited or unstaged. Below we provide a brief description of each field site as well as a description of the methods used for data collection in that particular site. We consider the results of this paper as a coarse description of a child's social life. For a more thorough description of each society we suggest consulting the references cited below.

Study Populations and Methods in each Region

Tanna, Vanuatu Tanya Broesch (TB) has been working in an established field host village since 2012. Tanna island is located within Tafea province and is one of several islands in the archipelago of the Republic of Vanuatu, located in the South Pacific. This particular region of Vanuatu has a cultural history that includes maintaining social and cultural traditions in the face of westernization and a long and complex colonial history. TB has been visiting Tanna since 2003 and conducting research on child development in these particular five villages since 2012, with the guidance of the cultural heritage center on Tanna and in Port Vila (Vanuatu Kaljoral Senta, VKS) and the local women fieldworkers, chiefs, and community members.

Each village on Tanna consists of approximately 100 individuals living in smaller hamlets which are all governed by one local chief and are bounded by a local cultural meeting place, the *nakamal* (Atkinson, 2018). We have a research agreement in five Tanna communities, all existing within a brief walk from one another. While conducting research in this region, our team (one or two graduate students or faculty members) resides in one village and travels by foot to each of the surrounding villages for data collection and observation. People residing in these villages are well aware of the nature of the research and have consented to having their local customs and parenting practices documented and examined by video. Villages and individuals are compensated monetarily for their time, but also we present the findings back to the community and the heritage center. We collected data for this project on two separate field visits (2014, 2016). The data were collected by one of the authors [blinded] as well as a local, trained field assistant. The focal children in this study were all living within the five-village region during the study. We identified focal individuals by gathering birthdates for children born the previous year. After obtaining approval from the chief and the cultural center, we spoke to parents and explained the nature of the research and obtained verbal consent to capture their child's daily life during a series of videos. Since we began working in these villages in 2012, there has been a slow but steady political, economic, and cultural shift in these villages, with more children attending school, which coexists with other recent changes on the island in the direction of a more urban lifestyle. Although no utilities are available in these particular communities, we do see lifestyles shifting gradually, including access to mobile phones and a reliable nearby road, making transport to school, town (market, etc.), and other villages easier. Life as a child on Tanna appears similar to many other contexts on Pacific Islands in that much of the child's life appears to be spent outdoors with extended family and mixed-age groups.

Tsimane, Bolivia We video recorded most families with infants in one Tsimane village (described below). A Tsimane research assistant did the video recording in June 2015. This individual was instructed to spend one day (daylight hours) with each family, taking intermittent video that focused on the infant but included in its focus a broad area around the infant to see how others interacted with them. The Tsimane people live in villages of 20–500 individuals in the neotropics of central Bolivia. Their economy is based on swidden horticulture (plantains, manioc, rice, and corn), hunting, fishing, and fruit gathering. Since the 1990s, primary schools have spread to most villages, and secondary schools now exist in several villages, but average educational attainment remains low, particularly among older individuals. The research for this study was conducted in a village with a longer history of formal education and greater proximity to a market town than the other villages, yet roughly 60% of men and 75% of women have not completed primary school, and 11% of men and 21% of women have no formalized education (von Rueden et al., 2018). The extended family, not the village, remains the central unit of social organization. On the other hand, unrelated community members will regularly visit each other to socialize and drink *shocdye*' (chicha), an alcoholic beverage fermented from manioc and maize (Hooper et al., 2013). Women specialize in chicha-making and so play a pivotal role in social integration across families (Melgar, 2009). Less than

5% of men are polygynously married, almost always to two sisters, and few marriages end in divorce (Gurven et al., 2009). During the first 6 years of a child's life, mothers provide 69% of direct care; siblings, 10%; fathers, 7%, and the rest from other kin, including grandparents (Winking et al., 2009). Parenting is fairly permissive, and even toddlers spend much of their time in unstructured and unsupervised play. Fathers tend to focus their direct care on older children, particularly instruction in normative behavior, tool-making, and subsistence practices. Fathers will increase their time in direct care when mothers are absent or occupied or the parents have few other children to assist in childcare (Winking et al., 2009).

Yasawa, Fiji Michelle Kline (MK) collected data on Yasawa Island, in the northwest region of the Fiji Islands. Each village is made up of 100–200 Indigenous Fijians. Social life is organized by a hierarchy of patri-clans with a hereditary chief. Even for children, life is shaped by a network of kinship relations and obligations, and by local Christian churches (Methodist and Assembly of God). Previous work has found striking similarities in the caregiver-infant interactions among mothers in Fiji and mothers in other sites (Broesch et al., 2016). Villagers engage primarily in a horticulture-fishing subsistence economy with a strongly-gendered division of labor, though many have worked in the tourist industry on occasion. There are no permanent local markets, broadcast television, or public utilities in these villages. Radios are common, and cell phones have become increasingly prevalent (though unreliable) since 2010. The British made Fiji an official colony in 1874, until Fijian independence in 1970. As a result, Fiji still has a British-style formal school system. Most adults in the study population have completed primary school; some have secondary or tertiary schooling (obtained off-island). As elsewhere in Fiji, parents in these villages often regard schooling as a means for gaining future employment through fluency in English, rather than as a goal that is valuable in itself or in the context of village life (Brison, 2003; Veramu, 1986).

MK and a research assistant collected video observations in Teci Village on Yasawa Island, Fiji, in 2009 and 2010 during the dry season months. MK had previously spent several months in the village in 2008 and secured permission from families to conduct focal follows of their children, which included following them inside residences and outdoors. Video was collected during daylight hours, with the start time generated randomly, and the focal individual for each observation was drawn at random from a complete list of all children under 7 years of age. This age range was selected because at age 7, most children begin to attend formal schooling in the village and as a result would not be available for observation.

Huatasani, Peru Huatasani is a rural town in the Southern Peruvian altiplano in the department of Puno. It is located 3,850 m above sea level and about 25 km north of Lake Titicaca. At the time of the 2007 census, 2,190 people lived there. Its residents rely primarily on subsistence agropastoralism, supplemented to varying degrees with market activities such as trade and mining out of town. The town lies on the Quechua-Aymara language boundary, with 50% of people above the age of 3 naming Quechua as a native language; 23%, Aymara; and 27%, the state language of

Spanish. School instruction is in Spanish and nominally mandatory through high school. Most people less than 60 years of age speak Spanish and have some schooling; 84% of people have completed primary school, and 52% have completed high school. Both Spanish speaking and educational rates are rapidly increasing. Apart from this shift in education setting, various social features are relevant to understanding socialization processes at this site. First, extended families are larger and more important than in many postindustrial settings. Women over the age of 40 had an average of 3.8 living children, meaning children have more siblings. Furthermore, living in the same residential complexes as aunts, uncles, cousins, and grandparents is commonplace. Second, children contribute to household economic activities such as herding, agricultural fieldwork, food processing, cooking, and childcare early in life. Third, because adults are often engaged in day-long subsistence activities and school ends in the early afternoon, children have plenty of time to themselves and often entertain themselves in mixed age peer groups. More ethnographic details about the site can be found in Moya and Boyd (2015).

