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Patterns of Collaboration and Communication While Working Together Among US Mexican Heritage Sibling Pairs

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Abstract

To examine the cultural organization of collaboration, 50 US Mexican-heritage sibling pairs (6-11) participated in a puzzle construction activity. Half were from families with more recent connection with rural practices, and limited schooling ("pueblo families") and half from "high schooling families" (more connection with middle-class practices, higher schooling). Children were given a previously constructed model, parts to construct another, and left alone. Every 10 seconds coders noted how the siblings coordinated either: jointly engaged, checking-in, solo, or off-task and if collaboration was organized either verbally, nonverbally, or with multiple means. "Pueblo" Siblings engaged jointly and used nonverbal and multiple means of communication more than "high schooling" siblings who more often worked solo, were off-task, and used talk to communicate.

**Patterns of Collaboration and Communication While Working Together
Among US Mexican Heritage Sibling Pairs**

This study examined the cultural organization of collaboration among sibling pairs of Mexican heritage whose families had varying experience with Indigenous and Western cultural practices. Of particular interest was whether children from families that presumably have more experience with Indigenous forms of organizing teaching and learning would coordinate more collaboratively compared to children whose families have more experience with middle class European American cultural practices (as indexed by extensive maternal schooling). Among Mexican immigrants to the United States there is large variability in experience with the institution of school (National Taskforce on Early Childhood Education for Hispanics, 2007). An emerging body of literature suggests Mexican mothers with fewer grades of school may have more experience with a form of organizing learning common in Indigenous communities of Mesoamerica called learning through Intent Community Participation (Rogoff, Moore, Najafi, Dexter, Correa-Chávez, & Solís, 2007; Rogoff, Paradise, Mejía Arauz, Correa-Chávez, & Angelillo, 2003).

Benefits of Collaboration and Cultural Patterns of Coordination

Many studies have shown the benefits of collaboration in helping children accomplish novel or complex tasks (Azmitia, 1988; Teasley, 1995; Tudge 1992; Tudge, Winterhoff & Morgan, 1996; Gauvain & Rogoff 1989). However researchers have pointed out that what happens in collaboration and how children organize their collaboration with one another is key to child learning and development (Azmitia and Crowley, 2001; Bransford, Brown, & Cocking, 1999). Of particular importance to this study is the fact that children must learn the skills of effectively collaborating with one other. It stands to reason that these skills would be learned in interactions with others, and that these would vary across different cultural communities.

Comparative cultural research suggests that in communities with Indigenous history specific patterns of interaction and collaboration may be related to children's familiarity with Indigenous and school ways of organizing teaching and learning. For example, Guatemalan Mayan mothers with 0-2 years of schooling were more likely to engage in multiparty collaboration when working with 3 children compared to Mayan mothers with 12 or more years of schooling who were more likely to subdivide tasks (Chavajay & Rogoff, 2002). When 3 siblings engaged with a novel science exhibit US Mexican heritage siblings tended to blend agendas building off what their siblings were doing in a smooth and undisputed way, rarely interrupting ongoing activity whereas European American siblings tended to engage with one another by interrupting other's activity and discussing turn-taking (Angelillo and Rogoff, 2005). Similarly US Mexican heritage children whose families were more familiar with the ways of rural Mexico and had fewer years of schooling were more likely to engage as a group when folding origami compared to US European heritage children and Mexican heritage children whose mothers had 12 or more years of schooling (Mejía-Arauz, Rogoff, Dexter, & Najafi, 2007).

The cultural skills of learning how to monitor others' interactions and find the appropriate moment in which to merge with ongoing events without interrupting, appears to be learned early on. When learning how to operate novel toys, Mayan toddlers were more likely to request help from their mothers using gaze, touch, and body posture compared to European American toddlers who hardly ever used those methods in asking for help (Rogoff, Mistry, Göncü, & Mosier, 1993). In another study US Mexican heritage children were ten times more likely to wait for the precise moment to request help from an adult (by waiting patiently and checking that the adult was not busy before asking) compared to US European American

children (Ruvalcaba, López, Rogoff, Correa-Chávez, & Gutierrez, 2011). Among children whose families have historical roots in Mexico and Central America the ability to skillfully coordinate with others in interaction may be related to experience with learning through Intent Community Participation.

Learning by Attending and Participating: Intent Community Participation

Traditionally in Indigenous North and Central American communities children have wide access to family and community activities and are treated as “legitimate peripheral participants” (Chamoux, 1992; Gaskins, 2000; Lave & Wenger, 1991; Rogoff, 2003; Suina and Smolkin, 1994). Intent Community Participation describes the cultural organization of this form of teaching and learning where children are included in family and community activities and are expected to learn by observing and pitching in to ongoing activity (Rogoff et al. 2003 & Rogoff et al., 2007).

Sometimes children contribute to community wide events as in Tepotztlán Mexico where children (not adults) fulfill the important ceremonial roles of decorating the neighborhoods and engaging in ceremonial dancing during the town fiesta (Corona, 2011). Other times children contribute to the running of everyday lives in families. Orellana (2001) writes of one particular immigrant community in Los Angeles:

> In my movements in and around the community, I recorded many other examples of children’s active participation in the work of daily life: running errands; caring for siblings; cleaning; doing the laundry; taking siblings to school, the library, and other appointments; helping siblings with homework; mediating with public institutions; answering and making phone calls; ordering food in restaurants; and translating between English and Spanish for monolingual speakers. (p. 372)

In situations where children and adults are engaged in important family and community tasks it is important for children to be able to contribute without interrupting or disrupting ongoing work. Observation seems to be especially important as children learn when to pitch in and coordinate

with others and children whose families have familiarity with Indigenous ways seem especially skilled at this compared to European American children (Childs & Greenfield, 1980; Correa-Chávez & Rogoff, 2009; Ellis & Gauvain, 1992; Gaskins & Paradise 2010; López, Correa-Chávez, Rogoff & Gutierrez, 2010; Silva, Correa-Chávez, & Rogoff, 2010; Silva, Shimpi, & Rogoff, 2011). It is likely that these skills at observation are related to being able to skillfully coordinate group interaction.

