

**Hands on: Nonverbal communication in Native and Non-Native American parent-child dyads during informal learning**

### Abstract

Parent-child communication is a rich, multi-modal process. Substantial research has documented the communicative strategies in certain (predominantly white) United States families, yet we know little about these communicative strategies in Native American families. The current study addresses that gap by documenting the verbal and nonverbal behaviors used by parents and their four-year-old children (N=39, 25 boys) across two communities: Menominee families (low to middle income) living on tribal lands in rural Wisconsin, and non-Native, primarily white families (middle income) living in an urban area. Dyads participated in a free-play forest-diorama task designed to elicit talk and play about the natural world. Children from both communities incorporated actions and gestures freely in their talk, emphasizing the importance of considering nonverbal behaviors when evaluating what children know. In sharp contrast to the stereotype that Native American children talk very little, Menominee children talked *more* than their non-Native counterparts, underlining the importance of taking into account cultural context in child assessments. For children and parents across both communities, gestures were more likely than actions to be related to the content of speech and were more likely than actions to be produced simultaneously with speech. This tight coupling between speech and gesture replicates and extends prior research with predominantly white (and adult) samples. These findings not only broaden our theories of communicative interaction and development, but also provide new evidence about the role of nonverbal behaviors in informal learning contexts.

*Keywords.* cross-cultural development, gesture, action, dyadic-interaction, Native American

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Our understanding of the world is shaped not only by the objects and events that we encounter, but also by the culture(s) in which we are raised and by the belief systems of those who raise us. For this reason, parent-child interactions provide a window through which to view the shaping role of communication, exploration, and engagement. Adopting a cross-cultural lens offers more nuanced insight into the variation of parent-child interactions and their effects on children's understanding of the world around them and their place within it (e.g., Cole & Bruner, 1971; Herrmann et al., 2010; Lew-Levy et al., 2017; Medin & Bang, 2014a; Morelli et al., 2003; Rogoff, 2003; Schieffelin & Ochs, 1986; Shneidman & Woodward, 2016; Taverna et al., 2020). Nonetheless, the evidence on parent-child communication has thus far focused predominantly on the spoken word. Yet, communication involves more than words alone (Loehr, 2007; McNeill, 1992), thus gaining a better understandings of gestures and other nonverbal behaviors that accompany speech is essential.

Although there is considerable evidence for the power of nonverbal communication, particularly in instructional contexts (Goldin-Meadow, 2005), this comes primarily from Western-educated, white people, with scant evidence from a broader range of cultural communities. Moreover, although there is a strong cross-cultural research tradition documenting parent-child interaction in less formal instructional settings, these investigations have been designed to reveal the social scaffolding available within communities to support children's learning (e.g., Rogoff, 2003). In the current paper, we take an initial step to broaden the empirical base by focusing on the communicative interactions among parent-child dyads from a rural Native American (Menominee Nation) community and an urban non-Native American

sample. The key question is how dyads from each community integrate verbal and nonverbal behavior in their rich multimodal systems of communication.

We begin by motivating our interest in gesture as a key component of communication. Then we turn to our specific observational context, both as relevant background for our cross-cultural comparisons and to underline the importance of context in speech, gesture and communication.

### **Communication spans beyond the spoken word**

Human communication is not restricted to verbal behavior; gestures and other nonverbal behaviors, which often accompany speech, are also instrumental to interaction (Goldin-Meadow, 2003). There is strong evidence that gestures produced in concert with speech (co-speech gestures) enhance comprehension and cognitive functions of both speakers and listeners.

Gestures, defined here as empty-handed hand movements that represent information without manipulating or acting upon objects, typically accompany speech. Substantial research with predominantly white children living in urban and suburban areas of the United States has demonstrated that gesture begins early and is ubiquitous throughout development (Bates et al., 1975; Carpenter et al., 1998; Iverson & Goldin-Meadow, 2005; Özçalışkan & Goldin-Meadow, 2011). In addition, children's gestures serve as an index of learning and developmental change (Novack et al., 2017). For instance, children often express *more* information through speech and gesture together, than through speech alone (Church & Goldin-Meadow, 1986; Gibson et al., 2019; Goldin-Meadow et al., 1993; Perry et al., 1988). Thus, attending to children's gestures, in concert with their speech, offers additional insight into what children are thinking or what they can understand.



Moreover, there is a tight temporal coupling between speech and gesture (Bernardis & Gentilucci, 2006; Church et al., 2014; Kelly et al., 2015; Kelly et al., 2010; Kita & Özyürek, 2003), which has been interpreted as evidence that speech and gesture emerge from a single integrated system (Loehr, 2007; McNeill, 1992). Gestures combine with speech to influence thinking and learning, and do so in a way that other types of hand movements, like actions that directly manipulate objects, do not (Novack & Goldin-Meadow, 2017). Importantly however, research on this speech-gesture coupling comes primarily from experimental paradigms with white adult participants. What remains unknown is whether this tight speech-gesture coupling is evident in a more diverse range of participants, and whether it is in place as early as four years of age.

