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Teaching Through Collaboration: Flexibility and Diversity in Caregiver–Child Interaction Across Cultures

Jennifer M. Clegg
Texas State University

Nicole J. Wen
University of Michigan Brunel University London

Paige H. DeBaylo
Austin Independent School District

Adam Alcott
The University of Texas at Austin

Elena C. Keltner
The University of Texas at Dallas

Cristine H. Legare
The University of Texas at Austin

Teaching supports the high-fidelity transmission of knowledge and skills. This study examined similarities and differences in caregiver teaching practices in the United States and Vanuatu (N = 125 caregiver and 3- to 8-year-old child pairs) during a collaborative problem-solving task. Caregivers used diverse verbal and nonverbal teaching practices and adjusted their behaviors in response to task difficulty and child age in both populations. U.S. caregivers used practices consistent with a direct active teaching style typical of formal education, including guiding children's participation, frequent praise, and facilitation. In contrast, Ni-Vanuatu caregivers used practices associated with informal education and divided tasks with children based on difficulty. The implications of these findings for claims about the universality and diversity of caregiver teaching are discussed.

Children learn critical skills through independent, active exploration of their environments (Gopnik & Wellman, 2012), yet much of what they know, they learn from others (Gelman, 2009; Harris, 2012; Vygotsky, 1978). Social learning allows children to acquire the cumulative cultural knowledge of previous generations and is often more efficient than independent trial-and-error learning (Boyd & Richerson, 1996; Henrich, 2015). A protracted childhood allows for social learning by providing children with an extended period for interaction with caregivers and peers (Bjorklund & Ellis, 2014; Cole, 2007). Teaching, or an alteration in behavior in response to a learner's needs (either expressed or anticipated by the teacher; Boyette & Hewlett, 2017; Hewlett & Roulette, 2016; Kline, 2014), is a key feature of social learning and is one of the primary means by which knowledge, practices, and skills are transmitted within and across generations (Strauss & Ziv, 2012). Studying both similarities and differences in teaching during caregiver–child interaction across diverse populations deepens our understanding of vertical cultural transmission (i.e., the transmission of cultural knowledge between generations; Cavalli-Sforza, Feldman, Chen, & Dornbusch, 1982) and the development of children's social learning (Lave & Wenger, 1991; van Leeuwen et al., 2018).

There is a lack of consensus, however, about the extent of both quantitative and qualitative global variation in teaching practices. Despite claims within the psychological literature that teaching is a universal and innate feature of adult–child interaction (Csibra & Gergely, 2011), some anthropologists

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Correspondence concerning this article should be addressed to Jennifer M. Clegg, Department of Psychology, Texas State University, San Marcos, TX 78666. Electronic mail may be sent to jclegg@txstate.edu.

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report relatively infrequent teaching outside of Western, Educated, Industrialized, Rich, and Democratic (Henrich, Heine, & Norenzayan, 2010) populations (Lancy, 2010, 2016). Data from hunter-gatherer (Boyette & Hewlett, 2017; Hewlett, Fouts, Boyette, & Hewlett, 2011; Lew-Levy, Reckin, Lavi, Cristobal-Azkarate, & Ellis-Davies, 2017), subsistence agricultural (Kline, Boyd, & Henrich, 2013; Little, Carver, & Legare, 2016), and industrialized populations (Csibra & Gergely, 2011) have provided support for claims about the universality of some teaching behaviors, such as pointing and joint attention. In contrast, other teaching behaviors, such as direct instruction and demonstration, vary substantially in frequency and kind between populations (Lancy, 2012; Lave & Wenger, 1991). Disagreement about the universality of teaching behaviors may be due to differences in how teaching has been defined (for a review, see Kline, 2014) and discrepancies between the kinds of populations usually featured in psychological versus anthropological research (Hewlett & Lamb, 2005).

Previous research suggests, however, that variation in teaching practices may be associated with between- and within-population differences in educational, economic, and social structures (see Legare, 2017; Paradise & Rogoff, 2009). In the current study, we examined similarities and differences in caregiver–child interaction and caregiver teaching behaviors in two populations with different educational, economic, and social institutions: a formally educated, urban, industrialized population (high socioeconomic status U.S.; hereafter HSUS) and an informally educated, rural, subsistence agricultural population (Tanna, Vanuatu; hereafter Tannese). Both formal and informal education are the products of particular cultural institutions and operate within complex economic and social contexts (Paradise & Rogoff, 2009); thus, the objective of this study is not to attribute similarities or differences in caregiver–child interaction or teaching style between populations exclusively to educational style. Instead, our objective is to build upon previous research documenting the relations between the frequency and form of particular teaching practices and formal (i.e., institutionalized) versus informal (i.e., observational learning and apprenticeship) education (Greenfield, 2009) using a structured task that allows for direct comparison within and between populations.

Next, we focus our review on differences in caregivers' beliefs and teaching behaviors between communities that practice formal versus informal education and discuss how they may influence caregivers' teaching. We map these differences onto predictions related to variability in caregiver–child interaction style and caregiver teaching behaviors between our study sites. We then discuss the ways in which caregiver teaching may be similar across these diverse populations in response to task difficulty and child age.

Formal Versus Informal Education and Teaching Practices

Formal education segregates children from community activity (Lancy, 2010, 2012; Rogoff, 2003) and institutionalizes particular styles of instruction (Paradise & Rogoff, 2009). One type of instruction common in formal educational settings is *direct active teaching*, which is defined teachers directly interacting with learners to explicitly present information using verbal or physical instruction (Greenfield, 2009; Kline, 2014). Formally educated caregivers' beliefs about how children learn reflect a hierarchical relationship, in which knowledge and information are transmitted from teacher to student (Childs & Greenfield, 1980; Greenfield & Lave, 1982). This may be a consequence of caregivers' own experiences with direct active teaching as students in formal education settings (Kağıtçıbaşı, 2007; Keller, 2017; Laosa, 1980; LeVine, Levine, Schnell-Anzola, Rowe, & Dexter, 2012). Formally educated caregivers also believe that it is adults' role to transmit knowledge to children (Odden & Rochat, 2004) through the use of verbal interaction (including questions and praise; Clark & Bernicot, 2008; Hess, Kashiwagi, Azuma, Price, & Dickson, 1980), modification of tasks and materials to make them more accessible (Hammond, Müller, Carpendale, Bibok, & Liebermann-Finestone, 2012), and direct demonstration of behaviors (Little et al., 2016). Here, we note that even though direct active teaching is common in formally educated populations, it is only one of many ways that caregivers can share knowledge with children (Greenfield, 2009; Kline, 2014).

Rather than segregating children from community activity, informal education requires participation in community activity and learning through observation (Paradise & Rogoff, 2009). Teaching behaviors consistent with expectations that children learn by observing the actions of others and actively participating (hereafter, observational learning) have been documented in a number of small-scale populations globally (Bird & Bliege Bird, 2002; Gaskins & Paradise, 2010; Odden & Rochat, 2004). Informally educated caregivers believe that children

are responsible for their own learning (Greenfield & Lave, 1982) and expect children to learn by observing and actively participating in meaningful activities with other community members (Rogoff et al., 1993). As a result, small-scale, subsistence agricultural populations with limited experience with formal education may be less reliant upon direct active teaching to educate their children (Childs & Greenfield, 1980; Greenfield, 2009). In informal education settings, caregivers support children's learning through practices that are distinct from direct active teaching, but instead emphasize children's observational learning, such as *teaching by social tolerance* (i.e., allowing children to observe behaviors), *teaching by social provisioning* (i.e., allowing children to participate collaboratively with others), and *teaching by stimulus enhancement* (i.e., drawing children's attention to features of ongoing behavior; Kline, 2014). Teaching behaviors consistent with informal education practices have been documented in both anthropological and psychological research in some informally educated populations (for a review, see Rogoff, 2003); however, global variation in teaching behaviors is still critically understudied (Kline, 2014; Nielsen, Haun, Kärtner, & Legare, 2017).