Videos of children were recorded in July and August of 2010. This corresponds to the Peruvian winter, a time of relatively little agricultural labor in the altiplano that also includes a two-week holiday from school. The videos were recorded by an undergraduate research assistant from the University of California in Los Angeles. She filmed 10 focal follows targeting children between the ages of 2 and 5 who were unlikely to have started school yet (although free state preschool is an option in town). These children were recruited primarily by approaching parents with whom the PI, Cristina Moya (CM), had established relationships from having worked there since 2007. For each filming session the goal was to follow each child for 3 h to examine their social learning opportunities. One filming had to be cut short by 20 min. The focal follow timing was determined using a stratified sampling method for time of day, with half of the focal follows starting in the morning and half in the afternoon.

Western Congo Basin The Aka (or BaYaka) foragers live in the tropical forests of southwestern Central African Republic (CAR) and northern Republic of the Congo. Aka communities are mobile and vary in size depending on the season, typically shifting between small forest camps of around 30 people to larger aggregations of a few hundred people situated close to communities of other ethnic groups who practice subsistence farming and small-scale commerce along the periphery of the forest. The Aka economy is based on a mix of hunting and gathering wild foods from the forest; small-scale, low-effort slash-and-burn agriculture; and exchange (of forest goods or labor) with neighboring farmers. Increasingly, wage labor for logging companies is becoming a possibility for some Aka as a way to earn cash. Aka society is highly egalitarian, with no formal leadership positions and strong norms against attempts to coerce others. This ethos is supported by a deeply held value for individual autonomy. Despite these values, people regularly cooperate in childcare, subsistence labor, and ritual practice. In addition, all food and material resources are shared regularly and widely within Aka communities.

Aka children learn about autonomy early on as they are allowed to nurse on demand and, from infancy, are rarely if ever reprimanded by others for their

behavior. After weaning, children typically either accompany their parents on foraging trips or stay close to home with other children younger than around 5 years of age, typically casually attended to by any adult who has not left camp. After around age 5, Aka children typically spend their days in an all-child group, playing and sometimes foraging independently. If they choose, children in middle childhood also accompany their parents on foraging trips to learn about the forest. During adolescence, hunting and gathering become more serious pursuits and children play less and spend more time autonomously participating in the daily economy. More about the Aka can be found in (Hewlett, 1996).

Two different datasets were collected from the Aka, one by Barry Hewlett (BH) and the other by Adam Boyette (AB). Both conducted research in or around a village in the southern part of the Central African Republic. Ten (five males and five females) Aka 12- to 14-month-old infants were videotaped for one continuous hour each, in a naturalistic setting (usually in or near the camp), during one field visit in August and September 2010. Infants came from nine different Aka camps within 3 km of the village. Caregivers and others in camp were asked to maintain normal activities as much as possible, but infants had to be awake and parents were asked to keep infants in public (not in the hut) as a condition of Institutional Review Board ethics approval, which was not difficult because families spend most of the day outside. Researchers have conducted infant focal follow observations with Aka in the study area for more than 30 years, so filming was not that unusual for parents and community members. The video camera was set up in camp for about 30 min before filming started to help diminish attention paid to the camera by the infant and camp members. BH collected the videos. Selection was based on age, and all infants of this age within 3 km of the village were included in the study. For the Aka infants, the camera was focused on the infant and the video recorder noted that there were often other interactions with the infant (e.g., looking at, talking to) from a distance (houses are very close to each other) that were not captured. We refer to data collected at this site as Aka-infant.

Adam Boyette (AB) collected additional video from eight small forest communities within 20 km of the village where the infants were filmed. Video recordings were done for a subsample of 50 children who participated in a larger time allocation study of learning in children's daily life. The data were collected between March and September of 2010. The children were chosen at random from within each of the three age categories: early childhood (~ 4–6), middle childhood (~ 7–12), and adolescence (~ 13–18). Note that only children aged 4–12 years were included in this dataset. Children were recorded at the start of a random hour for at least 30 min (time was extended if particular activities were especially relevant to the larger study aims). Each child's parents granted consent to video record the children, and each child gave their assent before data collection began. For all children, video recording was stopped if the children were too distracted by the camera, if they asked for it to be turned off, or if there was any visible sign from the children that it was evoking emotional stress. We refer to data collected at this site as Aka-child.

Rather than combining these data sets (infants and older Aka children), we treat them separately in the analyses below. Although they come from the same cultural group and region, the methods were different (infants were restricted to camp,

children were not), and the age distribution in an aggregated sample would complicate interpretation of the results. Given that the sample populations were selected opportunistically, we had no a priori hypotheses regarding similarities and notable differences in the early childrearing environment.

Participants

The video data consisted of observations of 87 children ranging in age from 2 months to 12 years (mean age = 17.1 months, $SD = 19.6$) from six different sample populations (Table 1). Six children were sampled twice in Fiji in different years, and therefore different developmental periods; we therefore treated their data as representing separate children.

Coding

A subset of the team of researchers who collected the data met in Vancouver for a two-day coding workshop where we reviewed our research questions, hypotheses, and several videos from each society and identified a process for coding the video library systematically across the different contexts. Next, the videos were stored and accessed by a team of undergraduate students (11), one graduate student, and one postdoctoral fellow at the university laboratory of the first author, Tanya Broesch (TB), who oversaw all of the coding. There were several training sessions, interrater reliability checks, and discussions throughout the coding process. Coders overlapped on 20% of the video coding, and interrater reliability was assessed by examining intraclass correlation coefficients (ICCs) across coding variables. Interrater reliability was excellent across the full dataset (ICC = 0.99, 95% confidence interval = [0.98, 0.99], $p < 0.001$), good within the Aka-infant sample (ICC = 0.86, 95% confidence interval = [0.80, 0.91], $p < 0.001$), and excellent within the five remaining society samples, including the Aka-child dataset (for each ICC ≥ 0.971, $p < 0.001$).

Coding Steps/Process First, TB trained research assistant video coders at our laboratory to watch all videos to determine if they met the minimum requirement to be designated a useable video file. Usability was based on meeting three criteria: the video follows a target individual (the child); the child is awake, viewable, and identifiable; and the video is longer than 20 s. The coders watched each video three additional times for behavioral coding. The coding approach was an interval continuous coding system, meaning that the students watched the videos continuously and coded for the following details. First, they coded the duration of time that different numbers, genders, and age categories (child/adult) were present. We refer to this as "opportunities to interact" (OTI). Next, they coded whether the primary caregiver (defined below) was present or absent and close to the child or more than 2 ft away,[1]

[1] 1 ft = ca. 30.5 cm. Distances measured in ft are reported here in ft.