### **Learning and interaction across diverse communities**

It has been widely noted that advances in psychological research have been hampered by focusing on a narrow range of study samples. Research on communicative gesture is no exception: detailed evidence on communicative gesture among more diverse participants is desperately needed. For instance, although it has been shown that infants across the world's communities begin to point at roughly the same developmental timepoint (Liszkowski et al., 2012; Salomo & Liszkowski, 2013), there is also substantial variability across cultures in the rates and usage of co-speech gesture among adults (e.g., see Kita, 2009 for review). There is particularly scarce research on gesture production among diverse communities, including minority communities within the United States (although, see Mejía-Arauz et al., 2005; Tamis-LeMonda et al., 2012).

Although research on gesture in Indigenous communities is scarce – there has been considerable work on cultural approaches to both teaching and learning in these communities.

For instance, within Indigenous communities, there is an emphasis on learning through observation and participation in community activities, rather than direct didactic interactions (Correa-Chávez & Rogoff, 2009; López et al., 2010; Silva et al., 2010; Tsethlikai & Rogoff, 2013). This body of work underscores the advantages of maintaining cultural practices that have existed across generations, rather than imposing western ideologies on educational practices (Tsethlikai, 2015). This idea is also supported by Vygotsky's framework that cognitive development can best be understood in the context of the tools of the culture and society in which a child develops (Vygotsky, 1980).

### **The Menominee Nation**

Despite the rich literature on cultural learning and interaction in Indigenous communities, to the best of our knowledge, there has been no systematic investigation of the amount, types, or usage of gesture, in Native American families. The current investigation offers initial evidence of communicative interaction – involving speech *and* gesture -- among 4-year-old children and their parents who are part of one Native American tribe – The Menominee. The Menominee Nation is federally recognized; and despite a 19<sup>th</sup> century effort to displace them and a 20<sup>th</sup> century period of termination (See Grignon et al., 1998; Peroff, 1982), they continue to live on their (much reduced, treaty by treaty) ancestral lands in Wisconsin. The Menominee are well-known for their sustainable forestry. And although there are excellent summaries of the Menominee history in general, and the Menominee relation to the forest in particular (See Beck, 2002; Beck, 2005; and Grignon et al., 1998 respectively), we are unaware of any literature on communication practices in Menominee parent/child dyads.

It is important to bear in mind that there are almost 600 federally recognized Native Nations living in distinct ecological contexts as well as many urban inter-tribal communities.

Although the long and ongoing history of colonialism and assimilationist efforts provides considerable common experience across Native communities, caution is warranted in making broad generalizations in the absence of supporting empirical information. Specifically, generalizing across Native peoples erases cultural and sovereign variation and participates in racializing Native peoples on U.S. terms.

This caution often has been ignored. For example, it is often claimed that Native American children are reluctant to talk (Connelly, 1985; Mitchell et al., 2011; Wolfe et al., 1996), a generalization made across tribes and contexts. In formal classroom settings this reticence to speak has been observed, but it has also been insightfully analyzed as a difference between cultural communicative practices and levels of cultural identification of Native children and their Non-Native teachers' expectations (e.g., Fryberg et al., 2013; Philips, 1992; Philips et al., 1972). To give one concrete example, when a Native child avoids eye contact with an adult or remains quiet during an interaction, non-Native teachers or service providers may mistakenly interpret this as inattention or disrespect. However, within the Native community, avoiding direct eye contact or other forms of assertive behavior when engaged with unfamiliar adults carries a very different valence: not only is it considered a sign of respect, it is also a sign of Native students' cultural identification, both of which are predictors of academic success in Native students (Fryberg et al., 2013). As will be evident shortly, in many contexts Native children are quite verbal.

Central to Menominee perspectives is their close reciprocal relation to nature. As an example of this integral relation with the natural world, Menominee describe themselves as 'part of' rather than 'apart from' nature (Medin & Bang, 2014b). For over a decade, we have worked in partnership with the Menominee community to study how Menominee adults and children

conceptualize the natural world and their place within it (Medin & Atran, 2004; Medin, Waxman, et al., 2010; Unsworth et al., 2012). We have found, for example, that Menominee children are less likely than non-Native children to assume that the biological world is centered around humans (Herrmann et al., 2010).

There is literature suggesting that both Menominee children and adults are more ecologically-oriented than their rural European-American counterparts (Unsworth, et al, 2012; Medin et al, 2006) and that Menominee children are more likely to take the perspective of animals than a comparable sample of rural European-American children (Unsworth, et al, 2012; Washinawatok, et al, 2017). Although these observations suggest greater Menominee attention to relationships (at least those involving animals), whether and how this might be manifest in parent-child dyads is not clear.

In previous work, we considered the emergence of conceptualizations about natural kinds in this community by observing young children interacting with a forest diorama (Washinawatok et al., 2017). This task was originally designed in collaboration with research partners in the Menominee community in an effort to uncover how 4-year-old children from Native American and non-Native American communities represent relations among biological entities (plants, animals) in their play (See Washinawatok et al., 2017). That is, the diorama was not initially developed with non-Native samples and then exported to Native communities (as often is the case) but rather largely developed by Menominee adults for Menominee children.

