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Cultural Variation in Triadic Infant–Caregiver Object Exploration

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Two studies examined the extent to which the type of triadic interaction pervasive in Western populations (i.e., shared visual attention and ostensive pedagogical cues) was representative of infant–caregiver object exploration in a non-Western indigenous community. Caregivers in the United States and Vanuatu interacted with infants and a novel object for 3 min. In Study 1 (N = 116, M_{age} = 29.05), Ni-Van caregivers used more physical triadic engagement and U.S. caregivers used more visual triadic engagement. In Study 2 (N = 80, M_{age} = 29.91), U.S. caregivers were more likely than Ni-Van caregivers to transmit an action and to use visual cues while interacting with their child. These studies demonstrate that the Western model of early social learning is not universal.

Triadic interaction in which adults and infants are jointly attuned to an external object or event is a hallmark of early human sociality. Social play with caregivers and objects facilitates the development of object knowledge (Striano, Chen, Cleveland, & Bradshaw, 2006; Wu, Gopnik, Richardson, & Kirkham, 2011) and person knowledge (Deák, Krasno, Triesch, Lewis, & Sepeta, 2014). Caregivers promote learning by transmitting relevant information about objects via overt, visual pedagogical cues, including pointing and gaze alternation (Csibra & Gergely, 2009; Sage & Baldwin, 2011). The social learning opportunities that adults provide for young children are facilitated and constrained by culture (Bornstein, 2012; Clegg & Legare, 2015; Herrmann, Legare, Harris, & Whitehouse, 2013; Legare & Nielsen, 2015; Legare, Wen, Herrmann, & Whitehouse, 2015; Mathew & Perreault, 2015). The pattern of face-to-face triadic interaction and ostensive pedagogy that dominates the literature on early social learning is characteristic of infant–caregiver interaction among Western, Educated, Industrialized, Rich, and Democratic populations (WEIRD) (Henrich, Heine, & Norenzayan, 2010). There is mounting evidence that WEIRD populations are unrepresentative of human culture globally and historically. Ethnographic accounts of behavior outside of this particular context document considerable variation in fundamental aspects of childrearing, including the modality and contingency of social interaction with infants (e.g., Bornstein et al., 1992; Kärtner, Keller, & Yovsi, 2010; Kärtner et al., 2008; Keller et al., 2009; Richman, Miller, & LeVine, 1992), and the propensity for adult-led didactic behavior (Bornstein, 2012; Harkness & Super, 2002; Lancy, Bock, & Gaskins, 2010).

Outside of the WEIRD cultural context, adults in many communities emphasize physical contact with infants instead of visual, face-to-face contact (e.g., in !Kung San communities, Konner, 2005; Gusii communities, Richman et al., 1992; Samoan communities, Ochs & Schieffelin, 2001). Within the context of social object exploration, object play is not always scaffolded by adult-led behavior, as learning experiences in many cultures are either more collaborative (e.g., in Guatemalan Mayan communities, Rogoff, Mistry, Göncü, & Mosier, 1993; Rogoff, Paradise, Arauz, Correa-Chávez, & Angelillo, 2003) or occur without the direct social support of adults (e.g., in !Kung San communities, Bakeman, Adamson, Konner, & Barr, 1990; and Yucatec Mayan communities, Gaskins, 2000). The desire to instruct, stimulate, and engage infants directly during object play are behaviors associated more commonly with urban, industrialized communities rather than agrarian, small-scale communities (e.g., caregivers in Germany and Greece rather than caregivers in rural Cameroon and rural India, Keller et al., 2009).

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The lack of evidence for ostensive visual cues guiding infants' experimentation with objects outside of Western contexts provides little support for "natural pedagogy," the evolved method of generic knowledge transmission (Csibra & Gergely, 2009) as the primary system of early knowledge acquisition in these cultures (Lancy et al., 2010). As one alternative, many studies cite observation-based social learning—without direct visual pedagogical cues—as the norm for early learning (e.g., Gaskins & Paradise, 2010; Heyes, 2012; Odden & Rochat, 2004). Observing an activity can be equally—if not more—salient than actually doing the activity (Cross, Kraemer, Hamilton, Kelley, & Grafton, 2009), and learning through observation is not a passive experience but rather requires intent participation on the part of the child (Rogoff et al., 1993, 2003). As another alternative to the visual direct instruction proposed in the natural pedagogy literature, physically manipulating a child's body to assist them in completing an action has also been observed as a form of cultural transmission (Maynard, 2002). Such cultural differences raise questions about the use of Western models of visual shared attention and didactic pedagogy to universally represent human socialization.

Even so, this knowledge of cultural variation stems primarily from ethnographic observations of naturally occurring behavior, where the context of the collaborative object exploration varies significantly across cultures. Due to the discrepancy in methodology between ethnography and experimental research, this evidence has not been sufficiently integrated into existing psychological accounts of social cognition (Harkness & Super, 2002; Harkness et al., 2010). Although developmental psychology has shifted over the past several decades to begin recognizing the relevance of cultural variation in early social learning, the majority of research in the field still shows a substantial Western-centric bias. Of all the papers published between 2006 and 2010 in *Child Development*, *Developmental Psychology*, and *Developmental Science* that reported the demographics of their participants, only 7% featured data from participants outside of Western countries, and of those, only 4% were authored by researchers outside of the Western world (Nielsen, Haun, Kaertner, & Legare, 2016). This lack of research on cultural variation in caregiving calls into question the generalizability of theory in social cognitive development and early social learning (Callaghan et al., 2011; Nielsen & Tomaselli, 2010). Psychological research would benefit from a more comprehensive understanding of how cross-cultural continuities and variation in caregiving contribute to the developmental trajectory of social learning, consistent with approaches that view culture as a dynamic process embedded in human development and behavior (Cole, 1995; Hong & Chiu, 2001; Rogoff, 2003). Without structured cross-cultural comparisons of infants' social learning opportunities, it is unclear whether the propensity of adults to use overt, visual pedagogical cues with infants is a universal feature of early experiences or whether it is a product of Western culturally transmitted interactional patterns.