Table 1 Participant and video information by society

Society	*n* (female)	Mean age (SD) in months	Mean age	Age range in months	No. of video observations	Mean video duration (minutes)	Total video duration (hours)
Tanna	27 (19)	12.67 (6.68)	1 yr	2–25	516	5	45
Yasawa	18 (9)	36.94 (22.1)	3 yrs	3–98	140	22	52
Tsimane	9 (1)	4.42 (2.07)	4.4 months	2–8	267	5	21
Peru	10 (6)	46.2 (17.19)	4 yrs	24–65	51	32	27
Aka Child	13 (7)	101.54 (36.53)	8.5yrs	48–144	14	21	5
Aka Infant	10 (5)	12.1 (0.57)	1 yr	11.5–13	10	62	10

or simply audible but not visible on camera. Last, they identified whether the infant was receiving direct visual gaze from anyone in the video (visual gaze). Videos were stored on our secure server, with only the coders having access to the videos. The coded data were recorded using BORIS (Friard & Gamba, 2016). All of the coded data are presented here.

Video Library The entire video library consisted of 1153 video files, of which we coded 998. 155 files were not suitable for coding because they did not meet the minimum observation duration of 20 s ($n = 97$); the focal child was asleep, obscured, or unidentifiable (e.g., unable to determine the focal individual) for the duration of the video ($n = 38$); or the files had been lost ($n = 11$) or were duplicates ($n = 9$).

Variable: Opportunities to Interact We first coded the proportion of time children were in the presence of other individuals and alone for each video-recorded observation. We identified both the number and gender of individuals on screen with the child target for each video. Student coders were trained to watch the videos and systematically code 12 variables indicating who was present with the focal child in continuous interval coding (meaning that each moment was coded, not specific events)[2]: 1 female child, 2 or more female children, 1 male child, 2 or more male children, 1 child whose gender could not be identified, 2 or more children whose gender(s) could not be identified, 1 female adult, 2 or more female adults, 1 male adult, 2 or more male adults, 1 adult whose gender could not be identified, and finally, 2 or more adults whose genders could not be identified. This coding enabled us to assess who is present in the video and the duration of time individuals remain in the video with the target child. (See "Discussion" for limitations in coding.)

Variable: Primary Caregiver For each video, student coders identified the first instance of a primary caregiver based on Melvin Konner's coding of the !Kung natural observations: "a caregiver/attendant (male or female) who is in closest proximity to the target (measured using an arm's length) and appears to be the most responsible for the target" (see Barr et al., 1991). The coder watched each video in real time (allowing for intermittent pausing) and determined and recorded the proportion of time the target child was in close proximity (within 2 ft) to the primary caregiver, close but not within arm's reach (> 2 ft) of this primary caregiver, the primary caregiver was off-screen but audible, or the primary caregiver left the screen and the child is now alone or with others (this included the portion of the video prior to which a primary caregiver was identified). Each of these variables was

[2] Although multiple variable intervals could be coded at the same time, there were six mutually exclusive pairs. For example, the presence of 1 female adult on screen could not be coded if 2 or more female adults were on screen (and vice versa). Similarly, the presence of 1 male child could not be coded if 2 or more male children were on screen (and vice versa). However, the presence of 2 or more female adults would not impact the coding of any other category, such as 1 female child, 2 or more female children, etc. (and vice versa). Similarly, the presence of 1 male child could not be coded if 2 or more male children were on screen (and vice versa). However, the presence of 2 or more female adults would not impact the coding of any other category, such as 1 female child, or 2 or more female children, etc.

coded in continuous intervals of time. Although there was some subjectivity in the assessment of who is "most responsible for" the child, in practice this was largely mitigated during coding by the first criterion of "closest proximity." Additionally, excellent interrater reliability observed for this coding (ICC = 0.993, 95% confidence interval = [0.988, 0.997], $p < 0.001$) indicates that the primary caregiver was readily apparent.

Variable: Visual Gaze Lastly, we coded the duration of time the target child spent receiving direct, unambiguous, visual gaze from other individuals, specifically as visual gaze on or off of the child in continuous intervals of time. We did not code mutual gaze.

Analytic Procedure

We calculated the proportion of time the target child spent with adults and other children of different genders, and whether direct visual gaze was present. This was done by first determining the total duration of the 12 coded interval variables within each video (described above in "Coding"), and the total duration of each video. Since each child was observed multiple times, we conceptually considered the multiple observations as one continuous video for each child. Therefore, for each child, we calculated the sum of each interval variable across all videos, and the sum of all their video durations. Finally, each child's interval variable sums were divided by their video duration sum, yielding the proportion of time spent in the presence of the interaction partners. This is to say, we calculated the total proportion of time across all the videos for each child, rather than an average proportion of time per video.

Results

Opportunities to Interact

Two main patterns emerged from our analysis. First, children in each society spend a large proportion of their time in the presence of "one female adult." Second, as children age, they spend more time in the presence of two or more male children and less time with one female adult (Fig. 1).

Analyses for Opportunities to Interact Differences in the proportions of total time that focal children spent interacting with various partners were assessed with a repeated measures Analysis of Variance (rANOVA) employing three within-subjects factors: partner age (child, adult), partner gender (female, male), and partner count (1, 2-or-more). Because of the small proportion of time that children spent with adults, and the children whose genders could not be identified during coding, these variables were excluded from inferential analyses, although descriptive statistics are provided in Table 2. Significant interactions were probed with follow-up