Study Sites

Austin, Texas, U.S.

Our sample of HSUS caregivers and children was recruited from Austin, TX based on the population's high rates of participation in formal education. In 2017, approximately 73% of Austin's adult population had attended college or received an advanced degree. Over 70% of Austin's workforce work in fields such as sales, management, business, and academics (U.S. Census Bureau, 2017). Most of Austin's population lives in urban and suburban neighborhoods in and around the metro area. Formally educated urban populations, such as our HSUS sample, are the kinds of populations typically sampled in psychological research (Henrich et al., 2010; Nielsen et al., 2017).

Tanna, Vanuatu

Our sample of Tannese caregivers and children was selected due to the population's limited experience with formal education (Aime, Broesch, Aknin, & Warneken, 2017; Aknin, Broesch, Hamlin, & Van de Vondervoort, 2015). Most of Tanna's population is divided among a number of small villages and communities located throughout the island (Dixson, Komugabe-Dixson, Dixson, & Low, 2017). Although attending primary school has become more common in recent years, particularly among children in coastal villages with access to schools, few Tannese adults have attended secondary school (Gregory & Gregory, 2001, 2002). Most Tannese adults participate in subsistence agriculture (Aknin et al., 2015) though some are employed in the tourism industry (Méheux & Parker, 2006).

Cross-Cultural Comparisons of Children's Learning in HSUS and Tannese Populations

Previous research with Tannese and HSUS caregivers suggests that Tannese caregivers may emphasize practices associated with observational learning to a greater extent than direct active teaching. For example, when asked to interact with a novel toy with their infants, Tannese parents were less likely than HSUS parents to directly teach their infant an affordance of the toy (Little et al., 2016). Tannese children and caregivers also expect children to observe and closely imitate an adult model without instruction to do so (Clegg, Wen, & Legare, 2017; Wen, Clegg, & Legare, 2019) and Tannese primary school-aged children imitated a modeled behavior at higher levels of fidelity than HSUS children (Clegg & Legare, 2016). Thus, starting in infancy, Tannese caregivers use teaching practices that reflect expectations that children will learn by closely watching and imitating others, consistent with informal education. In interviews conducted in Austin and Tanna about caregivers' ethnotheories of children's learning, the majority of HSUS caregivers indicated that adults are responsible for the transmission of information to children and that children learn from direct active teaching, consistent with formal education practices. In contrast, the majority of Tannese caregivers indicated that children are responsible for their own learning by observing others, consistent with informal education (see Appendix S1).

Study Objectives and Hypotheses

Our first objective was to examine the kinds of teaching practices HSUS and Tannese caregivers use during collaborative activity with children. Caregivers' teaching practices are shaped, in part, by their beliefs about children's learning (Harkness & Super, 2002; Kağıtçıbaşı, 2007) and experience with formal education (Greenfield, Maynard, & Childs, 2003; Keller, 2017; LeVine et al., 2012). Thus,

if caregivers expect children to learn by observing others, they should provide opportunities for children to observe when learning a new skill and actively participate when a skill is within their ability, rather than directly structuring children's involvement (Greenfield, 2009; Keller, 2017; Paradise & Rogoff, 2009). In contrast, if caregivers believe that children learn as a result of direct active teaching, they should prioritize children's active participation in all parts of a task and guide this involvement with high amounts of verbal and physical scaffolding.

To examine the extent to which HSUS and Tannese caregivers' teaching practices were consistent with different expectations for children's learning associated with formal versus informal education, we invited caregivers and children to complete a novel joint problem-solving task—creating shapes out of smaller tangram pieces. The design of this study is based on previous research that has used one task across diverse populations to explore variation in teaching style and interaction (e.g., origami and toy construction—Lopez, Correa-Chavez, Rogoff, & Gutierrez, 2010; Mejía-Arauz, Rogoff, Dexter, & Najafi, 2007; puzzle building—Chavajay & Rogoff, 2002, and Tinkertoy construction—Laosa, 1978) while also providing for an opportunity to explore variability in caregiver and child behaviors in response to different levels of task difficulty. We selected a task that would be interesting and challenging for children of a variety of ages across early childhood. We examined two components of caregivers' teaching practices during this task: how they interacted with children (*interaction style*) and how they used nonverbal and verbal teaching behaviors to scaffold children's participation (*teaching behaviors*).

Previous research using similar methods (e.g., caregivers and children constructing three-dimensional puzzles) has examined how caregivers and children interacted when completing a collaborative task. In these studies, Guatemalan Mayan caregivers with limited formal education experience worked collaboratively with children (i.e., all parties attended to the same elements of the task), whereas caregivers with more experience with formal education assumed a hierarchical director role to guide children's participation (Chavajay, 2008; Chavajay & Rogoff, 2002). In this research, caregivers were often asked to interact with multiple children at once and overall assessments were made about the actions of the group, which limits conclusions about the direct contributions of the adult versus child partners in the completion of the task.

In this study, we examined dyadic interaction by directly assessing children's versus caregivers' active participation in the task in specific increments (e.g., 10 seconds rather than minutes). We also measured when children's active participation was the direct result of caregiver instruction versus independent involvement in the task. When coding interaction styles, we examined when caregivers and children actively participated together (*shared participation*), when caregivers were the primary active participants (*caregiver primary participation*), when children were receiving or responding to caregiver instruction or direct active teaching (*caregiver-led participation*), and when children were acting independently as the primary active participants (*child primary participation*). Overall, *shared participation* and *caregiver primary participation* correspond with nonhierarchical practices associated with observational learning because they emphasize either joint participation or the child watching the caregiver completing the task. In contrast, *caregiver-led participation* corresponds with direct active teaching because the caregiver is guiding the child's direct involvement. In contrast, *child primary participation* captures children's independent completion of the task which could correspond with both observational learning and direct active teaching. In both formally and informally educated populations, children might be encouraged and permitted to independently participate when they are completing activities that are within their ability level.

In addition to documenting styles of caregiver–child interaction as a component of caregiver teaching practices, we also examined the prevalence of different nonverbal (i.e., pointing, stopping, and facilitation) and verbal (i.e., planning, correction, encouragement, and imperatives) teaching behaviors. Previous research has tended to focus on either interaction or teaching behaviors; however, in this study, we were interested in capturing both as complementary components of caregiver teaching practices. Some teaching behaviors, such as pointing and child-directed verbal instruction or imperatives, have been documented in a number of different cultural contexts and caregiver educational backgrounds, but other behaviors, such as facilitation and verbal planning, are less common outside of formally educated populations (Boyette & Hewlett, 2017; Teichman & Contreras-Grau, 2006). Here, we coded for behaviors that might be used in both populations, rather than privileging behaviors typically associated with direct active teaching practices. We predicted that both HSUS and Tannese caregivers would engage in similar levels of teaching behaviors previously documented to occur

across distinct cultural contexts, such as pointing and verbal imperatives. In both contexts, these behaviors might be used to enhance children's attention to key elements of the task. In contrast, we predicted that, consistent with previous studies of informally educated caregivers and children, Tannese caregivers would use behaviors associated with direct active teaching less frequently overall (Childs & Greenfield, 1980; Dixon et al., 1984; Laosa, 1978, 1980). Thus, we predicted that HSUS caregivers would demonstrate higher levels of facilitation, planning, and encouragement since these behaviors are directly associated with direct active teaching and are more commonly used by formally educated caregivers.

Our second objective was to examine the impact of task difficulty on caregivers' teaching practices. In recent work challenging the definition of teaching often used within the child development literature, Kline (2014) draws from ethnographic and experimental evidence to argue that, across cultures, caregivers' teaching varies in response to factors such as task difficulty and importance and learners' abilities (see also Freund, 1990; Pratt, Kerig, Cowan, & Cowan, 1988; Rogoff, Ellis, & Gardner, 1984). In particular, caregivers from diverse cultural contexts should use direct active teaching methods more when children are learning more demanding and higher cost tasks. In contrast, caregivers should expect children to observe or work alongside them during less demanding tasks. Thus, to provide an empirical test of this claim using a structured task, we assessed variation in caregivers' teaching practices in response to task difficulty over the course of the joint problem-solving task.