The present studies used a culturally mediated approach to exploring early learning processes by investigating variation in triadic interaction and pedagogy. In two studies, we examined how collaborative object exploration among infant–caregiver dyads in a Western, formally educated cultural community in the United States—representative of most psychological research—differed from a non-Western cultural community with limited exposure to Western-style institutions on the island of Tanna in Vanuatu. Although the U.S. population has high levels of cultural diversity along some dimensions (e.g., relative income, ethnicity, and language), children and caregivers in many non-Western contexts vary in ways that are distinct from the diversity seen within Western culture. One of the most prominent examples of this is participation in formal schooling. For example, there is strong evidence that exposure to Western-style education affects multiple aspects of childrearing (Chavajay & Rogoff, 2002; Gaskins & Paradise, 2010; Keller, 2002; Mejía-Arauz, Rogoff, Dexter, & Najafi, 2007). These effects include the way parents direct children's attention (Silva, Correa-Chávez, & Rogoff, 2010) and the amount of time children spend with nonparental caregivers and peers (Gaskins, 2006; LeVine, 2007).

To examine patterns of infant–caregiver object exploration in a non-Western community characterized by lower and more variable participation in formal schooling, we compared the behavior of adult female caregivers in suburban areas of the United States and on the island of Tanna, in the Tafea province of Vanuatu. The Melanesian archipelago of Vanuatu is one of the most isolated and culturally diverse countries in the world, comprising 80 small islands, 65 of which are inhabited. In addition to Bislama—an amalgamation of different versions of pidginized English and the official language of the country—the Ni-Van people speak many indigenous languages, giving Vanuatu the highest density of local languages per capita in the

world (Valjavec, 1986; Whiteford & Yoshihara, 2011). Ni-Van families rely on subsistence agriculture, and therefore the majority of the day is spent cultivating land and planting and harvesting crops, which consist primarily of yam, taro, and kava. Ni-Van parents expect children—from a very young age—to be responsible for assisting adults in such labor (e.g., cooking, planting and harvesting crops; preparing kava; prepping for ceremonial gatherings; and helping with the child care of younger siblings). Vanuatu's gross domestic product (GDP), an indicator of the health of a country's economy, is just below US$3,700, putting Vanuatu at a ranking of 122nd in the world. Demographic reports of poverty and inequality have shown wide-ranging results and are generally unrepresentative of the actual socioeconomic status level of the population, given that most Ni-Van families rely on home production of food and resources through subsistence agriculture. Vanuatu has a high fertility rate, which was documented as an average of 4.8 offspring in 1999. The institution of Western-style education has been gradually incorporated into Ni-Van culture, yet schooling is not compulsory. Due to school fees, rural homes, and a desire to retain *kastom* (i.e., traditional) ways of life, the Tafea province has the lowest percentage of participation in school systems (Hughes, 2004; Whiteford & Yoshihara, 2011). This separation from the institution of Western-style education makes Vanuatu—and Tanna in particular—a uniquely informative cultural context for examining non-Western caregiving practices. Although other researchers have addressed questions of cultural variation between Western and non-Western contexts with regard to infant–caregiver interaction (e.g., between Germany and rural Cameroon; Kärtner et al., 2010; Keller et al., 2009), there is substantial variability across non-Western cultures, just as there exists variability within Western caregiving practices. Therefore, in addition to novel procedures and measures focusing on strategies for shared attention within the context of social object exploration, the inclusion of the present Ni-Van sample was strategically chosen to contribute novel data to the growing body of work documenting cultural variation in caregiving.

In two studies, we examined two research questions. First, we asked whether the cross-cultural variation in triadic attention-sharing tendencies found in ethnographic observation (e.g., Bakeman et al., 1990) would still be evident in a structured, quantitative comparison of infant–caregiver object exploration. Female caregivers from Vanuatu and the United States were asked to interact with their infant with a novel object for 3 min (Study 1). Caregivers were measured on amount of contact with the object (i.e., object contact), as well as the contingency of their object contact in relation to the infant's attention (i.e., contingent responsiveness) and the modality of the caregiver's social engagement with the infant and the object (i.e., visual triadic engagement, physical triadic engagement, and vocal triadic engagement). Western models of triadic infant–caregiver object exploration often focus on the importance of adults following the lead of infants (i.e., high levels of contingency) and on the prevalence of eye contact, face-to-face social orientation, and gaze alternation as the primary strategy for sharing attention (i.e., visual modality). This project aimed to specifically investigate whether this high contingency and visual triadic engagement would be characteristic of Ni-Van caregivers as well or whether alternate strategies for collaborative object exploration would be used. Based on previous ethnographic work in many agrarian, non-Western cultures (e.g., Hill & Hurtado, 1996; Konner, 2005; Ochs & Schieffelin, 2001; Super & Harkness, 1986), we predicted that Ni-Van caregivers would engage in less object contact than U.S. caregivers. On the basis of data from Keller's Component Model of Parenting (Keller, 2002; Keller et al., 2009) and tests of the contingency and modality of caregiver responsiveness (Kärtner et al., 2008; Kärtner et al., 2010; Tamis-LeMonda, Kuchirko, & Song, 2014), we predicted that caregivers in the United States and Vanuatu would show similar levels of contingent responsiveness, or the prompt and appropriate responding to infants' cues (Bornstein, 2012), but that Ni-Van caregivers would be more likely to use physical triadic engagement to initiate shared attention with the infant on the object, whereas U.S. caregivers would be more likely to use visual and vocal triadic engagement.

Second, we asked whether caregivers in Vanuatu and the United States would be equally likely to transmit information about an object to their infant and whether they would use similar strategies for this pedagogical interaction. In Study 2, caregivers were asked to interact with their infant with a novel object after the experimenter demonstrated a specific action with the object. Caregivers were measured on whether they transmitted the demonstrated action to their infant during the subsequent play session (i.e., target action transmission). They were also measured on the modality of their transmission (i.e., visual transmission, physical transmission, and indirect transmission)

and the modality of the infant's attention on the object that preceded the caregiver's initiation of target action transmission (i.e., infant visual attention, infant physical attention). Given the lack of evidence for overt pedagogy with visual and vocal cues (i.e., gaze, pointing, narration) in many non-Western cultures (Gaskins & Paradise, 2010; Lancy et al., 2010), we predicted that fewer Ni-Van caregivers would transmit the target action to their infant than U.S. caregivers and that Ni-Van caregivers would be more likely to use physical transmission or indirect transmission, while U.S. caregivers would be more likely to use visual transmission. We expected infant attention on the object to parallel this predicted cultural difference in triadic interaction, such that the target action transmission of Ni-Van caregivers would be more likely to be preceded by infants attending to the object with physical cues, and that the target action transmission of U.S. caregivers would be more likely to be preceded by infant visual attention on the object.