Washinawatok et al., (2017) employed the forest diorama with three samples of 4-year-old children, playing alone with the diorama: 1) Menominee children living on Menominee land in rural Wisconsin, 2) Urban Native children associated with the inter-tribal community in Chicago, and 3) Non-Native children living in the Chicago area. Children from all three samples

actively engaged with the diorama using speech, actions, and gestures. The two Native samples displayed no reluctance to talk, and Menominee 4-year-olds actually talked *more* than the other two samples. Another striking result was that the two Native samples were more than twice as likely than non-Native children to take the perspective of an animal in play.

### **The current study**

In the current investigation we turn the previously solitary, child-focused forest diorama task into an interactive dyadic task for parents and their children. The dyad version of this task yields rich and diverse data that can be analyzed from a variety of perspectives. In the present paper we step away from focusing on biological cognition *per se* to focus specifically on the question of *how* parents and their children use both verbal and nonverbal behaviors to communicate in this task. For pragmatic reasons we present data from two samples: an urban, predominantly white community, and the rural Menominee community. The dyadic version of the diorama task allows us to address four main research questions.

Question 1: *How much talk do children and parents produce in the diorama task?* As noted earlier, the argument has been made that Native American children speak less than their non-Native counterparts in clinical and formal educational settings (Connelly, 1985; Wolfe et al., 1996). Here, we take a strengths-based approach, identifying rates of speech during a task which is inherently designed to be relevant to the experiences of the Menominee parents and children. Recall that Washinawatok et al. (2017) reported considerable talk in Menominee children in the solo version of the dyad task. Our goal here was to see if the presence of an adult (here, a parent) might engender in children a reticence to talk with the same forest diorama. We predict, instead, that this context will showcase the verbal abilities of Menominee children and parents, rather than the previously reported “deficit”.

Question 2: *Are verbal utterances produced alone or with accompanying nonverbal behaviors?* Second, we ask how verbal communication is supported by nonverbal information. Because what and how children convey with their hands is key to gaining a full picture of their communicative abilities, here we consider how Menominee and non-Native dyads incorporate manual behaviors in their spoken communication. To the best of our knowledge, this is the first examination of nonverbal behaviors in any Native American sample of parents and children.

Question 3: *Are the nonverbal behaviors that accompany verbal utterances more likely to be actions or gestures?* Third, we consider the nature of these nonverbal behaviors. Because dyads engaged with a physical diorama with movable parts, we expect to see not only gestures, but also actions – direct manipulations of the objects in the diorama. Actions, like gestures, can be used to communicate. But unlike gestures, actions cause the object to change state (i.e., pointing to a bear does not change the state of the bear, but picking up the bear and moving it changes its location).

Question 4: *Is speech coupled more tightly with gestures than with actions?* Finally, the current design allows us to test whether the tight link between speech and gesture, that is proposed to be integral to gesture's effects on thinking and learning, is indeed stronger for gestures than for other kinds of hand movements like actions. The dyad diorama task offers a particularly strong test of this prediction because its movable elements beckon participants to communicate with actions. Building upon prior experimental evidence, we predict that speech will be coupled more tightly to gesture than to action across all populations. Specifically, we predict that gesture should be more likely to co-occur temporally with speech, and should be more likely to be related to the content of the co-occurring speech, than action.

In addressing each of all these questions, we take a developmental perspective, comparing the communicative strategies of children and their parents in each community. Our decision to focus on four-year-old children was motivated by developmental matters. Four-year-old children sit at a transition, just about to enter kindergarten and thus participate in formal learning contexts. By considering the communicative strategies that they both use, and see during *informal* learning contexts at this developmental juncture, we can gain insight into the types of tools they bring with them to their kindergarten classrooms.

## Method

### Participants

The Menominee (“Wild Rice People”) are the oldest continuous residents of Wisconsin. There are 4,000 to 5,000 Menominee living on tribal lands in and around northeastern Wisconsin (again, see Grignon et al., 1998). As in the past, the reservation is heavily forested. Hunting and fishing are important activities for most adult males and for many adult females and children. The Menominee have a clan system organized around five major clans (bear, thunder or eagle, wolf, moose, and crane).

The Menominee (M) sample: Twenty-one dyads were recruited from the local Head Start program and community meetings. The children (8 girls, 13 boys) ranged from 3.05-5.68 years ( $M_{Age}=4.4$ ). Among parents, there were four fathers, and 17 mothers. Dyads participated in their homes. Although socioeconomic data on the specific sample was not collected, median family income was \$34,511 at the time of data collected (U.S. Census Bureau, 2012f).

Non-Native American sample (nNA): Twenty-one dyads from the Chicago area were recruited through a university database. Three of the original 21 dyads were excluded for technical error (1) or difficulties with the recording (2). The final sample included 18 children (6

girls, 12 boys<sup>1</sup>) ranging in age from 3.3-4.93 years ( $M_{Age}=4.3$ ). Among parents, there were three fathers, and 15 mothers. Dyads participated in a university child development lab. Demographic information was not collected from this sample, however it reflected the general demographics of the laboratory database: 75% white, median family income for families living in this town was \$68,051 in 2012 according to the U.S. Census Bureau (2012e).