The actions required to successfully complete the joint problem-solving task varied in complexity. To complete the task, caregiver–child pairs needed to select tangram pieces (less difficult *preparation* activity) before arranging the pieces to make a designated target shape (more difficult *construction* activity). The construction component was more complex because it required spatial rotation of multiple objects. Caregivers, regardless of their experiences with informal versus formal education, should be sensitive to task difficulty and prioritize children's direct participation during activity that aligns with their abilities (Kline, 2014). We predicted that children's active participation would be most prevalent during less difficult activity, in the form of child primary participation, shared participation, or caregiver-led participation—as all of these interaction categories included children's active participation in the task. Children's participation in this activity may need to be guided through the use of teaching behaviors. We predicted that caregivers might use teaching behaviors more frequently during less difficult activities. In contrast, we predicted that caregivers would take a more active role in the complex activity through caregiver primary participation. We also predicted lower frequency of teaching behaviors as the caregivers worked to complete the task themselves rather than guiding children's involvement. Another possibility, however, is that caregivers from both populations use more direct active teaching during the difficult parts of the task to scaffold children's learning.

Our third objective was to examine the impact of child age on caregiver teaching practices. Caregivers are sensitive to children's abilities (Kline, 2014; Vygotsky, 1978) and may adjust their teaching behavior in response to child age (Rogoff et al., 1984; Wertsch, Mcnamee, Mclane, & Budwig, 1980) based on the expectation that older children may be more capable than younger children. We predicted that, in both populations, caregivers might give older children more autonomy to complete the task, and therefore pairs with older children would have lower rates of caregiver-led participation and caregiver primary participation, and that caregivers would use fewer teaching behaviors with older children than with younger children.

In sum, in this study, we examined both the similarities and differences in caregiver teaching behaviors in HSUS and Tannese samples. We predicted that when examining overall trends in caregiver teaching practices, including interaction style and nonverbal and verbal teaching behaviors, that there would be distinct patterns in the prevalence of behaviors associated with direct active teaching versus observational learning between populations. We also predicted cross-population similarities, however, in caregivers' sensitivity to task difficulty and child age such that caregivers would use different teaching practices more frequently during difficult components of the task and as children became more adept at the task with age.

Method

Participants

Austin, TX, U.S.

In all, 80 caregiver–child dyads (52 female caregivers; 36 female children, mean child age = 4.73) recruited from a children's science museum from

October 2012 to April 2013 were included in the HSUS sample. Children were between the ages of 3- and 6-years old. Demographic data gathered for the study indicated that the families recruited were primarily Euro-American (70%) and that approximately 95% of the caregivers had some college experience. The composition of this sample is consistent with that of previous research with samples recruited from the same and other children's science museums in the United States (Soren, 2009). All materials in this study received approval from The University of Texas at Austin's Institutional Review Board, Protocol #2010-06-59—The Development of Imitation, for testing in both the United States and Vanuatu. HSUS caregivers completed written informed consent forms for themselves and separate consent forms for their children.

Tanna, Vanuatu

In all, 48 caregiver–child dyads (41 female caregivers; 32 female children, mean child age = 5 years; exact birthdate information was unavailable for most children) recruited from residences and community gathering areas around Tanna from July to August 2013 were included in the Tannese sample. Children were between the ages of 3- and 8-years-old. Beyond primary and some secondary school, caregivers had limited exposure to Western-style education (22% of the caregivers had no school experience, 45% completed school through primary school, and 33% obtained some secondary school experience or completed secondary school). Our Tannese sample size was smaller and the age range was larger than the HSUS sample size due to more limited access to caregiver–child pairs. Tannese caregivers provided verbal consent for themselves and their children after being read an IRB-approved consent script translated and back translated with the aid of research assistants fluent in English and Bislama.

Detailed demographic information by population and agent (caregiver, child) is included in Appendix S2. A further explanation of recruitment procedures is included in Appendix S4.

Age Differences Across Samples

We acknowledge that our Tannese sample featured a wider age range of children, which was reflective of the kinds of environments we drew our samples from (e.g., a children's museum that targeted a slightly younger age range in Austin and village centers with more variability in child age in Tanna). Expanding the age range in Tanna also allowed us to increase our sample size to make it more comparable with the HSUS sample. To account for these differences in the age range of the studies, we also conducted supplementary analyses comparing the 3- to 6-year-old subset of the Tannese sample with the HSUS sample (Appendix S3).

Procedure and Materials

In Austin, testing was conducted in English in a quiet room. Female research assistants conducted all testing after building rapport with the caregivers and children to establish a level of comfort with the experimental setting and familiarity with the experimenter. In Tanna, testing was conducted in a quiet room or secluded outdoor area. The study protocol was translated into Bislama and back-translated into English by two Tannese teachers who were highly proficient in English. Two female Tannese research assistants were recruited from local villages and were extensively trained by the first author on how to execute the protocol. All sessions were transcribed and translated into English to ensure compliance with the experimental protocol and to provide a transcript of caregiver–child conversation.

Before beginning each study session, the research assistant explained to the caregiver that none of the tasks were tests and that the caregiver and child should act as they normally would when playing a game together. The research assistant presented the caregiver and child with a tangram puzzle game in which they were instructed to use plastic shapes in a bowl to make a shape indicated on a card (for a full script and a description of research assistant training, see Appendix S4). The goal shapes on the cards were a hexagon and a six-sided polygon (see Figure S1 in Appendix S4). Each dyad completed the same two cards, one at a time. To ensure similar task comprehension in both locations, the Tannese research assistant demonstrated how to complete an example card. In both locations, the research assistant was seated across from the pair and if asked a question about the task, she answered without prescriptive language and repeated the goal of the task. Each dyad's interaction was video-recorded for coding purposes. Task completion rates were high in both populations; 95% of HSUS pairs and 98% of Tannese pairs completed both cards.

Coding

Pairs' interactions were divided into 10-s segments and each segment was coded for how the

caregiver and child interacted while completing the task (*caregiver–child interaction*), the nonverbal and verbal behaviors caregivers used to guide children's involvement (*caregiver teaching behaviors*), and the parts of the task being completed (*task difficulty*). Pairs' interactions were coded from the time the research assistant gave the pair a card to the time they confirmed completion for each of the cards. All coding was completed using Datavyu coding software (Datavyu Team, 2014). A table of coding categories and their subcategories is available in Appendix S5.

Caregiver–Child Interaction

Each segment was coded as one of four mutually exclusive interaction categories: *shared participation, caregiver primary participation, child primary participation,* or *caregiver-led participation*. If both the caregiver and the child actively contributed (e.g., selecting pieces, moving pieces, constructing the shape) to the completion of the same parts of the task, the segment was coded as *shared participation*. If the caregiver worked on the task while the child observed or made a minimal contribution, the segment was coded as *caregiver primary participation*. Segments were coded as *child primary participation* if the child appeared to participate without caregiver direction or by ignoring caregiver direction while the caregiver observed or made a minimal contribution. Segments were coded as *caregiver-led participation* if the child's actions were the result of caregiver direction (verbal and/or nonverbal). This subcategory also included segments when caregivers provided instruction to children but children did not actively participate. In line with past research on caregiver–child interaction (Chavajay, 2008; Chavajay & Rogoff, 2002), we also included two additional categories in our coding: *division of labor* (caregiver and child worked on separate parts of the task while attending to each other's actions) and *non-coordinated effort* (caregiver and child worked independently and did not attend to each other's actions or one interaction partner was not attending to the task). Division of labor occurred in 1% of pairs' interactions overall and non-coordinated effort occurred in 3% of pairs' interactions, so these categories were not included in analyses. For Tannese pairs, coding was primarily conducted by the first author. A second coder blind to the study hypotheses coded one-third of the caregiver–child pairs to establish reliability and interrater reliability was calculated using Cohen's *kappa* and indicated good reliability ($\kappa = .69$). For HSUS pairs, coding was conducted by two trained coders blind to the hypotheses of the study. Coders were trained on the coding scheme and coded six pairs to 95% reliability and then coded an additional five pairs to establish reliability ($\kappa = .52$).