Study 1

Early learning occurs through participation in social interaction with more competent members of a child's community (Rogoff et al., 2003; Vygotsky, 1978). Yet caregivers in different cultures vary with regard to the degree to which they manage infants' attention (Chavajay & Rogoff, 1999; Rogoff et al., 1993) and the contingency and modality of their responsiveness (Kärtner et al., 2008; Keller, 2002; Tamis-LeMonda, Bornstein, Cyphers, Toda, & Ogino, 1992) while interacting with infants and objects.

The objective of Study 1 was to provide a structured analysis of cultural variation in the triadic interaction style of caregivers in the United States and Vanuatu. Female caregivers in the United States and Vanuatu were asked to interact with a novel object with their infant for 3 min. Caregivers were measured on amount of object contact, as well as the contingency level and modality of their triadic engagement with the infant and the object. We predicted that Ni-Van caregivers would engage in less object contact than U.S. caregivers. We also predicted there would be similar levels of contingent responsiveness across groups, but that Ni-Van caregivers would be more likely to use physical triadic engagement, whereas U.S. caregivers would be more likely to use visual and vocal triadic engagement.

Method

Participants: Vanuatu

Sixty infant–caregiver dyads participated in this study in Vanuatu (demographic information provided in Table 1). Data were collected between September 2013 and November 2013. Caregivers were recruited in the villages surrounding the coastal town of Lenakel on the island of Tanna in Vanuatu. Caregivers were approached by the primary experimenter, who was proficient in a basic conversational level of Bislama. In cases in which the caregiver did not speak Bislama, a local research assistant helped with translation. The caregiver was given basic information about the purpose of the investigation and the procedure involved, and if she was interested, verbal consent to participate was obtained. Basic demographic information, including infant date of birth, caregiver age, and caregiver education level was solicited verbally from each participant (see Table 1).

Participants: United States

For the U.S. sample, 56 infant–caregiver dyads participated in this study (demographic information provided in Table 1). Four additional dyads were tested but were not included in the final analyses due to poor video quality. Data were collected in July 2013. Recruitment procedures for the U.S. sample were consistent with those used in Vanuatu, in that caregivers were approached by the primary experimenter at public beaches and parks of California, and the data were obtained in these natural settings on mats or grassy areas. In some cases, mothers who were at the university laboratory participated in the study, in which case the paradigm took place on a play mat on the floor in the

Table 1
Descriptives of the Infants and Caregivers in Studies 1 and 2

	N	Infant gender Female	Infant age (months) *M* (*SD*)	Caregiver age (years) *M* (*SD*)	Caregiver education (years of schooling) *M* (*SD*)
Study 1					
Vanuatu	60	34	11.79 (4.49)	27.11 (7.18)	6.92 (4.24)
U.S.	56	30	10.59 (4.06)	31.13 (4.49)	16.11 (2.23)
Study 2					
Vanuatu	40	14	12.38 (5.44)	27.9 (8.27)	6.4 (3.68)
U.S.	40	16	8.81 (2.14)	31.8 (4.18)	16.5 (1.74)

laboratory. The caregivers and infants whose session took place in the laboratory were already at the laboratory to participate in a different study, making their situation parallel to all other participants (i.e., the experimenter approached the caregiver in a location where they were already interacting with their infant, rather than bringing them somewhere new or strange). All caregivers were U.S. citizens and spoke English as their primary language. Written consent to participate was obtained for each participant, and all caregivers filled out a demographic information form including infant date of birth, caregiver age, and caregiver education level (see Table 1).

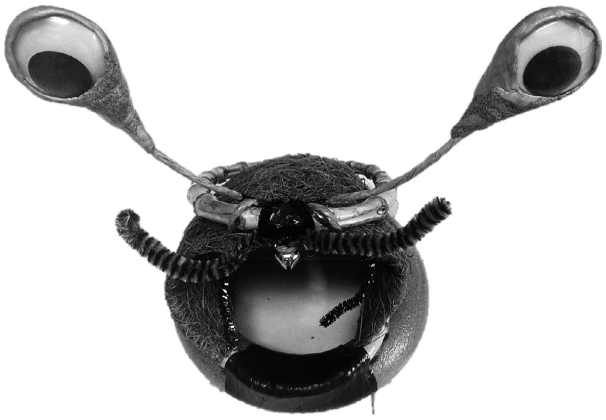

Figure 1. Novel object used as the stimulus toy for the 3-min play session in both Study 1 and Study 2.

Materials

The stimulus used for this study was a homemade toy, constructed from Styrofoam, potting moss, pipe cleaners, googly eyes, and a bell (see Figure 1). The design was intended to be comparably novel and interesting to infants in either cultural context, without being driven by bright lights or electronic sounds that might have been too overwhelming for Ni-Van infants who had never been exposed to such toys. Extensive observation of the naturally occurring behavior in both communities outside of the research context showed no indication that U.S. or Ni-Van infants were afraid of the stimuli. The experimental setup comprised a small FlipCam camcorder on a GorillaPod tripod facing the infant and caregiver, who were invited to sit on a local straw woven mat (Vanuatu) or a straw beach mat or rubber play mat (United States) placed on the ground outside or the floor inside. If the caregiver did not speak Bislama, a local research assistant explained the instructions in the caregiver's local language. In the United States, all data were collected in English by the primary experimenter.

Procedure

Caregivers were instructed to sit on the mat on the floor or ground with their infant. Once caregiver and infant were situated and the camera was positioned to capture both of them, the stimulus toy was placed in front of them within reach. The caregiver and infant were videotaped interacting with the toy for 3 min.

Conditions. Slight differences in the verbal prompt were used within each sample, such that half of the caregivers in each cultural group received the instructions, "Play with this toy with your baby" (play condition) and the other half were told, "Teach your baby how to play with this toy" (teach condition). This distinction was included to test for cultural differences in the construal of the meaning of "play." For U.S. adults, playtime is generally synonymous with teaching and learning, but this conception is not shared by many other cultures (Kazemeini & Pajoheshgar, 2013), and adult play is viewed as unimportant or inappropriate in many non-Western cultures (LeVine et al., 1996). This subtle distinction in the verbal prompting allowed us to ensure that differences in behavior were not simply attributed to cultural variation in the interpretation of the word *play*.