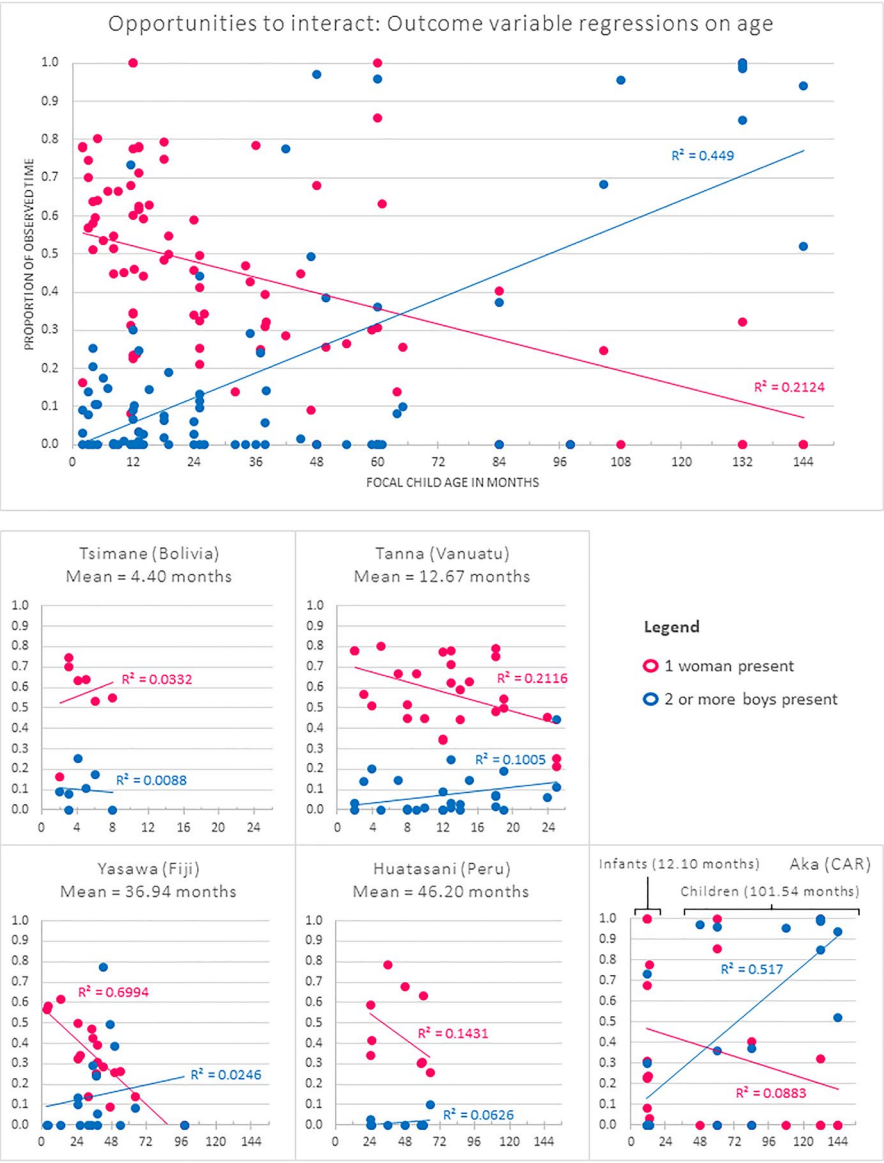

Fig. 1 As they increase in age, infants and children spend less time in the presence of 1 female adult and more time in the presence of 2 or more boys (in most but not all of the sample populations)

t-tests, ANOVAs, or correlation tests using the Bonferroni correction for multiple comparisons.

Overall, the rANOVA returned significant main effects for all three factors (Table 3). In addition, there were significant interactions of partner age by partner gender, and partner gender by partner count. The interaction of partner age by

Table 2 "Opportunities to interact" coding by society

	Tanna	Yasawa	Tsimane	Peru	Aka Child	Aka Infant
Total minutes of valid time	2141.0	547.7	822.9	206.2	52.8	40.4
Proportion of time spent: Mean (SD)						
with girls						
1 present	0.125	0.197	0.253	0.314	0.013	0.098
	(0.141)	(0.215)	(0.175)	(0.367)	(0.047)	(0.182)
2-or-more present	0.054	0.026	0.093	0.015	0.000	0.061
	(0.106)	(0.049)	(0.182)	(0.035)	(0.000)	(0.163)
None present	0.821	0.777	0.654	0.672	0.987	0.841
	(0.180)	(0.240)	(0.263)	(0.374)	(0.047)	(0.292)
with boys						
1 present	0.204	0.243	0.316	0.098	0.133	0.178
	(0.143)	(0.264)	(0.176)	(0.213)	(0.209)	(0.299)
2-or-more present	0.076	0.142	0.111	0.013	0.686	0.104
	(0.103)	(0.218)	(0.111)	(0.032)	(0.385)	(0.241)
None present	0.720	0.616	0.573	0.889	0.182	0.719
	(0.207)	(0.309)	(0.238)	(0.214)	(0.359)	(0.337)
with children of unknown gender						
1 present	0.069	0.044	0.070	0.023	0.059	0.194
	(0.079)	(0.086)	(0.072)	(0.034)	(0.144)	(0.213)
2-or-more present	0.042	0.008	0.005	0.011	0.096	0.382
	(0.068)	(0.024)	(0.010)	(0.035)	(0.280)	(0.331)
None present	0.889	0.948	0.925	0.965	0.846	0.424
	(0.118)	(0.087)	(0.076)	(0.065)	(0.319)	(0.356)
with women						
1 present	0.571	0.331	0.580	0.430	0.276	0.458
	(0.178)	(0.175)	(0.199)	(0.238)	(0.410)	(0.370)
2-or-more present	0.213	0.205	0.327	0.208	0.194	0.381
	(0.161)	(0.183)	(0.259)	(0.215)	(0.372)	(0.363)

Table 2 (continued)

	Tanna	Yasawa	Tsimane	Peru	Aka Child	Aka Infant
None present	0.216	0.465	0.093	0.362	0.530	0.161
	(0.135)	(0.246)	(0.083)	(0.336)	(0.459)	(0.327)
with men						
1 present	0.120	0.163	0.219	0.063	0.121	0.161
	(0.128)	(0.152)	(0.217)	(0.066)	(0.205)	(0.323)
2-or-more present	0.024	0.090	0.091	0.071	0.237	0.019
	(0.032)	(0.165)	(0.103)	(0.125)	(0.389)	(0.061)
None present	0.856	0.747	0.690	0.866	0.643	0.820
	(0.142)	(0.232)	(0.293)	(0.141)	(0.424)	(0.369)
with adults of unknown gender						
1 present	0.008	0.005	0.002	0.014	0.000	0.000
	(0.012)	(0.010)	(0.006)	(0.040)	(0.000)	(0.000)
2-or-more present	0.010	0.000	0.000	0.010	0.000	0.000
	(0.034)	(0.000)	(0.000)	(0.019)	(0.000)	(0.000)
None present	0.982	0.995	0.998	0.977	1.000	1.000
	(0.036)	(0.010)	(0.006)	(0.045)	(0.000)	(0.000)

partner count approached, but failed to reach, significance. For the interaction of partner age by partner gender, follow-up tests indicated that the greatest proportion of time was spent with female adults. In addition, for the follow-up tests of partner gender by partner count, the greatest proportion of time was spent with one female partner. As such, the results of this rANOVA supported the conclusion that across this sample of focal children, adult women were the most common partners for children to spend time with.

Are Opportunities to Interact moderated by subject gender, age, or population sample? Three separate tests were run to examine whether the proportion of time spent with various individuals was moderated by subject (child) gender, age, or population sample. All three tests used the same within-subjects factors as above, with the addition of a between-subjects factor (i.e., a grouping variable or a continuous covariate, as described by Baron & Kenny, 1986; Cohen et al., 2013). Significant interactions with grouping variables were further explored with follow-up *t*-tests. Significant interactions with covariates were explored by examining correlation coefficients.