Caregiver Teaching Behaviors

We coded whether or not caregivers displayed the following *nonverbal* and *verbal* teaching behaviors during each time segment.

Nonverbal teaching. Caregivers' nonverbal teaching behaviors of interest included *pointing* and *facilitation. Pointing* was defined as the caregiver pointing to any materials associated with the task. *Facilitation* included the caregiver holding the tray or card for the child, moving materials closer to the child, or handing the child a piece to facilitate the child's completion of the task.

Verbal teaching. Tannese pairs' interactions were translated and transcribed by the first and second authors in collaboration with Tannese research assistants. Two trained coders blind to the hypotheses of the study coded the translated Tannese and HSUS caregiver utterances. Coders were trained on the coding scheme to 95% reliability. The first author assessed the completed coding to ensure consistency with the context of the files. Coded utterances were then mapped onto each 10-s segment to assess whether or not each type of verbal teaching occurred. Verbal teaching included three mutually exclusive categories: planning, encouragement, and imperative. Planning included verbal prompts from the caregiver to the child to consider her own or the caregiver's current or future action. Encouragement included utterances when the caregiver verbally praised the child or provided affirmation. Imperatives included verbal prompts by caregivers for children to engage in an action related to the completion of the task.

Task Difficulty

We coded each 10-s segment for the difficulty of the activity being completed. The behaviors associated with the task were categorized as either less difficult *preparation* behaviors or more difficult *construction* behaviors. *Preparation* actions included moving plastic shapes in the bowl, selecting or replacing a plastic shape from the bowl, and placing a plastic shape on the hint bubble on the card. *Construction* actions included placing or arranging the plastic shapes to make the target figure. If both types of actions occurred, we categorized the

segment as construction, given that this was the more complex behavior. If no actions occurred (e.g., caregiver and child were looking at the card), we categorized the segment as preparation.

Results

Due to differences in the completion time of different pairs, analyses were conducted on the proportion of segments in which the behaviors that we coded for were displayed. Table 1 presents the frequency of the interaction styles and teaching behavior by population, child age, and task difficulty. For analyses, proportions were transformed using an arcsine transformation when appropriate. Caregiver gender was included in preliminary analyses of interaction styles and caregiver teaching behaviors. It did not significantly contribute to differences in interaction styles or behaviors; thus, gender was not included in the analyses reported below. We also examined the influence of caregiver education within each population, but education did not significantly predict interaction styles or behaviors, so education was not included in the analyses reported below. All analyses reported here were confirmatory and guided by our hypotheses, unless otherwise specified.

Three multivariate analyses of variance (MANOVAs) were run to examine the relation between population, child age, and their interaction on the prevalence of interaction styles (shared participation, caregiver primary participation, child primary participation, and caregiver-led participation), caregivers' nonverbal teaching behaviors (pointing and facilitation), and verbal teaching behaviors (planning, encouragement, and imperatives). In some instances, the arcsine transformation did not fully address the problem of non-homogeneity; therefore, any significant effects based on parametric tests were also verified using nonparametric tests.

Caregiver-Child Interaction Style

Using Wilks's lambda, there were significant effects of population, $\Lambda = .54$, $F(4, 112) = 23.54$, $p < .001$, partial $\eta^2 = .46$, and child age, $\Lambda = .64$, $F(20, 372.41) = 2.73$, $p < .001$, partial $\eta^2 = .11$, and a significant interaction between population and child age, $\Lambda = .79$, $F(12, 296.62) = 2.27$, $p = .009$, partial $\eta^2 = .07$. Separate post-hoc analyses of variance (ANOVAs; *p*-values Bonferroni corrected to $p < (.05/4) = .013$; for a full summary of coefficients see Table 2) were run to examine the effects of population and child age and their interaction on the prevalence of each interaction style. These post-hoc analyses indicated no significant interactions between population and child age on the prevalence of the different types of interaction styles. For each interaction style, there was a main effect of population. As indicated in Table 1, HSUS pairs were more likely to display child primary and caregiver-led interaction, whereas Tannese pairs were more likely to display caregiver primary and shared interaction styles. Pairs with older children also had significantly higher prevalence of child primary interaction.

Nonverbal Teaching Behaviors

Using Wilks's lambda, there was a significant effect of population, $\Lambda = .85$, $F(2, 114) = 10.12$, $p < .001$, partial $\eta^2 = .15$, and child age, $\Lambda = .78$, $F(10, 228) = 3.07$, $p = .001$, partial $\eta^2 = .12$, on the prevalence of caregivers' nonverbal teaching behaviors, but there was not a significant interaction between population and child age, $\Lambda = .97$, $F(6, 228) = 0.67$, $p = .677$. Separate post-hoc ANOVAs (*p*-values Bonferroni corrected to $p < (.05/2) = .025$; for a full summary of coefficients see Table 2) were run to examine the effect of population and child age on the prevalence of each type of nonverbal teaching behavior (pointing, facilitation). HSUS caregivers used facilitation ($M = .35$, $SD = .29$) more than Tannese caregivers ($M = .07$, $SD = .13$; Mann–Whitney $U = 651.00$, $p < .001$). Caregivers with younger children used more facilitation (Spearman's $r = -.50$, $p < .001$). There was no difference between populations in caregivers' use of pointing (HSUS: $M = .39$, $SD = .23$; Tannese: $M = .36$, $SD = .21$). Caregivers with younger children used more pointing (Spearman's $r = -.41$, $p < .001$).

Verbal Teaching Behaviors

Using Wilks's lambda, there was a significant effect of population, $\Lambda = .34$, $F(3, 113) = 72.03$, $p < .001$, partial $\eta^2 = .66$, on the prevalence of caregivers' verbal teaching behaviors, but there was not a significant effect of child age, $\Lambda = .89$, $F(15, 312.35) = 0.93$, $p = .537$ or a significant interaction between population and child age, $\Lambda = .88$, $F(9, 275.16) = 1.72$, $p = .084$. Separate post-hoc Mann–Whitney *U* tests (*p*-values Bonferroni corrected to $p < (.05/3) = .017$) were run to examine the effect of population on the prevalence of each type of verbal teaching behavior (planning, encouragement,

Table 1
Distributions of Caregiver–Child Interaction Styles and Teaching Behaviors by Population, Child Age Group, and Task Difficulty. Proportions Are Reported as M (SE)*. Caregiver–Child Interaction Proportions May Not Sum to 1—Two Additional Interaction Styles Were Coded for, But Were Relatively Low Frequency and Thus Not Included in the Analyses*

(a) Caregiver–child interaction style

	Shared	Caregiver primary	Child primary	Caregiver-led
HSUS				
3–4	.15 (.02)	.05 (.01)	.18 (.03)	.62 (.04)
5–6	.12 (.03)	.03 (.01)	.42 ((.05)	.44 (.05)
Overall	.14 (.02)	.04 (.01)	.29 (.03)	.53 (.03)
Tannese				
3–4	.27 (.05)	.22 (.05)	.11 (.07)	.29 (.06)
5–6	.29 (.04)	.26 (.05)	.15 (.06)	.27 (.04)
7–8	.29 (.05)	.13 (.03)	.30 (.06)	.28 (.04)
Overall	.28 (.03)	.20 (.02)	.19 (.04)	.28 (.03)
Interaction style: Preparation				
HSUS				
3–4	.13 (.03)	.03 (.02)	.13 (.02)	.70 (.04)
5–6	.07 (.03)	.00 (.00)	.36 (.06)	.57 (.06)
Overall	.10 (.02)	.02 (.01)	.24 (.03)	.64 (.03)
Tannese				
3–4	.30 (.09)	.07 (.03)	.09 (.06)	.53 (.09)
5–6	.24 (.06)	.08 (.04)	.24 (.08)	.43 (.09)
7–8	.19 (.07)	.05 (.02)	.39 (.08)	.37 (.07)
Overall	.24 (.04)	.07 (.02)	.25 (.05)	.44 (.05)
Interaction style: Construction				
HSUS				
3–4	.16 (.02)	.07 (.02)	.18 (.03)	.58 (.05)
5–6	.14 (.04)	.03 (.01)	.43 (.05)	.40 (.05)
Overall	.15 (.02)	.06 (.01)	.30 (.03)	.49 (.04)
Tannese				
3–4	.31 (.06)	.32 (.06)	.12 (.07)	.10 (.04)
5–6	.34 (.06)	.40 (.07)	.10 (.05)	.15 (.03)
7–8	.35 (.05)	.18 (.05)	.22 (.06)	.24 (.05)
Overall	.33 (.03)	.30 (.04)	.15 (.04)	.16 (.02)