Coding and Measures

Caregivers were measured on total duration of object contact, contingency level of the object contact, and modality of triadic engagement with the infant and the object. Coding was completed by two independent coders—blind to the hypotheses of the study—through the use of ELAN, video annotation software developed by the Max Planck Institute for Psycholinguistics (Lausberg & Sloetjes, 2009). The coders were trained together by the primary experimenter until a sufficient level of agreement (80%) was reached, after which they completed all coding independently. The coders overlapped on 25% of the subjects, for whom they showed an average agreement of 0.97, reported as an intraclass correlation coefficient. The coding system used for this study reflects a modified version of Keller's (2002) Component Model of Parenting, a categorical system of behaviors to universally describe cultural variation in parenting systems (i.e., primary care system, body contact system, body stimulation system, face-to-face system, and

object stimulation system) and interactional mechanisms (i.e., attention, sensitivity, warmth, and contingency). Keller's coding system has been used to effectively measure how adults interact with infants, leading to the recognition of predictable parenting patterns that correspond to ecological, behavioral, and ideological differences across cultures. Given that the aim of the current project was to document cultural variation specifically with regard to *how* adults and infants interact with a novel object, we modified the categories of the Component Model of Parenting (Keller, 2002) to measure the extent to which different parenting systems and interactional mechanisms occurred simultaneously with the caregiver object contact.

Object contact. Object contact was coded whenever the caregiver initiated direct engagement with the object, including any type of physical contact with the object. The final measure for object contact for each subject was the duration (in seconds) and the frequency (number of occurrences) out of the 3-min play session that the caregiver was in physical contact with the object in some way. Each segment of caregiver object contact was further categorized to indicate the contingency and modality of the caregiver's response (described below).

Contingent responsiveness. Each segment of object contact was coded as a contingent response if the infant was attending to the object during the 1-s window prior to the caregiver initiating object contact. The final score for contingent responsiveness was the number of caregiver object contact segments that were contingent to the infant attending to the object (i.e., by the infant looking at, touching, or approaching the object).

Modality of engagement. Each segment of contingent responsiveness was further categorized according to the modality of the cues used by the caregiver to engage the infant in shared attention on the object (i.e., visual triadic engagement, physical triadic engagement, and vocal triadic engagement, described below).

Visual triadic engagement. Visual triadic engagement was coded whenever the caregiver was in contact with the object while simultaneously positioning her body and head toward the infant in a way that allowed for face-to-face interaction, mutual eye contact, and gaze alternation between infant and caregiver. During visual triadic engagement, the angle between the caregiver's face and body and the infant's shoulders was no more than approximately 45° so that the infant could simply look straight ahead or did not have to move the head more than 45° to see the object and the caregiver's face. The final score for each subject was the number of object contact segments that were categorized as visual triadic engagement.

Physical triadic engagement. Physical triadic engagement was coded whenever the caregiver initiated physical contact with the infant in conjunction with object contact. Physical contact included holding (both feet or parts of one leg of the infant in contact with the caregiver), sitting (both legs of the infant in contact with the caregiver), lap (both legs and parts of the torso of the infant in contact with the caregiver), close proximity (the whole body of the infant in contact with the caregiver), vestibular (moving the whole body of the infant while the head was held in a stable position), kinesthetic (moving the whole body of the infant without holding the head), motor (moving body parts of the infant), and touching the infant using tactile stimulation (Keller et al., 2009). The final score for each subject was the number of object contact segments that were categorized as physical triadic engagement.

Vocal triadic engagement. Vocal triadic engagement was coded whenever the caregiver directed verbal or nonverbal vocalizations (e.g., cooing, gasping) at the infant while simultaneously being in contact with the object, not including any remarks made to other adults or to the experimenter. The final score for each subject was the number of object contact segments that were categorized as vocal triadic engagement.

Results

Analyses

To test whether the subtle difference in verbal cues (play vs. teach) was creating behavioral differences, we conducted an independent analysis of variance (ANOVA) for each dependent measure (i.e., object contact duration, object contact frequency, contingent responsiveness) and a multivariate analysis of variance (MANOVA) for each combined set of dependent measures (i.e., visual triadic engagement, physical triadic engagement, and vocal triadic engagement) with the condition (play vs. teach) as the categorical predictor variable in each test. To investigate the question of whether there were differences in the amount of object contact between U.S. and Ni-Van caregivers, we ran an ANOVA to check for an effect of cultural group on duration and frequency of object contact. We further tested whether there were differences in the amount of object contact characterized as

contingent responsiveness between U.S. and Ni-Van caregivers by running an ANOVA with contingent responsiveness as the dependent measure and cultural group (United States vs. Vanuatu) as the categorical predictor variable. To test for an effect of cultural group on the modality of triadic engagement of the caregiver's object contact, we ran a MANOVA with the modality of triadic engagement (visual, physical, and vocal triadic engagement) as dependent variables and the cultural group (United States vs. Vanuatu) as the categorical predictor variable. This was followed by three Bonferroni-corrected pairwise comparisons to clarify the specific group differences within each category.

Condition differences. The ANOVA revealed no effect of condition on object contact duration, $F(1, 114) = 0.01$, *ns*, or object contact frequency, $F(1, 114) = 0.001$, *ns*. There was also no effect of condition on contingent responsiveness, $F(1, 114) = 1.24$, *ns*. With regard to the type of responsiveness, the MANOVA revealed no effect of condition on modality of triadic engagement, $F(1, 114) = 1.63$, *ns*. Therefore, all subsequent analyses are collapsed across conditions to test for group differences in the dependent measures.

Object contact. The ANOVAs revealed no difference between cultural groups on the duration, $F(1, 114) = 1.20$, *ns*, or frequency, $F(1, 114) = 0.44$, *ns*, of object contact.

Contingent responsiveness. The ANOVA revealed no effect of cultural group on frequency of contingent responsiveness, $F(1, 114) = 0.89$, *ns*.

Modality of engagement. The MANOVA revealed a main effect of cultural group on triadic engagement, $F(1, 114) = 7.25$, $p < .001$ (see Figure 2). To elucidate specific differences in triadic engagement, this was followed by pairwise comparisons to measure group differences within each modality of triadic engagement.

Visual triadic engagement. The ANOVA revealed a main effect of group on amount of object contact categorized as visual triadic engagement, $F(1, 114) = 6.26$, $p = .04$, $\eta^2 = .05$ (p value Bonferroni corrected for multiple comparisons). The object contact of U.S. caregivers was significantly more likely to be characterized as visual triadic engagement ($M = 1.99$, $SD = 3.32$) than that of the Ni-Van caregivers ($M = 0.73$, $SD = 1.97$).