### Materials

The diorama measured 30 x 46 inches, mounted on a piece of 1-inch thick polystyrene foam. It included both fixed and movable parts. Fixed parts included the ground cover (a textured green mat simulating grass), rocks, logs, as well as a pond, some bushes and trees around the perimeter. Movable parts included four additional trees (two deciduous, two evergreen) as well as seven toy animals (bear, deer, eagle, turtle, cow, gorilla, zebra<sup>2</sup>), which were provided in a plastic bag for participants to play with by placing, moving and integrating into the set scene of the diorama (See Figure 1).



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*Figure 1.* Diorama provided to parent-child dyads. Note, animals typical to the North American forest ecosystem (e.g., deer), as well as those that are exotic (e.g., zebra), were included for the original purpose of the study, but a distinction between these was not made for the current purpose.

## **Procedure**

All procedures were approved by the IRB at Northwestern University under the protocol “Living and Learning in Relationships”, protocol number: STU00044698. The parent and child were seated next to each other in front of a table on which the diorama was placed. Dyads were encouraged to play in any way they liked and were assured that “...there is no right way or wrong way to play”. Sessions were videotaped from two cameras, one capturing a frontal angle and the other a side angle of the dyad diorama play. Dyads were invited to play for up to 15 minutes. Each dyad chose how long to play; there was no difference in the mean duration of the dyad sessions across communities ( $M_M=12.53$ ,  $SD=2.56$ ;  $M_{nNA}=11.67$ ,  $SD=3.26$ ,  $t(37)=0.92$ ,  $p=.36$ ). This provides assurance that the diorama task was equally engaging for dyads in both communities.

## **Coding**

First, all speech was transcribed from audio alone by a transcription service. Utterances that were either inaudible or off-task (e.g., the child asked for a snack) were excluded from further analysis (8% of all utterances). Next, all nonverbal behaviors were identified from the videos. Trained coders added line-by-line descriptions of all nonverbal behaviors occurring within a “turn”. Turns were defined as either a single verbal utterance (with or without accompanying actions or gestures) or an action or gesture without accompanying speech (i.e., placing the bear next to the pond, pointing to a rock, showing how the eager flies). Turns were

then coded to determine whether they included a verbal utterance only, nonverbal behavior only, or both verbal and nonverbal behavior together (intercoder agreement = 97%). Nonverbal behaviors were further coded as either actions or gestures (intercoder agreement = 90%) and for type (agreement = 84%) (see table 1), although here we only consider analyses on the former.

Turns that included both verbal and nonverbal behaviors were identified and coded for content relatedness. Turns in which verbal and nonverbal content was congruent were coded as “related” (e.g., participant says “look at this bear!” while pointing to the bear, or says “I think the bear wants some water” while walking the bear toward the water). Turns in which the verbal and nonverbal content differed were coded as unrelated (e.g., participant says “I think the bear wants some water” while placing the eagle in the tree) (intercoder agreement = .88). Any disagreements were resolved by discussion.

**Table 1**

*Examples of types of actions and gestures coded.*

Actions	Gestures
Touch: Touching objects to indicate them, examine them, or just hold onto them.	Point: Indicating objects by pointing to them. Includes points that touch objects and those that hover above the objects.
Place: Placing objects (in or next to diorama)	Show: Indicating objects by holding them up.
Representational Action: Manipulating objects in pretend play (e.g., making animal walk over to pond, bouncing animal up and down as it “talks”).	Representational Gesture: Using hands to represent objects and actions (e.g., using finger to trace the path an animal could move, making a circle with thumb and forefinger to show the shape of a berry)
Diorama Action: Actions manipulating the diorama (rotating the diorama for a different view)	Conventional Gesture: Gestures that have set conventional meanings (shaking head yes or no, thumbs up)

## **Dependent Variables**

The coding system provided a number of dependent variables that allowed us to explore the questions presented in the introduction. First, to ask how much talk was elicited during the task, we considered the number of verbal utterances produced per minute of interaction. Second, to ask whether verbal utterances were accompanied by nonverbal behaviors, we considered individual turns that contained a verbal utterance, and asked whether or not a nonverbal behavior occurred during the same turn. Note, this analysis is conducted as a binomial outcome at the level of the individual utterance, but we present graphs that show group-level data, reflected as the percent of utterances produced alone, or accompanied by actions or gestures. Finally, to test the hypothesis that gesture is unique in its ability to combine with speech compared to action, we considered all turns that included nonverbal behaviors, and compared the proportion of nonverbal behaviors that 1) were accompanied by a verbal utterance and 2) were related in content to the utterance.

This study was not preregistered. Analysis code is available at <https://osf.io/s5nqb/>. Data are not publicly available, but may be made available upon request from the authors and subsequent approval by the Menominee Nation.