(b) Caregiver nonverbal and verbal teaching behaviors

	Pointing	Facilitation	Imperative	Planning	Encouragement
HSUS					
3–4	.43 (.03)	.41 (.04)	.43 (.03)	.34 (.03)	.38 (.03)
5–6	.31 (.04)	.28 (.05)	.28 (.03)	.27 (.03)	.26 (.03)
Overall	.38 (.03)	.35 (.03)	.36 (.02)	.31 (.02)	.33 (.02)
Tannese					
3–4	.48 (.06)	< 10%	.42 (.07)	< 10%	< 10%
5–6	.38 (.05)		.50 (.05)		
7–8	.24 (.04)		.40 (.05)		
Overall	.36 (.03)		.44 (.03)		
Teaching behaviors: Preparation					
HSUS					
3–4	.52 (.04)	.47 (.06)	.51 (.06)	.39 (.04)	.32 (.04)
5–6	.40 (.06)	.31 (.06)	.35 (.05)	.38 (.05)	.13 (.04)
Overall	.47 (.03)	.39 (.04)	.44 (.04)	.38 (.03)	.24 (.03)

Table 1
Continued

(b) Caregiver nonverbal and verbal teaching behaviors	Pointing	Facilitation	Imperative	Planning	Encouragement
Tannese					
3–4	.70 (.06)	< 10%	.56 (.09)	< 10%	< 10%
5–6	.53 (.09)		.60 (.08)		
7–8	.33 (.07)		.37 (.06)		
Overall	.51 (.05)		.50 (.05)		
Teaching behaviors: Construction					
HSUS					
3–4	.42 (.03)	.41 (.05)	.42 (.03)	.34 (.03)	.42 (.03)
5–6	.26 (.04)	.27 (.05)	.26 (.04)	.23 (.04)	.32 (.04)
Overall	.34 (.03)	.34 (.04)	.34 (.03)	.29 (.02)	.38 (.03)
Tannese					
3–4	.37 (.07)	< 10%	.40 (.08)	< 10%	< 10%
5–6	.27 (.06)		.41 (.06)		
7–8	.18 (.04)		.43 (.06)		
Overall	.27 (.04)		.41 (.04)		

and imperatives). HSUS caregivers used planning (M = .32, SD = .19) more than Tannese caregivers (M = .02, SD = .05; Mann–Whitney U = 143.00, $p < .001$). HSUS caregivers also used encouragement (M = .33; SD = .21) more than Tannese caregivers (M = .04, SD = .08; Mann–Whitney U = 249.50, $p < .001$). There was no significant difference between populations in caregivers' use of imperatives (HSUS: M = .37, SD = .23; Tannese: M = .44, SD = .22; Mann–Whitney U = 1,463.00, p = .083).

Nonverbal and Verbal Teaching Behavior by Interactional Style

We examined the frequencies of the most common nonverbal (pointing) and verbal (imperatives) teaching behaviors in each population by interactional style. This analysis was exploratory. Means reported later represent the mean proportion of interaction style segments in which each teaching behavior occurred.

Tannese Caregivers

Tannese caregivers' use of pointing and imperatives in each interaction style were as follows: Caregivers pointed most frequently during caregiver-led participation (M = .71, SE = .05), followed by shared participation (M = .36, SE = .05), caregiver primary participation (M = .14, SE = .04), and child primary participation (M = .09, SE = .03). Tannese caregivers used imperatives most frequently during caregiver-led participation (M = .80, SE = .04), followed by shared participation (M = .48, SE = .05), caregiver primary participation (M = .24, SE = .04), and child primary participation (M = .11, SE = .04).

HSUS Caregivers

HSUS caregivers' use of pointing and imperatives in each interaction style were as follows: Caregivers pointed most frequently during caregiver-led participation (M = .54, SE = .03), followed by shared participation (M = .39, SE = .05), caregiver primary participation (M = .37, SE = .08), and child primary participation (M = .12, SE = .03). HSUS caregivers used imperatives at similar levels of frequency across three of the four interaction styles: caregiver-led participation (M = .48, SE = .03), shared participation (M = .46, SE = .05), and caregiver primary participation (M = .48, SE = .09). Imperatives were less frequent during child primary participation (M = .07, SE = .02).

Impact of Task Difficulty on Teaching Practices by Population

We examined the impact of task difficulty on the rates of different interaction styles and teaching behaviors by population given overall differences in the frequency of the different interaction styles and teaching behaviors. For the analyses presented in the following, we used multilevel models to examine the impact of task difficulty (2: preparation, construction) while controlling for child age (Tannese

Table 2
Results of Post-Hoc Analyses of Variance Examining the Impact of Population, Child Age, and Their Interaction on the Prevalence of Each Caregiver–Child Interaction Style and Caregiver Teaching Behaviors. Partial η^2 Reported for Significant Effects

	Effect	*F*	*p*	Partial η^2
(a) Caregiver–child interaction style				
Shared participation	Population	$F(1, 115) = 16.27$	< .001***	.12
	Child age	$F(5, 115) = 1.30$	.268	
	Population × Age	$F(3, 115) = 1.34$	.265	
Caregiver primary participation	Population	$F(1, 115) = 73.15$	< .001***	.39
	Child age	$F(5, 115) = 2.74$	.022	
	Population × Age	$F(3, 115) = 2.20$	.092	
Child primary participation	Population	$F(1, 115) = 14.00$	< .001***	.11
	Child age	$F(5, 115) = 4.88$	< .001***	.18
	Population × Age	$F(3, 115) = 1.33$	.268	
Caregiver-led participation	Population	$F(1, 115) = 16.23$	< .001***	.12
	Child age	$F(5, 115) = 0.57$	.658	
	Population × Age	$F(3, 115) = 1.06$	.370	
(b) Caregiver teaching behaviors				
Pointing	Population	$F(1, 115) = 1.39$	.241	
	Child age	$F(5, 115) = 4.15$	.002**	.15
	Population × Age	$F(3, 115) = 0.54$	.657	
Facilitation	Population	$F(1, 115) = 18.15$	< .001***	.14
	Child age	$F(5, 115) = 2.13$	.016*	.11
	Population × age	$F(3, 115) = 0.82$	.488	
Imperative	Population	$F(1, 115) = 4.20$	.043	
	Child age	$F(5, 115) = 2.10$	.071	
	Population × Age	$F(3, 115) = 2.50$	.063	
Planning	Population	$F(1, 115) = 134.75$	< .001***	.54
	Child age	$F(5, 115) = 0.86$	.508	
	Population × Age	$F(3, 115) = 0.68$	.567	
Encouragement	Population	$F(1, 115) = 85.58$	< .001***	.43
	Child age	$F(5, 115) = 0.55$	.740	
	Population × Age	$F(3, 115) = 2.57$	.058	

*$p < .025$. **$p < .01$. ***$p < .001$.

3: 3- to 4-year olds, 5- to 6-year olds, and 7- to 8-year olds; HSUS 2: 3- to 4-year olds and 5- to 6-year olds)—both fixed effects—on the prevalence of each interaction style and teaching behavior with a random effect of pair to account for non-independence of observations. All proportions were transformed using an arcsine transformation. The full results of each of these analyses are reported in Table 3. We report the key findings below.