Physical triadic engagement. The ANOVA revealed a main effect of group on amount of object contact categorized as physical triadic engagement, $F(1, 114) = 11.30$, $p = .003$, $\eta^2 = .09$ (p value Bonferroni corrected for multiple comparisons). The object contact of Ni-Van caregivers was significantly more likely to be characterized as physical triadic engagement ($M = 4.02$, $SD = 5.19$) than that of U.S. caregivers ($M = 1.49$, $SD = 2.22$).

Vocal triadic engagement. The ANOVA revealed no main effect of group on amount of object contact that was categorized as vocal triadic engagement, $F(1, 114) = 0.03$, *ns*.

Discussion

The current data showed cultural variation in triadic interaction style between caregivers in the United States and Vanuatu in the context of a structured object manipulation paradigm. There were no group differences in amount of object contact or even the degree of contingent responsiveness of that object contact, showing that caregivers were equally engaged across groups. However, there were significant differences with regard to the modality of the triadic engagement that caregivers used to interact with the infant and the object. Caregivers in Vanuatu spent significantly more time in physical triadic engagement than caregivers in the United States, whereas caregivers in the United States spent more time in visual triadic engagement. There was no significant difference between groups with regard to time spent in vocal triadic engagement.

Caregivers in both communities responded contingently to their infants' cues. However, as predicted, physical triadic engagement was a more prevalent form of attention sharing for caregivers in Vanuatu than caregivers in the United States, who used more visual cues to direct infant attention on the object than Ni-Van caregivers. Given the emphasis on eye gaze and visual cues in most Western models of early social learning (Akhtar & Gernsbacher, 2008), this result motivates further examination of how infants gain social knowledge in cultural contexts in which physical contact takes precedence over visual contact. For example, responding to and eliciting joint attention, which generally manifests as gaze alternation and pointing, may be achieved through tactile means (e.g., infant and caregiver touching an object at the same time).

Study 1 confirmed several predictions based on ethnographic work on infant–caregiver interaction in non-Western cultures, motivating the need to incorporate this cultural variability into theoretical models of early social learning. One possible limitation of the design was that engaging in interaction with toy-like objects was far less common for caregivers in Vanuatu than for caregivers in the United States, and consequently, caregivers in Vanuatu

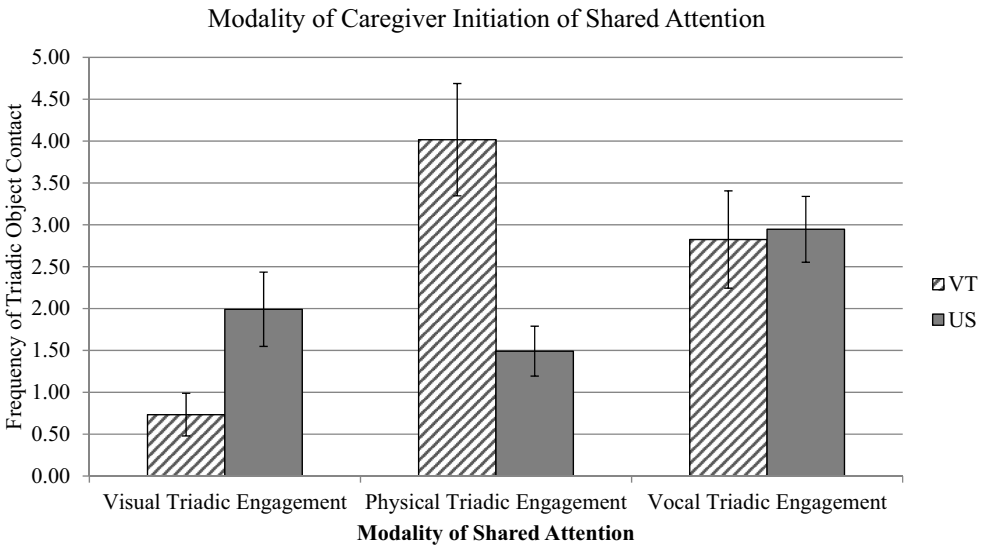

Figure 2. Group means for caregivers in Vanuatu (VT) and the United States (US) for Study 1. Caregivers were measured on frequency of object contact characterized by visual, physical, and vocal triadic engagement during the play session. Error bars represent standard error of the mean.

may not have understood the purpose of the object or how to interact with their infant with the object. Study 2 addressed this possibility by explicitly showing the caregiver a novel action to do with the object, which also allowed us to test whether caregivers in both groups would be equally as likely to spontaneously transmit information about the object to infants and whether they would use similar strategies for this transmission.

Study 2

Early object exploration is a highly scaffolded social experience (Vygotsky, 1978), during which adults explicitly convey information about objects with overt visual cues (e.g., pointing and gaze alternation; Csibra & Gergely, 2009), yet this pattern may be representative solely of Western social interaction. Adults in some cultures are less likely to manage the attention of children and instead adopt a more collaborative approach to learning through shared activity (i.e., in Guatemalan Mayan communities; Rogoff et al., 2003). Caregivers also show cultural variation in the cues to which they choose to respond, such that adults in some cultures are more likely to respond contingently to touch cues rather than vocal or visual cues (i.e., mothers from a Cameroonian Nso community; Kärtner et al., 2008).

By showing caregivers a novel action with an object before a play session, Study 2 aimed to expand upon the results of Study 1 by addressing three questions. First, Study 2 tested whether caregivers in both cultures would be equally likely to convey information about the object by transmitting the demonstrated action for the infant during the play session (i.e., target action transmission). Second, Study 2 aimed to measure how caregivers would transmit the target action, testing whether the model of pedagogy characterized by gaze following and gaze alternation (i.e., visual transmission) would be equally as common among Ni-Van caregivers in their transmission of the target action or whether they would use an alternate modality of overt pedagogy (i.e., physical transmission) or would not use overt cues at all (i.e., indirect transmission). Third, Study 2 expanded on the investigation of cultural differences in the modality of contingent responsiveness by measuring differences in the modality of infant attention on the object preceding the caregiver's target action transmission (i.e., infant visual attention and infant physical attention).

We predicted that more caregivers in the United States would transmit the target action than Ni-Van caregivers, given that modeling a previously demonstrated action for naïve conspecifics is considered a pervasive behavior of Western adults (Csibra & Gergely, 2009). Due to the differences in physical and visual triadic attention indicated in Study 1, we predicted that caregivers in Vanuatu would be more likely to use physical transmission to transmit the target action, whereas caregivers in the United States would be more likely to use visual transmission. We also predicted that Ni-Van

caregivers would use more indirect transmission, given that this behavior might correspond to the observational learning that is common in many non-Western cultures. With regard to the modality of infant attention, we predicted that the target action transmission of Ni-Van caregivers would be more likely to be preceded by infant physical attention on the object and that the target action transmission of U.S. caregivers would be more likely to be preceded by infant visual attention. However, given that no empirical work has yet tested whether infants in different cultures are more likely to look at an object versus touch an object, this measure was largely exploratory.