## **Results**

### **Verbal Behavior**

*Question 1: How much talk do children and parents produce in the diorama task?* This task elicited considerable verbal communication (11,424 total utterances, with, on average, 23.5 utterances per min, per dyad, see Table 2). To consider how the amount of talk varied between

groups we submitted the average number of verbal utterances produced per minute by each speaker to a mixed effects ANOVA, with community (M, nNA) as a between-subjects variable and speaker (Parent, Child) as a within-subjects variable. This analysis revealed a main effect of speaker ( $F(1,35) = 24.12, p < .001, \eta^2 = .40$ ); across both communities parents talked more than their children (Menominee:  $t(20) = 2.31, p = .03$ , Hedges  $g = .59$ ; nNA:  $t(17) = 4.66, p < .001$ , Hedges  $g = 1.38$ ). This was qualified by a significant speaker by community interaction ( $F(1,35) = 3.98, p = .05, \eta^2 = .10$ ). Among parents, there was no difference in the number of utterances produced in each community ( $t(37) = .55, p = 0.58$ , Hedges  $g = 0.19$ ). In contrast, among children, Menominee children produced more utterances per minute than their non-Native counterparts ( $t(37) = 2.12, p = .04$ , Hedges  $g = .68$ ).

This outcome, which stands in contrast to prior reports that Native American children speak less than non-Native children (Connelly, 1985; Wolfe et al., 1996), suggests that in conversation with their parents, Menominee children are anything but reticent to speak.

Table 2. Average number of verbal utterances per minute, grouped by speaker and community.

*SD in parentheses.*

Community	Speaker	Utterances/min
Children	Menominee (n=21)	11.6 (2.75)
	Non-Native American (n=18)	9.82 (2.35)
Parents	Menominee (n=21)	13.3 (2.85)
	Non-Native American (n=18)	13.9 (3.32)

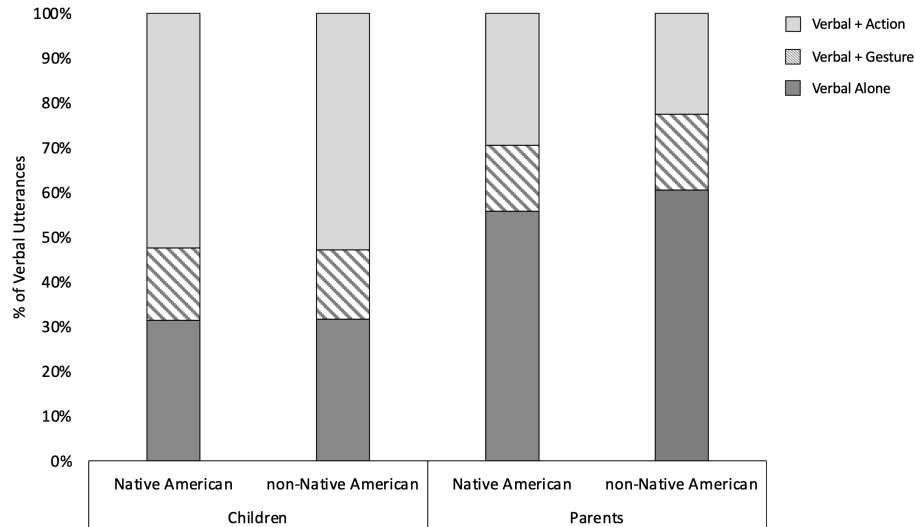
### Nonverbal Behaviors

We next explore the nonverbal behaviors elicited in the task and ask about their role in supporting verbal communication.

***Question 2: Are verbal utterances produced alone or with accompanying nonverbals?***

We asked how likely participants were to produce verbal utterances alone, or to accompany them with nonverbal behaviors. For example, if a parent asks, “Which one drinks water?”, their child might respond verbally (e.g., “the deer!”), or might augment this with nonverbal behavior (either a gesture: points to the deer; or an action: ‘walks’ the deer toward the pond). For this analysis, we asked a) whether verbal utterances were produced with or without nonverbal behaviors, and b) when verbal utterances were accompanied by nonverbals, whether these were actions or gestures (see Figure 2).

These analyses were conducted at the level of the utterance, using mixed-effects logistic regression models (lme4 package in R: Bates et al., 2014), with *p*-values computed using the lmerTest package (Kuznetsova et al., 2017). For all analyses described, child age was initially considered, but removed because it had no significant effect on any of the dependent variables. All models included fixed effects for speaker (child, parent) and community (M: Menominee, nNA: non-Native American) as well as a random intercept for dyad (to allow for the variability contributed by each dyad) and speaker-by-dyad random slopes (to allow for the effect of speaker to vary by dyad). All final models include only main effects, since no interactions were found to be significant unless otherwise specified.



*Figure 2.* Utterances Produced with and without Nonverbals *Note.* Percentage of verbal utterances produced alone (gray) and produced together with a nonverbal action (patterned red) or a nonverbal gesture (solid red). Data here show percentage of all verbal utterances; analyses are conducted at the level of the individual utterance.