Table 3 "Opportunities to Interact" ANOVA results; significant interactions are in **bold**

Effect	df	*F*	*p*	η_p^2
Opportunities to Interact repeated measures ANOVA				
PartnerAge	**1,86**	**29.442**	**< .001**	**0.255**
PartnerCount	**1,86**	**24.216**	**< .001**	**0.22**
PartnerGender	**1,86**	**14.598**	**< .001**	**0.145**
PartnerAge*PartnerCount	1,86	3.79	0.055	0.042
PartnerAge*PartnerGender	**1,86**	**116.549**	**< .001**	**0.575**
PartnerCount*PartnerGender	**1,86**	**14.804**	**< .001**	**0.147**
PartnerAge*PartnerCount*PartnerGender	1,86	0.619	0.434	0.007
OTI*SubjectGender				
PartnerAge	1,85	28.949	**< .001**	0.254
*SubjectGender	1,85	0.002	0.966	0
PartnerCount	1,85	23.384	**< .001**	0.216
*SubjectGender	1,85	0.439	0.510	0.005
PartnerGender	**1,85**	**14.038**	**< .001**	**0.142**
*SubjectGender	1,85	0.341	0.561	0.004
PartnerAge*PartnerCount	1,85	3.367	0.070	0.038
*SubjectGender	1,85	2.186	0.143	0.025
PartnerAge*PartnerGender	**1,85**	**114.713**	**< .001**	**0.574**
*SubjectGender	1,85	2.031	0.158	0.023
PartnerCount*PartnerGender	**1,85**	**14.346**	**< .001**	**0.144**
*SubjectGender	1,85	0.119	0.731	0.001
PartnerAge*PartnerCount*PartnerGender	1,85	0.609	0.437	0.007
*SubjectGender	1,85	0	0.993	0
SubjectGenderMainEffect	**1,85**	**9.777**	**0.002**	**0.103**
OTI*Culture				
PartnerAge	**1,81**	**26.899**	**< .001**	**0.249**
*Culture	5,81	2.013	0.085	0.111
PartnerCount	**1,81**	**25.04**	**< .001**	**0.236**
***Culture**	**5,81**	**7.623**	**< .001**	**0.32**
PartnerGender	**1,81**	**20.832**	**< .001**	**0.205**
***Culture**	**5,81**	**11.682**	**< .001**	**0.419**
PartnerAge*PartnerCount	1,81	2.203	0.142	0.026
*Culture	5,81	2.048	0.081	0.112
PartnerAge*PartnerGender	**1,81**	**104.654**	**< .001**	**0.564**
***Culture**	**5,81**	**2.326**	**0.05**	**0.126**
PartnerCount*PartnerGender	**1,81**	**14.756**	**< .001**	**0.154**
***Culture**	**5,81**	**3.503**	**0.006**	**0.178**
PartnerAge*PartnerCount*PartnerGender	1,81	0.041	0.840	0.001
*Culture	5,81	2.133	0.070	0.116
CultureMainEffect	**5,81**	**3.883**	**0.003**	**0.193**
OTI*SubjectAge				
PartnerAge	**1,83**	**46.837**	**< .001**	**0.361**

Table 3 (continued)

Effect	df	*F*	*p*	η_p^2
***SubjectAge**	**1,83**	**15.804**	**< .001**	**0.16**
PartnerCount	**1,83**	**67.47**	**< .001**	**0.448**
***SubjectAge**	**1,83**	**35.376**	**< .001**	**0.299**
PartnerGender	**1,83**	**62.16**	**< .001**	**0.428**
***SubjectAge**	**1,83**	**43.361**	**< .001**	**0.343**
PartnerAge*PartnerCount	1,83	0.568	0.453	0.007
*SubjectAge	1,83	0.958	0.330	0.011
PartnerAge*PartnerGender	**1,83**	**53.39**	**< .001**	**0.391**
*SubjectAge	1,83	0.132	0.718	0.002
PartnerCount*PartnerGender	1,83	0.568	0.453	0.007
***SubjectAge**	**1,83**	**9.468**	**0.003**	**0.102**
PartnerAge*PartnerCount*PartnerGender	**1,83**	**7.995**	**0.006**	**0.088**
***SubjectAge**	**1,83**	**11.147**	**0.001**	**0.118**
SubjectAgeMainEffect	1,83	0.002	0.969	0

Moderation by Gender To test whether the proportion of time spent with various individuals was moderated by subject gender, a mixed factors ANOVA was run using a between-subjects factor of subject gender (male, female). Gender did not significantly impact results (Table 3, OTI*Subject Gender). That is to say, focal boys and girls were surrounded by similar gender mix of people.

Moderation by Population Sample The moderating effect of site was examined using a mixed factors ANOVA with site as a between-subjects factor (six groups). There was a clear moderating influence of research site on results. First, all main effects and interactions detected in the initial ANOVA remained significant. In addition, there were significant interactions of site with the main effects of partner count and partner gender, and the interactions of partner age by partner count, and partner age by partner gender (Table 3, OTI*Society).

We ran follow-up tests to probe the interactions of site with the OTI outcome variables. Specifically, the significant mixed effect ANOVA was followed by separate rANOVAs within each site to break apart the observed group effects. Within the Vanuatu, Fiji, Bolivia, and Aka-infant samples, we found significant interactions of partner gender by partner age, which follow-up tests revealed were driven by a significantly greater proportion of time spent with adult women than with other partner categories (see "Methods" for category descriptions). In contrast, although the same interaction was significant within the Aka-child sample, follow-up tests indicated that it was driven by significantly greater proportion of time spent with boys than with others. Within the Peru sample, this interaction was not significant. However, a significant interaction of partner count by partner gender was seen in this sample, and follow-up tests indicated that this interaction was driven by more time spent with one female partner than another type/count of partner. This would support the notion that within the Peruvian sample, there was a similar pattern of female adults

spending large proportions of time with focal children. Finally, within the Vanuatu subsample, all main effects and interactions were found to be significant, including the three-way interaction of partner age by gender by count. Follow-up tests suggested that these focal children spent the most time in the presence of the coded category "one female adult" and the least amount of time with two or more girls.

Taken together, these follow-up tests indicate that the general pattern of most time being spent with adult women that was seen in the initial OTI ANOVA was also clearly seen at four sites: Vanuatu, Fiji, Bolivia, and Aka-infant. This pattern did not exist in Peru. Finally, a different pattern was seen among the Aka-child data—that is, most time spent with male children, rather than a female adult. Moderation analyses of OTI variables by focal child age (see next subsection) suggest that this differing pattern may have been driven by the older age of the Aka children in this sample.

Moderation by Subject Age The moderating effect of subject age was examined using an Analysis of Covariance (ANCOVA) test with the three within-subjects factors, and a continuous covariate of subject age (months). Results indicated that subject age moderated the proportions of time spent with others (Table 3, OTI*SubjectAge). That is to say, older and younger focal children spent their time with different categories of people. First, the main effects of partner age, gender, and count, as well as the interaction of partner age with partner gender, remained significant in the moderation ANCOVA. All three main effects interacted significantly with the age covariate. The previously significant interaction of partner count by partner gender was replaced by a significant three-way interaction with the age covariate. Finally, a significant four-way interaction was found for partner age by partner gender by partner count with the subject age covariate.

To probe these interactions, follow-up tests were performed examining the correlations of subject age with each of the eight Opportunities to Interact outcome variables. There was a large significant positive correlation of subject age with the proportion of time spent with two or more male children ($r = 0.66$, $p < 0.001$, $n = 85$), and a medium significant positive correlation of age with time spent with two or more male adults ($r = 0.310$, $p = 0.004$, $n = 85$). In addition, there was a moderately significant negative correlation between subject age and time spent with one female adult ($r = -0.452$, $p < 0.001$, $n = 85$). All remaining correlations between opportunity to interact variables and subject age were small, nonsignificant, and negative (for each, $r \leq -0.178$, $p \geq 0.102$). Taken together, these correlations suggest that across the sample, older children spent less time with their mothers or other female primary caregivers and spent more time with groups that include multiple male partners of various ages. The relationship between age and a decline in the time spent with one female adult, versus increasing amount of time spent with two or more male children, can be seen in Fig. 1.