Method

Recruitment methods for the Ni-Van caregivers and the U.S. caregivers were the same as Study 1. None of the participants of Study 1 participated in Study 2. For both samples, the data were collected by the same primary experimenter in the same locations in both the United States and Vanuatu as the Study 1 data collection. The participants for both groups were recruited after all data from Study 1 had already been collected.

Participants: Vanuatu

A total of 40 infant–caregiver dyads participated in this study in Vanuatu (demographic information provided in Table 1). Data were collected between July 2013 and August 2013.

Participants: United States

For the U.S. sample, 40 infant–caregiver dyads participated in this study (demographic information provided in Table 1). Data were collected between January 2014 and March 2014.

Materials

The stimuli and the setup were identical to Study 1, except for the addition of a set of nesting cups used as warm-up toys to distract the infant while the experimenter demonstrated the target action for the caregiver.

Procedure

Caregivers were instructed to sit on the mat (if outside) or the floor (if inside) with their infant. The nesting cups were laid out in the middle of the experimental area and the caregiver was told to play freely with the cups to get the infant comfortable. In Vanuatu, the instructions were given in Bislama or the caregiver's alternate native language by a trained local research assistant. After approximately 2 min of warm-up play, a new toy was introduced (the same stimulus toy from Study 1). The experimenter explained to the mother that she would show her how to do something with the toy, out of the infant's view. The experimenter modeled a novel action with the toy (i.e., holding the eyes of the toy in each hand and touching them together) for the caregiver, out of view of the infant. The nesting cups were then removed from the experimental area and the toy was given to the caregiver. The infant and caregiver were videotaped interacting with the toy for 3 min.

Conditions. To parallel the procedure used in Study 1, the caregiver was instructed to either "Use this toy to play with your baby" (play condition) or "Use this toy to teach your baby" (teach condition). As in Study 1, this distinction was included to test for cultural variation in the understanding of "play" and to avoid a bias toward pedagogy in the U.S. sample. Based on Study 1, we predicted there would be no effect of condition on the dependent measures.

Coding and Measures

Caregivers were measured on a binary scale indicating whether they transmitted the target action to their infant during the play session (i.e., target action transmission, described below) and were also measured on the specific modality of engagement used when transmitting the action (i.e., visual transmission, physical transmission, or indirect transmission, described below). These categories for measuring the modality of transmission were based on the modified version of Keller's (2002) Component Model of Parenting used in Study 1. Caregivers were also measured on the modality of infant attention on the object that preceded each instance of target action transmission (i.e., infant visual attention or infant physical attention, described below). These categories of infant attention were based on the findings of Study 1, such that we were interested in whether the differences in visual triadic engagement and physical triadic engagement were reflective of differences in the modality of infant attention or whether these differences were driven mainly by differences in the adults' strategies for social engagement. Coding was completed with ELAN by two independent,

trained coders—blind to the hypotheses of the study—who were trained together by the primary experimenter until reaching sufficient agreement (80%), then completed all coding independently. They overlapped on 30% of the subjects and had an average agreement of 0.90, reported as an intraclass correlation coefficient.

Target action transmission. Behavior was coded as target action transmission if the caregiver transmitted the demonstrated action by holding the two eyes of the toy in each hand and doing an exact imitation of the target action (i.e., touching the eyes together two times) or doing an approximate imitation of the action (i.e., holding the eyes in each hand and moving them back and forth). Caregivers were given a 1 if they performed the target action at all during the 3-min play session and a 0 if they did not.

Modality of transmission. Each segment of target action transmission was categorized to reflect the modality of cues used by the caregiver in their transmission (i.e., visual transmission, physical transmission, indirect transmission, described below).

Visual transmission. Visual transmission was coded when the caregiver transmitted the target action while simultaneously being in a face-to-face body orientation and sharing visual attention with the infant by looking at the infant and/or alternating gaze between the infant and the object. The final score for each subject was the proportion of target action transmission segments categorized as visual transmission.

Physical transmission. Physical transmission was coded when the caregiver transmitted the target action while simultaneously being in physical contact with the infant or sharing tactile attention with the infant by alternating touch between the infant and the object. The final score for each subject was the proportion of target action transmission segments categorized as physical transmission.

Indirect transmission. Indirect transmission was coded when the caregiver transmitted the target action without using any overt visual or physical cues to engage the infant. The final score for each subject was the proportion of target action transmission segments categorized as indirect transmission.

Modality of infant attention. Modality of infant attention was used to measure the amount of target action transmission segments that were preceded by the infant displaying attention on the object via visual or physical cues. The aim of these measures was to categorize whether differences in the modality used by adults to teach infants about the object may be associated with differences in the infant's modality of attention on the object.

Infant visual attention. Infant visual attention was coded whenever the caregiver's target action transmission was preceded (during the 1-s window before the start of target action transmission) by the infant attending to the object with visual cues (i.e., gaze on the object). The final score for each subject was the proportion of target action transmission segments preceded by infant visual attention.

Infant physical attention. Infant physical attention was coded whenever the caregiver's target action transmission was preceded (in the 1-s window before the start of target action transmission) by the infant attending to the object with physical cues (i.e., touching). The final score for each subject was the proportion of target action transmission segments preceded by infant physical attention.

Results

Analyses

To test for cultural differences related to differences in the verbal prompting (play vs. teach), we conducted a chi-square test of independence to see if there were condition differences in the number of caregivers transmitting the target action, and conducted a MANOVA for each combined set of dependent measures (i.e., visual transmission, physical transmission, indirect transmission; infant visual attention, infant physical attention) with the condition (play vs. teach) as the categorical predictor variable. In Study 2, we were interested in whether caregivers in one group were more likely than caregivers in the other group to transmit the target action to the infant. Among the subset of caregivers who did transmit the target action, we were interested in group differences in the modality of that transmission (i.e., visual, physical, or indirect transmission) as well as the modality of the infants' cues preceding the transmission (i.e., infant visual attention or infant physical attention). We therefore ran a chi-square test to compare the number of caregivers who chose to transmit the target action in each group, and analyzed the differences in type of target action transmission by conducting two multivariate ANOVAs followed by Bonferroni-corrected pairwise comparisons.