Figure 2 shows that the majority of child utterances were produced with some nonverbal behavior, either action or gesture. Therefore, only 31% of Menominee child utterances and only 32% of non-Native American child utterances were produced as verbal alone. In contrast, the majority of parent utterance were verbal alone (M: 55%, nNA: 60%). To consider whether this pattern differed significantly by speaker or community we submitted all verbal utterances (N=11,424) to a logistic regression model that predicted whether an utterance was produced together with a nonverbal behavior (1) or as verbal alone (0). The model included fixed effects for speaker (parent, child) and community (M, nNA) a random slope for speaker and random intercept of dyad. The analysis revealed a significant effect of speaker ( $\beta = 1.15$ ,  $SE=0.11$ ,

$p < .001$ ) confirming that children are more likely than adults to accompany their speech with nonverbal behaviors, but no effect of community ( $\beta = 0.09$ ,  $SE = 0.15$ ,  $p = 0.54$ ).

**Question 3: *Are nonverbal behaviors that accompany verbal utterances more likely to be actions or gestures?*** Figure 2 also shows that the majority of nonverbal behaviors that children used to accompany their verbal utterances were actions, whereas parent nonverbals were more evenly split between actions and gestures. To consider whether this observed pattern differed significantly by speaker or community, we submitted all verbal utterances that were accompanied by nonverbals ( $n = 6211$ ) to a binomial model predicting whether the nonverbal was an action (1) or a gesture (0). This model included fixed effects for community (M, nNA), speaker (Child, Parent), as well as a random slope for speaker and random intercept of dyad. The analysis confirmed a main effect of speaker ( $\beta = 0.71$ ,  $SE = 0.12$ ,  $p < .001$ ): children accompanied their speech with proportionally more actions than did parents. There was no effect of community ( $\beta = .20$ ,  $SE = 0.20$ ,  $p = .32$ ).

***Research Question 4: Is speech coupled more tightly with gestures than with actions?***

Finally, we considered the relation between speakers' actions and gestures and their speech. This would allow us to ask: is the tight coupling between speech and gesture specific to *gesture*, or it is a feature of all kinds of nonverbal behaviors? Because actions were so prevalent in this task, the current data provide a sufficiently strong base from which to assess whether action is coupled as tightly to speech as is gesture. We ask whether this tight coupling is a characteristic of the Menominee and whether it is already in place in children as young as 4.

We address this question in two ways, first by asking whether nonverbals were produced in conjunction with speech (1) or in silence (0). For instances, if asked about who lives in trees, a child could point to the bird while saying "the bird!" (speech+gesture), could place the bird in

the tree while saying “the bird!” (speech+action), or could produce either of those nonverbals (the point, or the placement) without the accompanying verbal utterance. To determine whether likelihood to accompany a nonverbal with speech differed by the type of nonverbal, we submitted all nonverbal behaviors ( $n=7866$ ), to a binomial regression which included main effects for nonverbal type (action vs gesture), speaker (Child, Parent), and community (M, nNA) as well as all two- and three-way interactions, random slopes for nonverbal type and speaker and a random effect of participant. As predicted, there was a main effect of nonverbal type: gestures were more likely than actions to be accompanied by speech ( $\beta = 1.08$  SE= 0.20,  $p < .001$ ) (or in other words, participants were more likely to produce silent actions than to produce silent gestures). There was also a significant main effect of speaker ( $\beta = .92$ , SE= 0.31,  $p = .003$ ), and an interaction between speaker and nonverbal type ( $\beta = .66$ , SE= 0.25,  $p = .009$ ). There was no significant effect of community ( $\beta = .10$  SE= 0.43,  $p = .81$ ), and no other interactions reached significance ( $p$ 's  $> .12$ ). To more clearly explore the effect of non-verbal type, we conducted follow up analyses comparing the relative likelihood that actions or gestures were accompanied by speech within each participant group. As can be seen in Figure 3a, we discovered that the pattern that gestures were more likely than actions to be produced together with speech, was significant for both parents and children and across both communities (all  $p$ 's  $< .05$ ).

As a second approach, we focused specifically on only the co-speech nonverbals ( $n=6073$ ), to ask whether they were related to the *content* of the accompanying speech (1) or were unrelated (0). As a reminder, saying “look at this bear!” while pointing at a bear would be considered “related” whereas saying “I think the bear wants some water” while placing the eagle in a tree would be considered “unrelated”. We expected gestures to be more likely to be accompanied by related speech than actions. To analyze this, we submitted the data to a mixed-



effects binomial logistic regression model that included effects for nonverbal type (action vs gesture), speaker (Child, Parent), and community (M, nNA) as well as all two- and three-way interactions, random slopes for nonverbal type and speaker and a random effect of participant.

As predicted, there was a significant effect of nonverbal type, demonstrating that speech-gesture combinations were more likely to be related in content than speech-action combinations ( $\beta = 1.5$ ,  $SE = 0.39$ ,  $p < .001$ ). There was also a significant interaction between speaker and nonverbal type ( $\beta = 1.4$ ,  $SE = 0.63$ ,  $p = .02$ ), but no main effects of community ( $\beta = .46$ ,  $SE = 0.51$ ,  $p = .36$ ) or speaker ( $\beta = .79$ ,  $SE = 0.63$ ,  $p = .21$ ), and no other interactions ( $p$ 's  $> .30$ ). Follow-up analyses within each of participant group confirmed that gestures were more likely than actions to be related in content to accompanying speech; this effect held up among both parents and children, and across both communities (all  $p$ 's  $< .001$ , Figure 3b). In short, the tight coupling of content in gesture and speech was robust across all groups.