Tannese Caregivers

Caregiver–child interaction. The results of the multilevel models indicate that the prevalence of two interaction styles—caregiver primary participation and caregiver-led participation—differed significantly when pairs were completing less difficult preparation versus more difficult construction activities. This was not the case for the other two interaction styles. Post-hoc analyses using paired-samples *t*-tests and Bonferroni-corrected *p*-values of .025 (.05/2 comparisons) were used to examine the significant main effects. The analysis for caregiver primary participation indicated that caregivers were more likely to actively participate while children observed during construction ($M = .30$, $SE = .04$) than during preparation ($M = .07$, $SE = .02$; $t(44) = -7.42$, $p < .001$, $d = 1.92$). In contrast, the analysis for caregiver-led participation indicated that caregivers directed children more during preparation ($M = .44$, $SE = .05$) than during construction ($M = .16$, $SE = .02$; $t(44) = 5.56$, $p < .001$, $d = 1.75$).

The multilevel model analyses indicated a significant effect of age on the prevalence of caregiver

Table 3
Results of Multilevel Models Examining the Impact of Task Difficulty, Controlling for Child Age, on the Prevalence of Each Caregiver–Child Interaction Style and Caregiver Teaching Behaviors by Population

		Tannese		HSUS	
	Effect	*F*	*p*	*F*	*p*
(a) Caregiver–child interaction style					
Shared participation	Task difficulty	$F(1, 86) = 0.12$	.726	$F(1, 151) = 4.21$	.042*
	Child age	$F(2, 86) = 0.42$	.658	$F(1, 151) = 5.33$	.022*
Caregiver primary participation	Task difficulty	$F(1, 86) = 40.10$	< .001***	$F(1, 151) = 9.73$	.002**
	Child age	$F(2, 86) = 3.13$	.049*	$F(1, 151) = 4.22$	.042*
Child primary participation	Task difficulty	$F(1, 86) = 2.25$	.137	$F(1, 151) = 1.40$	.238
	Child age	$F(2, 86) = 5.05$	.008**	$F(1, 151) = 25.26$	< .001***
Caregiver-led participation	Task difficulty	$F(1, 86) = 17.41$	< .001***	$F(1, 151) = 5.65$	.019*
	Child age	$F(2, 86) = 0.42$	.658	$F(1, 151) = 9.41$	.003**
(b) Caregiver teaching behaviors					
Pointing	Task difficulty	$F(1, 86) = 19.67$	< .001***	$F(1, 151) = 8.14$	.005**
	Child age	$F(2, 86) = 7.33$	.001**	$F(1, 151) = 10.93$	.001**
Facilitation	Task difficulty			$F(1, 150) = 0.26$	.613
	Child age			$F(1, 150) = 5.46$	.021*
Imperatives	Task difficulty	$F(1, 86) = 1.60$	.209	$F(1, 150) = 2.05$	.154
	Child age	$F(2, 86) = 3.28$	.074	$F(1, 150) = 13.83$	< .001***
Planning	Task difficulty			$F(1, 151) = 3.08$	.081
	Child age			$F(1, 151) = 2.18$	.142
Encouragement	Task difficulty			$F(1, 151) = 17.76$	< .001***
	Child age			$F(1, 151) = 15.78$	< .001***

*$p < .05$. **$p < .01$. ***$p < .001$.

primary participation and child primary participation, but not on any of the other interaction styles. For any significant effects of age in these and subsequent difficulty analyses, we further examined the effects using one-way ANOVAs to assess impact of child age on the overall prevalence of each interaction style and teaching behaviors. Next, we present these analyses in the *child age* analyses.

Caregiver teaching behaviors. For Tannese pairs, we examined the impact of task difficulty on two teaching behaviors: pointing and imperatives. We limited our analyses to these two teaching behaviors because encouragement and planning occurred in < 4% of pairs' task completion segments and facilitation occurred, on average, in only 7% of pairs' task completion segments. The results of the model for pointing indicated significant effects of both task difficulty and child age. We further explored the impact of task difficulty on caregivers' use of pointing using a paired-samples *t*-test. Caregivers pointed significantly more often during preparation activity ($M = .51$, $SE = .05$) than during construction activity ($M = .27$, $SE = .03$; $t(44) = 4.94$, $p < .001$, $d = 0.86$). The impact of child age is further explored in the *child age* analyses later. There was not a significant effect of task difficulty or child age on the prevalence of imperatives.

HSUS Caregivers

Caregiver–child interaction. The results of the multilevel models indicate that the prevalence of three interaction styles—shared participation, caregiver primary participation, and caregiver-led participation—differed significantly when pairs were completing less difficult preparation versus more difficult construction activities. There was not a significant effect of task difficulty on child primary participation. Post-hoc analyses using paired-samples *t*-tests and Bonferroni-corrected *p*-values of .017 (.05/3 comparisons) were used to examine the significant main effects. The analysis for shared participation indicated that caregivers and children were more likely to actively participate together during construction ($M = .15$, $SE = .02$) than during preparation ($M = .10$, $SE = .02$; $t(73) = 2.89$, $p = .005$, $d = 0.33$). In contrast, the analysis for caregiver-led participation indicated that caregivers

directed children more during preparation (M = .64, SE = .03) than during construction (M = .49, SE = .04; $t(73) = -3.81$, $p < .001$, d = 0.44). The analysis for caregiver primary participation did not support a significant difference between construction (M = .06, SE = .01) and preparation (M = .02, SE = .01; $t(73) = 1.88$, $p = .064$, d = 0.22).

The multilevel model analyses indicated a significant effect of age on the prevalence of all four interaction styles, which is further explored in the *child age* analyses in the following.

Caregiver teaching behaviors. For HSUS pairs, we examined the impact of task difficulty on the following teaching behaviors: pointing and facilitation (nonverbal) and imperatives, planning, and encouragement (verbal) because each of these behaviors, on average, occurred in 30% or more of pairs' task completion segments.

The results of the models indicated significant effects of task difficulty on the frequency of pointing and encouragement. We further explored the impact of task difficulty on caregivers' use of pointing and encouragement using paired-samples t-tests with Bonferroni-corrected p-values of .025 (.05/2 comparisons). Caregivers pointed significantly more often during preparation activities (M = .47, SE = .04) than during construction activities (M = .35, SE = .03; $t(73) = 3.62$, $p = .001$, d = 0.42). Caregivers used encouragement significantly less during preparation activities (M = .23, SE = .03) than during construction activities (M = .38, SE = .03; $t(73) = -4.75$, $p < .001$, d = 0.56). There was not a significant effect of task difficulty on caregivers' use of facilitation, imperatives, or planning.

There was a significant effect of child age on caregivers' use of pointing, facilitation, imperatives, and encouragement, but not on planning. The impact of child age is further explored in the *child age* analyses in the following.