Condition differences. The chi-square test of independence revealed no effect of condition on target action transmission, $\chi^2(1, 80) = 0$, *ns*. Each MANOVA

revealed no effect of condition on modality of target action transmission, $F(1, 78) = 11.76$, *ns*, or modality of infant attention, $F(1, 78) = 0.50$, *ns*. Therefore, all subsequent analyses collapsed across conditions to test only for group differences.

Target action transmission. The chi-square test of independence revealed a reliable difference between groups with regard to the number of caregivers transmitting the target action, $\chi^2(1, 80) = 11.96$, $p < .001$, with more caregivers in the United States transmitting the target action than caregivers in Vanuatu (see Figure 3).

Modality of transmission. With regard to differences in the modality of transmission of the target action, the MANOVA revealed a main effect of cultural group on modality, $F(1, 78) = 11.53$, $p < .001$. This was followed by three Bonferroni-corrected pairwise comparisons to clarify the specific group differences within each modality of transmission.

Visual transmission. The ANOVA revealed a main effect of group on amount of visual transmission used to transmit the target action, $F(1, 78) = 33.78$, $p < .001$, $\eta^2 = .30$ (p value Bonferroni corrected for multiple comparisons). U.S. caregivers spent a significantly higher proportion of time using visual transmission to transmit the target action ($M = 0.80$, $SD = 0.30$) than Ni-Van caregivers ($M = 0.33$, $SD = 0.40$).

Physical transmission. The ANOVA revealed no effect of group on amount of physical transmission used to transmit the target action, $F(1, 78) = 0.85$, *ns*.

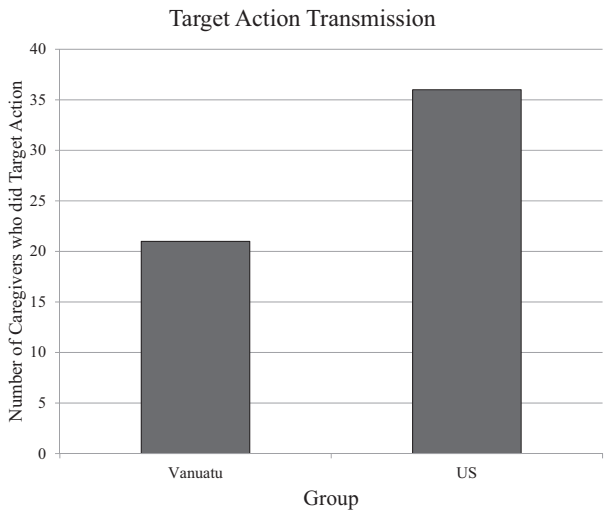

Figure 3. Number of caregivers in Vanuatu and the United States who transmitted the demonstrated target action for their infant in Study 2.

Indirect transmission. The ANOVA revealed no effect of group on amount of indirect transmission used to transmit the target action, $F(1, 78) = 2.55$, *ns*.

Modality of infant attention. With regard to differences in the modality of the infant's attention preceding target action transmission, the MANOVA revealed a main effect of cultural group, $F(1, 78) = 13.08$, $p < .001$. This was followed by two Bonferroni-corrected pairwise comparisons to clarify the group differences within each category of infant attention.

Infant visual attention. The ANOVA revealed a main effect of group on amount of infant visual attention preceding transmission of the target action, $F(1, 78) = 23.40$, $p < .001$, $\eta^2 = .03$ (p value Bonferroni corrected for multiple comparisons). The proportion of target action transmission of U.S. caregivers that was preceded by infant visual attention on the object was significantly higher ($M = 0.80$, $SD = 0.32$) than that of Ni-Van caregivers ($M = 0.39$, $SD = 0.43$).

Infant physical attention. The ANOVA revealed no effect of group on amount of infant physical attention preceding transmission of the target action, $F(1, 78) = 0.75$, *ns*.

Discussion

Study 2 used an experimental task to measure cultural variation in the extent to which caregivers spontaneously chose to show their infant a novel action with an object, as well as the modality of cues used in their transmission and the modality of infant attention preceding the transmission. As predicted, we found that caregivers in the United States were more likely than caregivers in Vanuatu to spontaneously transmit the target action during the play session. This effect of cultural group cannot be attributed to disparities in whether the person transmitting the action was foreign or an in-group member because in the United States, the action was demonstrated by the U.S. primary experimenter, and in Vanuatu, the action was demonstrated by a local Ni-Van research assistant. Nor can this effect be attributed to how the action was demonstrated, given that with both samples the demonstration was consistent in its face-to-face orientation and verbal prompting. Nevertheless, this finding lends some insight into important differences in adult imitation and propensities for pedagogy that to date have not been examined.

Consistent with our predictions, caregivers from the United States were more likely to use visual

transmission when performing the target action than caregivers from Vanuatu. In contrast to our predictions, our data revealed no cultural difference in rates of physical transmission or indirect transmission. The results of Study 1 suggested that triadic interaction in Vanuatu is often achieved through shared physical attention, yet having the experimenter demonstrate the target action with visual—rather than physical—cues may have reduced the likelihood of the caregiver using physical transmission in Study 2. With regard to the lack of differences in indirect transmission, ethnographic descriptions have shown observation-based social learning to be a widely practiced strategy in many cultures (e.g., Gaskins & Paradise, 2010; Heyes, 2012; Heyes & Frith, 2014; Odden & Rochat, 2004; Rogoff, 2003), but it may be the case that learning through observation is not as widely practiced in Vanuatu as it is in other non-Western cultures. Similarly, the ostensive, visual demonstration of the novel action by the experimenter may have prompted caregivers in Vanuatu to be more likely to use visual transmission in this particular experimental scenario than they would be in naturally occurring interactions. Additionally, analyzing these findings from a perspective that assumes the adult is transmitting the knowledge and the child is receiving the knowledge, is a construct of Western models of learning and may not effectively capture learning that occurs through shared activity, a strategy used in other non-Western cultural contexts (Rogoff et al., 1993).