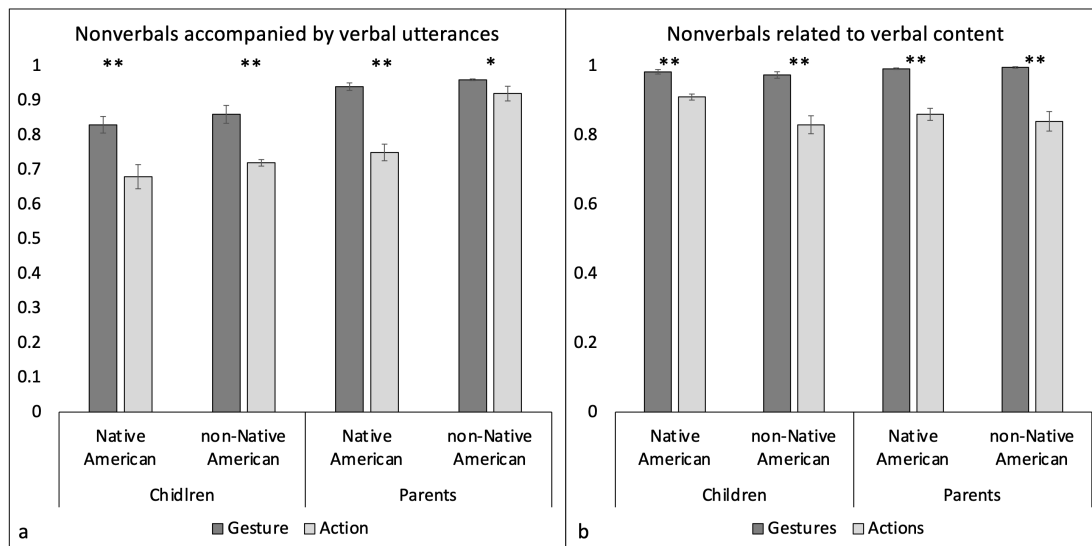


Figure 3. Proportion of actions and gestures accompanied by speech. Graphs display the proportion of actions and gestures that a) are accompanied by speech and b) are related in content to speech. \*  $p < .05$ , \*\*  $p < .001$

## Discussion

To understand how children and parents across diverse communities communicate with one another, we need to look beyond words alone to consider non-verbal information as well. We also need to broaden the empirical base beyond primarily white samples. In the current paper, we considered the communicative interaction between parents and their four-year-old children in two distinct US communities as they interacted with a diorama designed in a culturally responsive way to represent a forest scene in the natural world. Adopting an inclusive view of communication, we considered nonverbal behaviors (actions and gestures) in addition to spoken language.

This task, designed by a research team that included Menominee adults, attests to the benefit of engaging collaboratively with community members to reduce cultural bias associated with exporting tasks developed with WEIRD (Western, educated, industrialized, rich and democratic) samples to other populations (e.g., Medin, Bennis, et al., 2010). Cultural bias can influence design decisions and hence results. For example, research on the sheer *amount* of talk tends to ignore the *contexts* in which the talk occurs (Avineri et al., 2015).

This observation is likely related to one of our main findings (and the answer to Question 1). In contrast to reports documenting that Native American children talk less than their non-Native American counterparts (Connelly, 1985; Wolfe et al., 1996), Menominee children showed the opposite pattern, producing more speech than non-Native children. The data reported here replicate prior evidence from four-year-olds playing with the forest diorama alone, and extend this work to include children's interactions with their parents (Washinawatok et al., 2017).

We also found a consistent developmental pattern: children in both communities were more likely than their parents to accompany their speech with nonverbal behaviors, especially actions. This observation, which addresses Questions 2 and 3, may simply reflect the nature of the task: because the diorama was designed specifically to engage child play and interaction, it makes sense that children would be eager to touch, point, and explore with their hands. There is, however, another possibility, one that may work in concert with the first. Perhaps children produce more nonverbals because these serve to scaffold their talk. Prior evidence reveals that for both children and adults, gesturing while speaking frees up cognitive resources (Goldin-Meadow et al., 2001; Ping & Goldin-Meadow, 2010; Wagner et al., 2004). Although it is not known whether the same is true for actions, it is possible that producing *any* kind of nonverbal behavior frees up cognitive resources, and that this helps children express their ideas better. It is also possible that children's use of nonverbal behaviors was influenced by the fact that they were interacting with their parent, specifically. It is an open question whether we would see different rates of nonverbal communication if children were engaged with a different peer, for instance.