Impact of Child Age on Teaching Practices by Population

Tannese Caregivers

Caregiver-child Interaction style. A multivariate analysis of variance (MANOVA) was run to examine the impact of child age (3: 3- to 4-, 5- to 6-, and 7- to 8-years-old) on the prevalence of the four interaction styles. Using Wilks's lambda, there was a significant effect of child age, $\Lambda = .61$, $F(8, 78) = 2.78$, $p = .009$, partial $\eta^2 = .22$. Separate post-hoc ANOVAs (p-values Bonferroni corrected to $p < (.05/4) = .013$; for a full summary of coefficients see Table 4) were run to examine the effects of child age on the prevalence of each interaction style. These post-hoc analyses indicated there was a significant influence of child age on the prevalence of child primary participation, but not on any of the other interaction styles. Tukey post-hoc tests examining the prevalence of child primary participation

Table 4
Results of Planned (Tannese) and Post-Hoc Analyses of Variance (HSUS) Examining the Impact of Child Age on the Prevalence of Each Caregiver–Child Interaction Style and Caregiver Teaching Behaviors by Population. Partial η^2 Reported for Significant Effects

	Tannese HSUS					
	F	p	Partial η^2	F	p	Partial η^2
(a) Caregiver–child interaction						
Shared participation	$F(2, 42) = 0.10$	.904		$F(1, 78) = 3.49$	.065	
Caregiver primary participation	$F(2, 42) = 2.39$	.104		$F(1, 78) = 1.09$	.301	
Child primary participation	$F(2, 42) = 4.72$	.014*	.18	$F(1, 78) = 16.09$	< .001***	.17
Caregiver-led participation	$F(2, 42) = 0.01$	.991		$F(1, 78) = 7.86$	.006**	.09
(b) Caregiver teaching behaviors						
Pointing	$F(2, 42) = 6.72$	.003	.24	$F(1, 78) = 7.32$	< .001***	.09
Facilitation				$F(1, 78) = 3.45$	.067	
Imperatives	$F(2, 42) = 1.03$	.366	.05	$F(1, 78) = 11.51$	< .001***	.13
Planning				$F(1, 78) = 3.63$	.060	
Encouragement				$F(1, 78) = 8.89$	.004**	.10

*$p < .05$. **$p < .01$. ***$p < .001$.

by age indicated that pairs with 3- to 4-year olds (M = .11, SE = .07) displayed significantly less child primary participation than pairs with 7- to 8-year olds (M = .30, SE = .06; p = .013), but there was not a significant difference between pairs with 5- to 6-year olds (M = .15, SE = .06) and 3- to 4-year olds (p = .640) or 7- to 8-year olds (p = .103).

Caregiver teaching behaviors. Separate one-way ANOVAs were used to examine the impact of child age (3: 3- to 4-, 5- to 6-, and 7- to 8-years old) on the prevalence of the two most common teaching behaviors used by Tannese caregivers—pointing and imperatives (see Table 4). There was a significant effect of age on Tannese caregivers' use of pointing. Tukey post-hoc tests examining the overall prevalence of pointing by age indicated that caregivers interacting with 3- to 4-year olds (M = .48, SE = .06) displayed significantly more pointing than caregivers interacting with 7- to 8-year olds (M = .24, SE = .04; p = .002), but there was not a significant difference between pairs with 5- to 6-year olds (M = .38, SE = .05) and 3- to 4-year olds (p = .309) or 7- to 8-year olds (p = .089). There was not significant effect of age on Tannese caregivers' use of imperatives.

HSUS Caregivers

Caregiver-child interaction style. A MANOVA was run to examine the impact of child age (2: 3- to 4-, 5- to 6-years old) on the prevalence of the four interaction styles. Using Wilks's lambda, there was a significant effect of child age, Λ = .76, $F(4, 75)$ = 5.89, $p < .001$, partial η^2 = .24. Separate post-hoc ANOVAs (p-values Bonferroni corrected to $p < (.05/4) = .013$; for a full summary of coefficients see Table 4) were run to examine the effects of child age on the prevalence of each interaction style. These post-hoc analyses indicated there was a significant influence of child age on the prevalence of child primary participation and caregiver-led participation, but not on caregiver primary or shared participation. Pairs with 3- to 4-year olds (M = .18, SE = .03) displayed significantly less child primary participation than pairs with 5- to 6-year olds (M = .43, SE = .05; Mann–Whitney U = 415.00, $p < .001$). In contrast, pairs with 3- to 4-year olds (M = .62, SE = .04) displayed significantly more caregiver-led participation than pairs with 5- to 6-year olds (M = .44, SE = .05; Mann–Whitney U = 519.50, p = .008).

Caregiver teaching behaviors. MANOVAs were used to examine the impact of child age (2: 3- to 4-, 5- to 6-years old) on the prevalence of the nonverbal (pointing and facilitation) and verbal teaching behaviors (imperatives, planning, and encouragement). Using Wilks's lambda, the results of the MANOVA examining the nonverbal teaching behaviors indicates a significant effect of child age, Λ = .89, $F(2, 77)$ = 4.91, p = .010, partial η^2 = .11. Separate post-hoc ANOVAs (p-values Bonferroni corrected to $p < (.05/2) = .025$; for a full summary of coefficients see Table 4) were run to examine the effects of child age on the prevalence of each nonverbal teaching behavior. These post-hoc analyses indicated there was a significant influence of child age on caregivers' use of pointing, but not facilitation. HSUS caregivers interacting with 3- to 4-year olds (M = .43, SE = .03) used pointing significantly more than those interacting with 5- to 6-year olds (M = .31, SE = .04; Mann–Whitney U = 501.00, p = .004).

Using Wilks's lambda, the results of the MANOVA examining the verbal teaching behaviors also indicate a significant effect of child age, Λ = .84, $F(3, 76)$ = 5.02, p = .003, partial η^2 = .17. Separate post-hoc ANOVAs (p-values Bonferroni corrected to $p < (.05/3) = .013$; for a full summary of coefficients see Table 4) were run to examine the effects of child age on the prevalence of each verbal teaching behavior. These post-hoc analyses indicated there was a significant influence of child age on caregivers' use of imperatives and encouragement, but not planning. HSUS caregivers interacting with 3- to 4-year olds (M = .43, SE = .03) used imperatives significantly more than those interacting with 5- to 6-year olds (M = .27, SE = .03; Mann–Whitney U = 461.50, p = .001). HSUS caregivers interacting with 3- to 4-year olds (M = .38, SE = .03) also used encouragement significantly more than those interacting with 5- to 6-year olds (M = .26, SE = .03; Mann–Whitney U = 484.00, p = .003).

Discussion

Teaching is a universal human behavior, yet there is substantial variation in the frequency and kinds of caregiver teaching within and between populations. We examined caregiver–child interaction style and caregivers' teaching behaviors during a collaborative problem-solving task in the United States and Vanuatu, two populations that vary in experience with formal education and the socio-cultural institutions associated with formal education. Our data revealed both similarities and differences in caregiver teaching practices between populations, as well as evidence of caregiver responsiveness to

task difficulty and child age. Below, we review each of our research objectives, highlighting similarities and differences between populations.

Similarities and Differences in Caregiver Teaching Practices During Collaborative Activity

Caregiver-child interaction Style

Three interaction styles—shared, child primary, and caregiver-led participation—all occurred with considerable frequency in both populations' completion of the task. Our data provide evidence that both HSUS and Tannese caregivers used a variety of interaction styles when completing the task. Caregiver–child interaction in both populations was dynamic over the course of the task, suggesting that a universal feature of caregiver teaching may be its flexibility. This allows teachers to better meet the needs of the learners and supports claims that teaching is a constellation of a number of different behaviors rather than one static mode of transmitting information (Kline, 2014).

Differences between HSUS and Tannese pairs' interaction styles were consistent with variation in teaching practices previously documented in formally versus informally educated populations (Greenfield, 2009; Paradise & Rogoff, 2009). HSUS caregivers encouraged children's firsthand participation in all task activities and engaged in direct active teaching. Rather than completing the tasks themselves, caregivers structured children's direct involvement using interaction styles associated with either the direct scaffolding of children's participation or children's independent participation. For example, HSUS caregiver–child interaction consisted primarily of caregiver-led participation and child primary participation, regardless of child age. In contrast, Tannese caregivers' teaching practices were consistent with the expectation that children learn through observation and collaboration. Rather than the child directly completing the majority of the task activities, Tannese caregivers and children divided labor through high levels of shared participation. Tannese caregivers took a more direct role in the completion of the task than HSUS caregivers, although rates of caregiver primary and child primary participation were approximately equal overall for Tannese pairs. This kind of interaction may increase collaborative efficiency such that tasks are allocated based on skill level and experience, rather than to novices who require high levels of scaffolding. Caregiver behavior of this kind may also serve pedagogical functions, such as facilitating learning through intent participation and observation.