The key strength of the current study is that it draws on observational data of children from multiple sociocultural contexts, across a wide age range. Although this enables us to explore cross-cultural developmental variation, the large age range of this sample, and the nonoverlapping age ranges of the six subsamples, present an important constraint on our ability to draw firm conclusions. Therefore, after

assessing correlations between age and each of the Opportunity to Interact variables across the entire sample, these correlations were also examined within each of the different subsamples. Given the small sample sizes of each group (with the exception of the Vanuatu sample), these tests were unlikely to have returned statistically significant correlations for even large effect sizes. However, these tests were important because the children in the Aka-child sample were significantly older than the rest of the sample (for all mean age comparisons using independent sample *t*-tests, mean difference ≥ 55.338, $p < 0.001$). Furthermore, as described above, analyses by site indicated that the Aka-child sample spent their time differently to those from the other five sites. Specifically, these children spent less time with adult women and more time with groups of boys, a pattern that mirrored the effect of age across the entire sample of 87 children.

Therefore, there are two possible interpretations of why age moderated opportunities to interact with various partners in the current study. On one hand, it could be the case that because the older Aka children were older than those in the other samples, they were more likely to spend time with groups of boys and less likely to spend time with a female primary caregiver. That is to say, the Aka children simply spent their time in a way that followed an overall cross-cultural trend in which age is negatively correlated with time spent with mothers, and positively correlated with time spent with groups of boys. On the other hand, it is possible that a cultural difference among Aka children results in children spending less time with mothers and more time with groups of boys regardless of age. If so, given the differing methods and objectives between the study sites, the fact that these children were the oldest children observed in the current study may have driven the significant effects of age observed for analyses of the entire sample. However, with Aka-child focal subjects excluded, the negative correlation between age and time spent with one adult woman remained significant, and it became stronger ($r = -0.502$, $p < 0.001$, $n = 73$). Furthermore, there were significant negative correlations of age and time spent with one woman in Vanuatu ($r = -0.460$, $p < 0.01$, $n = 27$) and Fiji ($r = -0.836$, $p < 0.001$, $n = 18$), and a moderate negative correlation that failed to reach significance in Peru ($r = -0.378$, $p > 0.01$, $n = 10$). The relationship between age and time spent with one woman versus two or more boys is demonstrated within each sample in graphs presented in Fig. 1. As such, there is evidence to suggest that the age-related changes in time spent with adult women versus groups of children reflects a real trend across several cultures, rather than being driven by just one culture.

Primary Caregiver

Differences in the proportions of total time children spent with a primary caregiver were assessed with an rANOVA employing one within-subjects factor of primary caregiver presence (absent, present and visible within 2 ft, present and visible more than 2 ft away, present off-screen but audible; see Table 4 for means and SDs). The rANOVA returned a strong significant main effect (Table 5). This

Table 4 Primary caregiver and visual gaze coding by society

	Tanna	Yasawa	Tsimane	Peru	Aka Child	Aka Infant
Primary Caregiver Coding						
Total minutes of valid time	2599.5	508.3	939.7	197.8	52.7	40.2
Proportion time: Mean (SD)						
Primary caregiver absent	0.358 (0.131)	0.474 (0.259)	0.107 (0.104)	0.268 (0.240)	0.458 (0.472)	0.087 (0.211)
Female primary caregiver within 2ft	0.463 (0.160)	0.215 (0.208)	0.756 (0.194)	0.362 (0.200)	0.137 (0.332)	0.636 (0.445)
Female primary caregiver more than 2ft away	0.087 (0.070)	0.081 (0.065)	0.038 (0.057)	0.234 (0.158)	0.165 (0.355)	0.128 (0.229)
Female primary caregiver offscreen but audible	0.005 (0.009)	0.025 (0.033)	<0.001 (0.001)	0.087 (0.055)	0.000 (0.000)	0.043 (0.081)
Male primary caregiver within 2ft	0.046 (0.070)	0.097 (0.178)	0.052 (0.072)	0.004 (0.013)	0.105 (0.280)	0.098 (0.309)
Male primary caregiver more than 2ft away	0.014 (0.029)	0.039 (0.067)	0.003 (0.007)	0.001 (0.004)	0.132 (0.302)	0.002 (0.007)
Male primary caregiver offscreen but audible	<0.001 (0.005)	0.018 (0.033)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Visual Gaze Coding						
Total minutes of valid time	1635.7	959.7	843.9	289.4	110.1	40.3
Proportion time: Mean (SD)						
Visual gaze off child	0.535 (0.142)	0.685 (0.117)	0.683 (0.131)	0.746 (0.145)	0.876 (0.133)	0.673 (0.185)
Visual gaze on child	0.454 (0.131)	0.315 (0.125)	0.307 (0.127)	0.246 (0.149)	0.123 (0.133)	0.327 (0.185)

Table 5 Primary caregiver ANOVA results; significant interactions are in **bold**

Effect	df	F	*p*	η_p^2
Primary caregiver repeated measures ANOVA				
Primary caregiver Presence	**3,258**	**44.71**	**< .001**	**0.342**
PA*SubjectGender				
Primary caregiver Presence	**3,258**	**43.989**	**< .001**	**0.341**
*SubjectGender	3,255	0.009	0.999	0
SubjectGenderMainEffect	1,85	1.155	0.286	0.013
PA*Culture				
Primary caregiver Presence	**3,243**	**51.89**	**< .001**	**0.39**
***Culture**	**3,243**	**6.136**	**< .001**	**0.275**
CultureMainEffect	**5,81**	**2.504**	**0.037**	**0.134**
PA*SubjectAge				
Primary caregiver Presence	**3,249**	**55.244**	**< .001**	**0.384**
***SubjectAge**	**3,249**	**18.77**	**< .001**	**0.184**
SubjectAgeMainEffect	1,83	1.55	0.217	0.018

means subjects were not equally likely to spend time with a caregiver absent, within 2 ft, beyond 2 ft, or off-screen. Follow-up *t*-tests indicated that primary caregivers were most often absent, yet when they were present, they were close to the child (within 2 ft).

Moderation by Subject Gender, Age, and Site As with the Opportunities to Interact variables, three separate tests were run to examine whether primary caregiver proximity was moderated by subject gender, subject age, or site. All used the within-subjects factor as described above, with the addition of a between-subjects factor (i.e., grouping variable or continuous covariate). Primary caregiver proximity showed no significant interactions with subject gender, but it was significantly moderated by subject age and site.