As predicted, cultural differences in modality of transmission were paralleled by differences in the modality of infant attention on the object, such that the target action transmission of U.S. caregivers was more likely than that of Ni-Van caregivers to be preceded by infant visual attention on the object. While infants in the United States may have developed an expectation to frequently receive visual information from their caregivers, prompting them to look at the object more often than Ni-Van infants, Ni-Van infants demonstrated less of an expectation to gain information visually. Although we predicted that infants in Vanuatu would be more likely than infants in the United States to show attention on the object before the caregiver's demonstration by touching it, we did not see evidence of this. The lack of group differences in infant physical attention may have been driven by fundamental differences in visual versus tactile communication. Specifically, gaining information via shared tactile contact does not require the infant to be attending to the object at all, as the caregiver can place the infant's hands onto the object for them, guiding their attention more deliberately than they would during shared visual attention. As indicated by the differences in the modality of target action transmission and infant attention, the data from Study 2 confirm that there are many ways in which adults collaboratively explore objects with infants.

General Discussion

Early learning occurs within the context of social interaction with caregivers and objects, yet the processes by which this learning occurs is culturally mediated. In contrast to the Western pattern of triadic interaction that currently defines social learning, our data suggest that the model of visual, adult-led attention sharing and cultural transmission does not universally reflect early learning processes. In two studies, we measured the attention-sharing and pedagogical strategies of caregivers in two cultural communities within the structured context of exploring a novel object with their infant. In Study 1, there were no cultural differences in overall duration or level of contingency of caregiver object contact, yet Ni-Van caregivers showed higher levels of physical triadic engagement with their infant and the object, while U.S. caregivers showed higher levels of visual triadic engagement. In Study 2, more caregivers in the United States than in Vanuatu transmitted a novel action to their infant after seeing it demonstrated. U.S. caregivers were more likely than Ni-Van caregivers to use visual transmission to demonstrate the target action and this was more likely to be preceded by infant visual attention on the object. Although previous work has demonstrated cultural variation in caregiver social contact with infants (e.g., Kärtner et al., 2010; Keller, 2002; Keller et al., 2009; Tamis-LeMonda, Song, Leavell, Kahana-Kalman, & Yoshikawa, 2012), in modality and contingency of responsiveness (Bornstein, Tamis-LeMonda, Hahn, & Haynes, 2008; Kärtner et al., 2008), in the ways adults direct children's attention (Chavajay & Rogoff, 1999; Rogoff et al., 1993), and in strategies for instruction (Rogoff et al., 2003), the current data reflect cultural variation that was specific to the context of collaborative object exploration and that was documented in a previously unstudied culture, thus providing novel contributions to the literature beyond previous work.

Given that current models focus almost exclusively on the role of visual communication by high-

lighting gaze following, gaze alternation, and shared eye gaze as the primary ways through which infants and caregivers share attention (Akhtar & Gernsbacher, 2008), these data provide the first source of empirical motivation for investigating how joint attention and knowledge transmission might occur in other modalities (i.e., shared touch). Although physical contact is one of the evolutionarily oldest and the most basic pattern of mammalian social interaction (Bard, 2002), the role of tactile communication has—to date—been relatively neglected in the domain of social cognitive development. A nascent line of experimental laboratory work suggests that touch is an even stronger form of communication than verbal or visual contact, and that it is able to convey discrete emotions (Hertenstein, 2002; Hertenstein, Keltner, App, Bulleit, & Jaskolka, 2006) and can attenuate the effects of distress (e.g., in the still-face paradigm; Stack & Muir, 1990). Given that early attention sharing was achieved by Ni-Van dyads through shared touch rather than shared gaze in Study 1, further research is needed to elucidate the specific mechanisms by which infants in certain cultural contexts develop social learning strategies that capitalize on physical—rather than visual—cues from caregivers.

In addition to sharing attention through visual cues, the natural pedagogy model proposes that humans have evolved a tendency to use overt referential communication to transmit cultural knowledge from competent members of a group to naïve conspecifics (Csibra & Gergely, 2009). Although Ni-Van caregivers were less likely to spontaneously demonstrate the target action for their infant and were less likely to respond to infants' visual attention on the object by leading them in an instructive interaction, they were also not significantly more likely to use physical transmission or indirect transmission. This unexpected result may be due to our attempt to measure the instructive interaction from a perspective that assumes an adult-led interaction, when in fact the Ni-Van dyads may participate in a more collaborative approach to learning.

Importantly, the group of Ni-Van caregivers in our studies represents just one culture that engages in social interaction patterns distinct from those of caregivers in Western-educated, industrialized societies, and like all cross-cultural work, there is a confluence of cultural and developmental factors that may be driving these differences in behavior. Cultural variation in caregiving has commonly been attributed to climate and physical environment (e.g., among the Quechua of Andean Peru; Tronick, Thomas, & Daltabuit, 1994), subsistence demands (e.g., among the Ache of Paraguay; Hill & Hurtado, 1996), and education level (Chavajay & Rogoff, 2002; Gaskins & Paradise, 2010). In Vanuatu, caregiver education level is of particular importance given that participation in formal schooling—which has been historically low in contrast to Western nations—is undergoing a period of transition with increasingly more government attention being directed to school attendance and literacy programs (Hughes, 2004). Although the effect of this changing participation in formal schooling was originally a factor of interest in our investigation, recent work has highlighted culturally transmitted patterns of social learning to be the primary driving factor in human behavioral variation (Mathew & Perreault, 2015). Although it is possible that diverging interpretations of the object, the experimenter, or the video recording process may have driven behavioral differences across groups, extensive observation time in both communities outside of the research context confirmed that the findings were aligned with normal and representative patterns of infant–caregiver interaction.

In Study 1, there was no difference in duration of vocal triadic engagement across the two cultures, and in Study 2, there were no differences in physical transmission, indirect transmission, or infant physical attention on the object preceding the target action transmission. Although these null findings were in contrast to our predictions, the only data available on which to base our predictions were collected not in Tanna, but in other non-Western cultures, which cannot necessarily be generalized to the current sample as there exists substantial variation across non-Western cultures. The goal of this research was not to emphasize the dichotomy between Western and non-Western populations, but rather to understand patterns of continuity and variation in the ways in which infants across human cultures develop into socially competent members of their community.

The aim of this study was to quantitatively examine caregiver–infant interaction in a cultural context distinct from the WEIRD communities that have traditionally been the focus of developmental research. Our procedure was unique in providing a context of collaborative object exploration that would be equally novel across both cultures, and through this design, we provided a systematic comparative analysis of social object exploration. The variation in attention-sharing and instruction strategies indicates that our current understanding

of how caregivers interact with and transmit information to infants is not universal. Our data contribute to a growing literature documenting cultural variation in early learning opportunities that must be incorporated into psychological theory on social cognitive development. Further research is needed to continue to document variation and similarities in early social experiences that exist within and across cultural groups, as well as the underlying processes at work in shaping caregiving practices.

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