Teaching Behaviors

Caregivers from both populations also guided children's participation using verbal and nonverbal teaching behaviors. HSUS and Tannese caregivers used similar levels of pointing and imperatives, consistent with the kinds of behaviors documented across populations in other studies of caregiver–child interaction examining both formally and informally educated populations (Boyette & Hewlett, 2017; Kline, 2014). The similarity in frequency of imperatives between the two populations is also consistent with past research that Tannese and HSUS caregivers engaged in similar levels of verbal interaction with infants (Little et al., 2016) and, that like their Western counterparts, Tannese caregivers adjust their speech when interacting with infants, potentially for instructional purposes (Broesch & Bryant, 2015, 2018).

In contrast to HSUS caregivers, however, Tannese caregivers displayed lower levels of facilitation, or adapting the task to fit the needs of the child, as would be expected if children are not completing actions beyond their ability levels. HSUS and Tannese caregivers also differed in their use of encouragement and planning, with HSUS using both of these verbal behaviors with higher levels of frequency. Encouragement and planning are features of direct active teaching that are associated with higher levels of caregiver experience with formal education (Childs & Greenfield, 1980; Dixon et al., 1984; Laosa, 1978, 1980).

Flexibility in Caregiver Teaching Practices Associated with Task Difficulty

Our data provide evidence that both HSUS and Tannese caregivers were sensitive to task difficulty. Caregivers were more directly involved in the difficult parts of the task, with HSUS caregivers working alongside children through shared participation and Tannese caregivers engaging in caregiver primary participation, which also corresponded with decreased frequency in pointing in both populations. Thus, caregivers' increased involvement might also have resulted in a decrease in scaffolding via pointing. HSUS caregivers' behavior reflected a continued emphasis on children's direct participation; even though the frequency of caregiver-led participation decreased during the

difficult parts of the task, caregivers directly participated with children through shared participation rather than engaging in the task alone. In addition to a decrease in the prevalence of pointing during difficult activity, the prevalence of encouragement increased. The increase in encouragement may reflect an attempt to keep children engaged during the more difficult portion of the task but could also correspond with overall task praise that would occur at the completion of a target shape. Differences in Tannese caregivers' teaching practices in response to task difficulty reflected a focus on children completing the actions within their ability level and observing skills beyond their ability level. The frequency of caregiver primary participation increased and the frequency of caregiver-led participation and pointing decreased during the more difficult parts of the task. One potential explanation for the increase in caregiver primary participation is that by completing the more difficult task themselves, caregivers were modeling the behavior for the child, thus allowing for observational learning.

Flexibility in Caregiver Teaching Practices Associated with Child Age

Child age influenced caregivers' teaching practices in both populations. Both HSUS and Tannese older children seem to have been given more leeway to complete the task independently. HSUS pairs with older children demonstrated higher levels of child primary participation and lower levels of caregiver-led participation, pointing, imperatives, and encouragement. Like HSUS pairs, Tannese pairs with older children engaged in higher levels of child primary participation and caregivers displayed less pointing. These differences in the frequency of child primary participation and teaching behaviors between caregivers interacting with younger versus older children may reflect caregivers' recognition of older children's ability to complete the task without intervention.

Overall, our data demonstrate that caregiver teaching is a dynamic constellation of behaviors that is responsive to task demands and children's abilities but also reflects culturally specific beliefs about children's learning. Although differences in overall teaching practices between populations may be influenced by culturally specific experiences such as exposure to formal education, teaching is a universal human behavior—an adaptation for acquiring and transmitting information (Caro & Hauser, 1992; Kline, 2014).

Limitations and Future Directions

Our data provide evidence for differences in teaching practices between the HSUS and Tannese caregivers that could be associated with experiences with formal education and differences in beliefs about children's learning. Our data also reveal similarities in teaching practices that are reflective of universal features of teaching behaviors across populations. The current study is limited, however, in that it included samples from two populations completing one task and examined only two potential sources of within-subject variance in teaching—task difficulty and child age. Future research should more directly explore the link between formal education experience and teaching behaviors by examining gradation in experience rather than the two extremes represented in our data. There were substantial differences in relative experience with formal education between the populations studied here; most of the HSUS caregivers had college experience, whereas the Tannese caregivers had very little experience with formal education. Thus, examining threshold effects of education and how variation in the amount and kind of formal education impact caregiver ethnotheories of children's learning and teaching practices is necessary for better understanding of both within- and between-population variation in teaching practices.

Examining further sources of variation in teaching within and between populations beyond experience with formal education is also critical to increasing our understanding of global diversity in social learning and transmission (Legare, 2017). Children's learning environments are shaped not only by their caregivers' experience with formal education but also broader cultural and class environments (Tudge, 2008). In addition, systems of social organization, kinship structures, population size, economies, and ecologies may contribute to variation in teaching behaviors between populations (Nielsen et al., 2017). Comparisons between multiple populations that vary systematically on these dimensions are also needed to identify which factors explain cross-cultural variation in teaching beliefs and behaviors (Greenfield, 2009).

Finally, our joint problem-solving tangram task provided a controlled comparison of HSUS and Tannese caregivers' teaching practices. Although the task was piloted prior to data collection to ensure accessibility in both populations, it is possible that this task may be interpreted as a more school-based task in both locations. This

interpretation could have biased caregivers toward more direct active teaching practices. Although the Tannese pairs' distribution of interaction styles does not support this claim, future research should also examine caregiver teaching across different types of tasks, particularly those that vary in their relative difficulty and ecological relevance. For example, examining variation in children's chore learning within and between populations would provide the opportunity to assess children's learning of ecologically relevant behaviors both within and beyond their ability levels (Alcalá, Rogoff, Mejía-Arauz, Coppens, & Dexter, 2014). Another direction for future research is to examine the extent to which caregivers' responses to changes in task difficulty and child age might depend on the degree of task difficulty or the type of task. It is possible that if the joint problem-solving task had become much more difficult (e.g., well beyond the realm of children's ability to complete the task alone), HSUS caregivers' behaviors might have been more similar to those of Tannese caregivers. Moreover, direct instruction is not possible for all types of tasks. Consider, for example, children learning about a ritual performed only on special occasions—in this case, the only teaching practices available might be allowing children to observe.

Conclusion

This cross-cultural research illustrates the value of using controlled tasks to directly quantify and compare behavior between populations. By systematically measuring caregiver–child interaction and verbal and nonverbal teaching during the same task, we are better able to attribute variation in the frequency and kinds of teaching behavior to differences across populations, and not exclusively to context-specific differences in the particular kinds of tasks and skills characteristic of these populations. This study also reveals the importance of conducting cross-cultural comparisons. If the study had been conducted in only one of these populations or examined only one approach to teaching (e.g., direct active teaching) and generalized to caregiver teaching behavior globally—we would have drawn different conclusions about the frequency and kinds of teaching behaviors. For example, limiting the definition and exploration of teaching behaviors to only include those that capture direct active teaching (i.e., an emphasis on caregiver direction and scaffolding) may lead to limitations in viewing teaching as a cross-culturally pervasive behavior (Kline, 2014). Our data support the need to study populations that represent the global diversity in human cognition and behavior while maintaining a broader definition of teaching to identify both similarities and differences in teaching behaviors.

The results of this study provide evidence that there were differences in HSUS and Tannese caregivers' teaching practices that were consistent with expectations that children learn through direct active teaching versus through observing others. The use of particular caregiver teaching practices may vary substantially between populations. In both populations, caregivers' teaching practices varied in response to both task demands and children's age. In sum, teaching practices include a flexible and diverse repertoire of behaviors that are responsive to multiple factors and support the transmission of skills and knowledge across diverse populations.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Figure S1. Tangram Puzzles Completed by Caregivers and Children.

Appendix S1. Caregiver Interviews About Children's Learning

Appendix S2. Demographic Information by Population for Caregivers and Children

Appendix S3. Supplemental Analyses With Restricted Tannese Age Range

Appendix S4. Research Assistant Training, Recruitment, Full Protocol, Protocol Justification, and Materials for Joint Problem-Solving Task

Appendix S5. Description of Coding Categories