Moderation by Site Site interacted significantly with primary caregiver presence in a mixed factors ANOVA. Follow-up ANOVAs within each site revealed that the main effect of primary caregiver presence was significant for Vanuatu, Bolivia, Aka-infant, and Fiji, but not for Peru or Aka-child (Table 5). Within the groups for which the effect was significant, the greatest proportion of time was spent within 2 ft of a primary caregiver in the samples with the youngest subjects: Vanuatu (0.509), Bolivia (0.808), and Aka-infant (0.734). In these groups a primary caregiver was unlikely to be absent, though the rates varied (0.358, 0.107, and 0.087, respectively). On the other hand, in the Fijian sample the greatest proportion of time was spent with a primary caregiver absent (0.474), followed by being within 2 ft (0.312).

Moderation by Subject Age Subject age interacted significantly with the main effect of primary caregiver presence in an ANCOVA (Table 5, PA*SubjectAge). Follow-up correlations revealed a large negative correlation of age with the proportion of time that a primary caregiver was within 2 ft of a child ($r = -0.520$, $p < 0.001$,

$n = 85$), and moderately positive correlation with the proportion of time that a primary caregiver was absent ($r = 0.328$, $p < 0.001$, $n = 85$) or more than 2 ft away ($r = 0.375$, $p < 0.001$, $n = 85$). Taken together, this would suggest that as children age, they spend less time in the close proximity of a primary caregiver.

As noted for analyses of opportunities to interact, the nonoverlapping age ranges of the various subsamples necessitate caution in drawing conclusions. Therefore, additional tests examined the correlations of age with primary caregiver proximity within each site. Similar results to the findings for the overall sample were found within Fiji (a positive correlation of age with primary caregiver absence, and a negative correlation of age with a primary caregiver being within 2 ft) and Vanuatu (a negative correlation of age with a primary caregiver being within 2 ft). Similar trends were observed for the other sites, but small sample sizes precluded finding significant results for even strong correlations.

Visual Gaze

Visual gaze could not be coded for six subjects from the Aka-child sample, and as such they were excluded from these analyses. The impact of subject gender on the proportion of time that the subject was the object of another person's visual gaze was assessed using a one-way ANOVA with a between-subjects factor of subject gender (male, female). Results indicated that visual gaze on the child was not impacted by the child's gender. The effect of site on the proportion of time that the subject was the object of another person's visual gaze was assessed using a one-way ANOVA with a between-subjects factor of culture (six groups). This test returned a significant main effect. Follow-up *t*-tests indicated that this effect was driven predominantly by children from Vanuatu—children from Vanuatu were more likely to be the target of another's gaze than children in other societies were.

Finally, the association between subject age and the proportion of time that the child was the object of another person's visual gaze was assessed by examining the correlation between the two variables. Overall there was a large negative correlation between age and visual gaze ($r = -0.448$, $p < 0.001$), suggesting that as children become older they are less likely to be the recipient of direct gaze. Given the possibility that this effect was driven by the previously described increased visual gaze on children from Vanuatu, we reexamined the correlation excluding those children. This analysis confirmed the presence of the effect across the remaining children ($r = -373$, $p = 0.006$, $n = 52$). However, further tests suggested that this negative correlation was moderated by the gender of the focal child. Although there was a strong significant negative correlation between age and visual gaze for girls ($r = -0.649$, $p < 0.001$, $n = 43$), for boys the effect was small and failed to reach significance ($r = -0.237$, $p = 0.164$, $n = 36$). A Fisher *r*-to-*z* transformation confirmed that the negative correlation between visual gaze and age was indeed significantly greater for girls than for boys ($z = -2.26$, $p = 0.024$, two-tailed). Means and standard deviations of the proportions of time that visual gaze was on or off the target children are provided in Table 4 and displayed in Fig. 2.

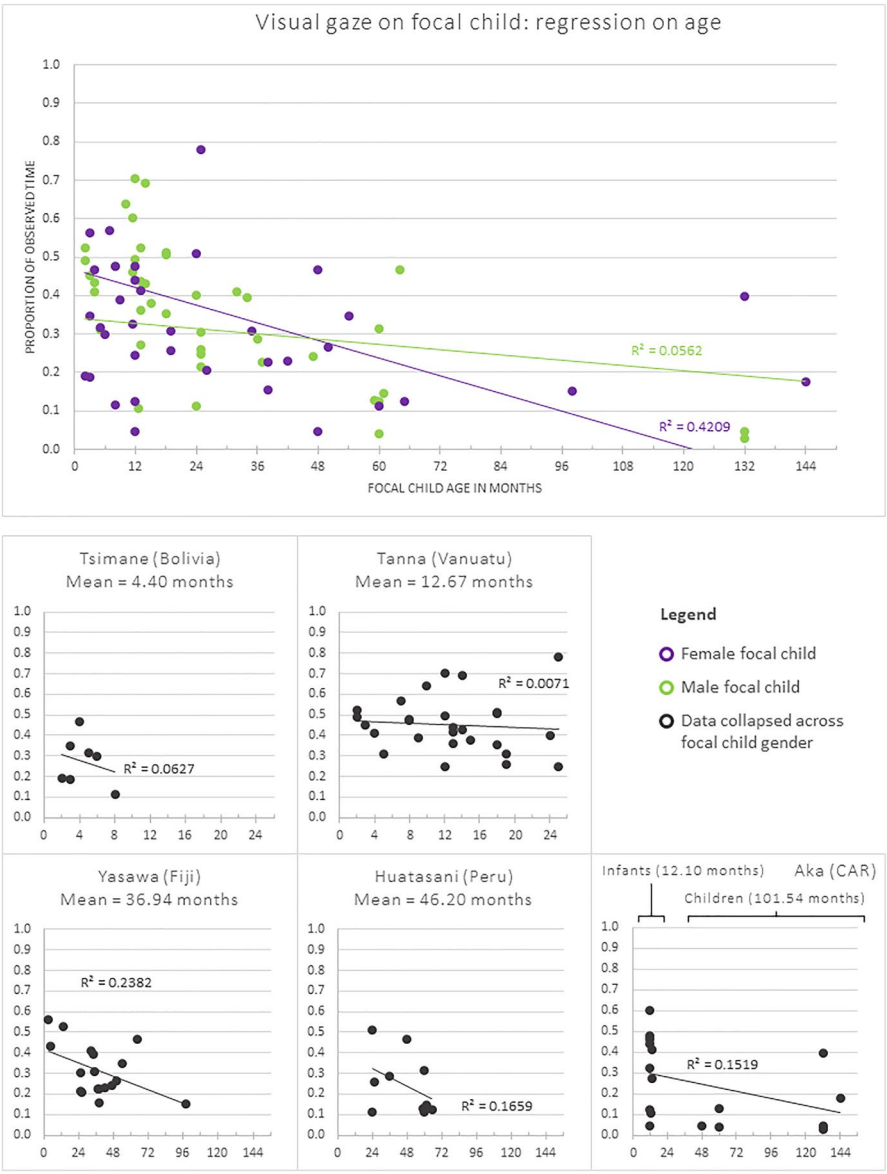

Fig. 2 As children become older, they are less likely to be the recipients of direct gaze

Discussion

In this paper, we sought to examine children's opportunities for social interaction across diverse social contexts and with age. Our aim was to observe and describe variability and similarities in whom infants and children spend their time with early in life. We were also interested in determining whether the infant or child is the

focal point of those interactions—as measured by visual gaze toward the child. Data collection occurred over several years for ethnographic projects with different objectives. We collated and video-coded this rare dataset with the primary goal of describing the overall social context available to children across societies. We followed and recorded 81 children in five different societies at various points throughout our fieldwork and produced 998 videos (160 total hours). Although there are obvious limitations to this unstructured and less-than-systematic data collection procedure, there is value in the dataset, which we highlight below.