Documenting co-speech gesture among the Menominee, important in itself, also highlights that gesture is critical to cognitive outcomes. Previous work with non-Native samples has found that child gesture serves as an indicator of what children know (Goldin-Meadow et al., 1993) and encouraging gesture can scaffold and enhance learning (Broaders et al., 2007). On the input side, parent gesture has been linked to child language outcomes (Rowe & Goldin-Meadow, 2009) and teacher gesture has been shown to support student learning (Singer & Goldin-Meadow, 2005). Here, we report that gesture production was equivalent across both age and community. This research presented in the current study begins to broaden the scope of this prior

work by demonstrating the robust use of gesture in a sample of Native-American parents and children.

These findings also have clear implications for the educational practices that may best support learning among children from Indigenous cultures. Past research suggests that children's learning is deeply grounded in the cultural practices from which they are raised (Correa-Chávez & Rogoff, 2009; López et al., 2010; Silva et al., 2010; Tsethlikai, 2015; Tsethlikai & Rogoff, 2013). For instance, children raised in communities with a rich oral tradition may benefit from educational practices that engage and support their strength in narrative expression (Allen & Lalonde, 2015; Tsethlikai, 2015; Tsethlikai & Rogoff, 2013). This may contrast with a western perspective that places greater emphasis on written and on didactic expression. Because gesture spontaneously emerges with verbal expression, and because our findings suggest robust gesture use among the Menominee dyads, this may have implications for educators. Providing opportunities to talk (and therefore to gesture) may be a culturally congruent method of assessing what children from Native American communities know or understand. Teachers, particularly those working with these communities, should be aware of the rich and important information that children can express through their hands.

Studying the multimodal communicative strategies of parents and children in two distinct communities within the US also strengthens our theories of communicative interaction and development. For instance, the results reported here support the claim that speech and gesture may be part of a single, unified communicative system (Loehr, 2007; McNeill, 1992) and that the ways in which gesture combines with speech is unique to *gesture*, and not other kinds of hands movements, like action (Novack & Goldin-Meadow, 2017). Across all groups, there was a tight coupling between speech and gesture that was not observed for speech and action (Question 4).

Specifically, gesture was more likely than action to co-occur with speech, and was more likely than action to be related to speech in its content. The current findings replicate constructs already observed in white adults (Bernardis & Gentilucci, 2006; Church et al., 2014; Kelly et al., 2015; Kelly et al., 2010; Kita & Özyürek, 2003), and extend them to Menominee adults as well as children in both communities.

These findings also tie into the growing body of literature examining verbal and non-verbal expression in Indigenous groups (Correa-Chávez & Rogoff, 2009; López et al., 2010; Silva et al., 2010; Tsethlikai, 2015; Tsethlikai & Rogoff, 2013). For instance, this literature has shown that children from Indigenous cultures demonstrate increased attention and learning from observing non-directed interactions compared to children from Euro-American families raised in western-educated families. The current study adds a new dimension: it was designed to engage a single parent and child in an open-ended play-based interaction, and not designed specifically to study third-party learning. In future work, it will be important to align studies of goal-based cooperation and observational learning, with broader verbal and nonverbal communicative strategies in diverse populations.

One limitation in the current work is that Menominee dyads played with the diorama at home while non-Native dyads participated in a university laboratory, albeit in a comfortable, home-like setting. It remains to be seen how interactions might differ as a function of the location in which the dyads participated.

Another difference may also be of consequence. This task was designed to showcase experiences of the Menominee children for whom the natural environment plays an especially strong role. In contrast, the non-Native sample live in a metropolitan area, and were less familiar with forest settings. Indeed, many non-Native dyads talked about visiting the forest for camping

or vacations but did not discuss the same day-to-day experience with nature that the Menominee participants did. It is an open question how much these factors may have influenced speaker's communicative strategies, and this could be a topic for future research. Data from rural non-Native American dyads or urban Native-American dyads would address this question while at the same time extending the generalizability of our findings.

Finally, there are other differences between the two communities in the current investigation. Families living in the Evanston community tend to have higher family income (U.S. Census Bureau, 2012e; 2012f) greater education (U.S. Census Bureau, 2012a; 2012b), and smaller average family sizes (U.S. Census Bureau, 2012c; 2012d) compared to families living in the Menominee community. Yet despite evidence documenting differences in verbal and nonverbal behavioral communication based on socioeconomic status (Farkas & Beron, 2004; Hart & Risley, 1995; Hoff, 2003, 2006; Pan et al., 2005; Rowe & Goldin-Meadow, 2009), here we found more convergences than divergences in the communicative strategies used by parents and children across communities. This suggests that, at least in the context of this free play task, socioeconomic differences between the communities were unlikely to have had strong effects on our findings. Future work should consider the effect of socioeconomic factors more thoroughly.

The current study showcases how studying the multimodal communicative strategies of parents and children in two distinct communities within the US strengthens our theories of communicative interaction and development. It also provides a broader, more culturally inclusive foundation upon which to build on existing strengths of young children in classrooms and informal learning contexts. Further, this work supports educational research focused on the pedagogical role of “hand work” in teaching and learning (e.g., Rose, 2005; Vossoughi et al., 2020). We found that parents and children use rich representational repertoires when

communicating about the natural world which emphasizes the benefit of considering a multi-modal approach when investigating communicative interactions between parents and children across cultures.

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