Our data reveal some consistent developmental patterns, as well as some interesting variability, across the diverse contexts. Although we have some datasets with nonoverlapping age distributions, making it difficult to disentangle age and society factors, there do seem to be trends that hold across societies in our video observations. First, analysis of the categorical codes indicated that the greatest proportion of observations included the presence of one female adult. Additional coding revealed that the female adult was in close proximity (within 2 ft) of the infant or child and appeared to be "responsible" for the infant or child, suggesting that she may be the infant or child's primary caregiver. This suggests that women in this particular video dataset (not necessarily the mothers) are attending to infants or children more than are any other category of person—in other words, more than other coded categories of adults or children. We also found that as children increased in age, they spent less time in the presence of one female adult, which was not surprising as children become less "helpless" and more able to socialize with peers and other adults on their own. We also found a shift around age 5, with children spending more time in the presence of other children. Although this effect is largely consistent with ethnographers' observations in their respective societies, the quantitative finding in this project is driven by the Aka-child sample, which is on the upper end of the age distribution for our subjects. We also found that when children begin to spend more time with other children, it is typically with two or more male children. These findings have important implications for parents, caregivers, and developmental theories.

First, as Bowlby (1958, 2008) suggested, infants are born helpless and therefore spend a significant proportion of their time in the first few years of life in close proximity to one primary caregiver. Note that although Bowlby underscored the primacy of the mother, contemporary interpretations and research investigating the role of others in infancy indicate that fathers, grandparents, and other caregivers also satisfy this role, depending on the context. In this project, we found that children tend to spend more time in the coded category of "one female primary caregiver"—though this varies even within the infant samples from the same society, from less than 5% to 100% of the time in the videos. Our data support Bowlby's Attachment Theory, which proposes that infants and young children spend a significant proportion of time under the care of one primary caregiver (not necessarily the mother, and not all of the time)—allowing for the child to form a reliable, trusting, emotional bond from which they can explore the world and develop other trusting relationships (Bowlby, 1958, 2008).

We also examined the proportion of time that children were recipients of direct visual gaze. We found that as children become older, they are less likely to be the

recipient of direct visual gaze from others—and this was consistent across sites. The mean proportion of observed time when visual gaze was on the child ranged from 0.45 (Tanna) to 0.12 (Aka-child). What is notable about this finding is that children were in direct visual gaze for a significant proportion of their observed time (approximately 1/3) in the first few years of life. Again, this finding is not trivial as it lends support to existing theories of infant language and social development which suggest that the infant is an interactive partner who receives direct attention from a caregiver, rather than passively observing others interacting.

As stated, we were opportunistic in bringing the videos together from experts at each site. We should note, however, that the methods were strikingly similar for all sites except in the older Aka children sample. These children tended to leave camp to autonomously forage and play outside the presence of adults, making filming (and subsequent coding) more challenging as the children moved through the dense forest off of trails. Peru and Fiji were similar in that the researchers observed the same child for one continuous observation (with interspersed stop-and-start videos). And Bolivia and Vanuatu were most similar in that they observed young children for shorter, more frequent observation. Lastly, the Aka-infant dataset is unique in that it captures similar-aged infants for the same video observation duration daily. Given the variable methods and procedures used, we of course may be missing striking differences by site, or misattributing methodological differences to site-based ones. For example, it is likely that one video angle cannot capture the surrounding rich social interactions and individuals focused on or attending to the infant. Furthermore, the differing research objectives and approaches of the contributors to this project have implications for the sample sizes of the datasets from each society. It is important to note that the relatively small sample sizes for several societies included in this study—particularly the Tsimane, Peruvian, Aka-child, and Aka-infant samples—limit the degree to which we can draw strong conclusions regarding between-site differences. The statistical power of the rANOVA models and correlation tests examining society were fairly low. However, given the exploratory nature of the current study, and the limited existing research on this topic, these analytic tools provide a useful, objective lens to guide our investigation.

Although we note that, with increasing age, children spend more time with two or more male children, there are limitations to our coding that need to be stated. First, although the coding for identifying the gender and age of individuals was reliable, some aspects may have been reliably inaccurate. For example, to identify the primary caregiver we used Konner's operational definition of a primary caregiver while coding the videos. However, Konner's ethogram was developed for use in the field by individuals highly familiar with the context and the focal individuals. Our data were collected and later coded by individuals unfamiliar with the context and the individuals in the film. This may have impacted the accuracy of the coding for individuals to identify the gender of children as well as identify the primary caregiver. However, our finding that children tended to spend more time with male children rather than female children may be explained by the finding that boys tend to play for longer than girls since girls enter the labor force at younger ages than boys across a range of small-scale societies, including the Aka (Boyette, 2016a; Lew-Levy & Boyette, 2018; Montgomery, 2010). In other words, our observations are consistent

with the possibility that girls were more likely than boys to be off-camera, working away from spaces occupied by younger children.

Overall, these findings suggest that children are, in fact, spending a significant proportion of time with one female caregiver across these diverse sociocultural contexts. It should be noted, however, that the average age for the children observed was 1.5 years and that the age range is wide (2 months to 12 years). This finding also supports the claim that middle-childhood is an important period for collaborative cultural learning and teaching across human societies (Boyette, 2016b; Lew-Levy et al., 2020). Although this effect is driven by the sample with older children, it reflects qualitative observations of this team of researchers. These findings may seem intuitive and unremarkable on the surface given the similarity to childhood in an urban and Western context; nevertheless, they are not trivial in light of the ethnographic observations that suggest that the context for childhood is variable depending on the sociocultural goals, subsistence practices, and socialization pressures of a society.

Equally important, the quantitative data provide estimates for the extent of cross-site variation that we can expect in early childhood social interactions. For example, the Tanna infants experienced the highest proportion of visual attention (45% of observed time), whereas infants in the Tsimane sample, who were 8 months younger on average, experienced less visual gaze (30% of observed time). This suggests that human infants and children can expect certain broad patterns of social interactions, but these may vary quantitatively according to the context. We therefore urge developmental social scientists to build theories that account for both cross-cultural regularities and variation in the kinds of social worlds that infants and children inhabit.

Acknowledgments Participants, experts, and leaders in the communities where the research was conducted.

Funding This project was supported by a SSHRC Insight Development Grant (31-R640044) to Tanya Broesch and a Jacobs Foundation Young Scholar Grant to Chris von Rueden and Tanya Broesch.

Declarations

Ethical approval The office of research ethics at Simon Fraser University provided the ethics approval for study #2019s0433.

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