Talk and Joint Activity in Collaboration

Although scholars have stressed the importance of talk in collaboration (Teasley, 1995), in communities where children are accustomed to integrating themselves into community and family work without interrupting others, many collaborative interactions may rely heavily on the act of working together (joint activity) as an organizer in addition to talk. In some circumstances engaging in large amounts of talk may not necessarily be the most effective way to accomplish an activity or organize collaboration.

Joint activity, as well as talk, was important when older siblings were teaching a younger sibling how to construct a model windmill. Although talk was used by the siblings, they were more likely to use nonverbal interactions in teaching compared to interactions involving peers. Younger siblings were more likely to observe their older sibling's activity and imitate it, and older siblings were more likely to block their younger sibling's move when the younger one was about to make a mistake and correctly place the piece for the younger sibling (this activity was rare among peers). Younger siblings taught by an older sibling performed better on a posttest than those taught by a peer (Azmitia & Hesser, 1993).

Similarly when pairs of college students collaborated to design a block structure that would withstand an earthquake simulation, Azmitia and Crowley (2001) found that explicitly

stating a shared theory did not necessarily lead to good progress on the task and that non-verbal interaction was as important as verbal interaction in leading to theory development and change in the activity. In referring to two particular participants (LS and TF) they wrote:

> While LS did not state her belief that the stories needed to be lined up and TF did not state her view that symmetry was important, both built towers that contained these features, a finding that demonstrates once again the importance of non-verbal demonstrations for theory building, refinement, and testing in this task and in science in general (Azmitia and Crowley, 2001, pg 71).

A replication of the earthquake task that specifically examined the verbal strategies used by successful teams found that extensive discussion of the task did not necessarily lead to success on the task or to productive collaboration. In fact the most successful and effective teams engaged in what the authors called "rapid prototyping," building and testing ideas with minimal discussion (Apedoe, Mattis, Rowden-Quince & Schunn, 2010). From a Vygotskian point of view it makes sense that much of the shared understanding in these collaborations would come from joint activity and use of tools, as well as through talk (Vygotsky 1978).

However schools and people from highly schooled Western communities seem to prioritize talk as a marker of engagement and learning (Dixon, Levine, Richman, & Brazelton, 1984; Kim, 2002; Li 2005; Maynard, 2004; Rogoff, 2003). Zinacantec Mayan children with only a few years of school used more talk when teaching a younger sibling compared to children who had not been to school who tended to use more bodily closeness and bodily guidance as teaching tools (Maynard 2004). Triads of US Mexican heritage children whose families were more familiar with rural ways were more likely to engage in multiple nonverbal turns at communication (what the authors called nonverbal conversation) in organizing interactions compared to triads of European American children and Mexican heritage children whose mothers had extensive schooling. The European American children were more likely to organize

their interactions only through chat or talk. The Mexican heritage children whose families had high schooling were intermediate between the two (Mejía-Arauz et al., 2007).

In highly schooled communities talk may be prioritized as a way of engaging with people and ideas that are not physically present. European American middle class toddlers in two US communities were rarely exposed to adult work although they engaged in many child focused activities (Morelli, Rogoff, & Angelillo, 2003). However in communities familiar with learning through Intent Community Participation nonverbal means of communication as people work together in joint activity may play an equally important role in organizing group interaction and child learning.

Schooling as a Cultural Practice and Familiarity with Indigenous Ways

For generations the institution of school has organized childhood in European American middle class communities but its role is often overlooked (Hernandez, 1997; Rogoff, Correa-Chávez, & Navichoc-Cotuc, 2005). However practices such as engaging in child focused activities, mini language lessons, and other teaching and learning scenarios modeled on school are common in communities with a long history of school, but uncommon elsewhere (Briggs, 1991; Fortes, 1938/1970; Gaskins, 1999; Heath, 1983; LeVine, 1990; Morelli, et al., 2003; Scribner & Cole, 1973).

Mass schooling of the rural countryside became a priority in Mexico after the revolution of 1910-1917. Schooling was seen as a way to create a "Mexican Identity" out of the disparate Indigenous groups (Flores 2010; Vasconcelos 1925; See also Mexican Constitution, Article II) as well as "modernize" the countryside by cutting ties with Indigenous languages and traditions (Bonfil Batalla, 1988; Stavenhagen, 1988). Many communities in rural Mexico today no longer consider themselves Indigenous although they are likely to engage in some traditional practices

and ways of life (Bonfil Batalla 1988; Corona 2001; Lorente y Fernandez, 2006; Najafi, Mejía-Arauz, & Rogoff, 2008; Urrieta 2003; Vigil, 1998). Migration to the United States has been most common from these rural areas (Consejo Nacional de Población, 2001). Silva et al., (2010) and López et al., (2010) argue that in many immigrant Mexican communities in the United States with limited schooling people may be familiar with another cultural way of organizing learning: Intent Community Participation. Therefore forms of behavior in organizing child life and learning are not seen as arising from a “lack” of schooling, or deficit, but rather from engagement with another cultural form of supporting learning.

The National Taskforce on Early Childhood Education for Hispanics (2007) highlights the variability that exists in the Mexican immigrant community with regard to the cultural institution of school. Among Mexican immigrant mothers of 8 year old children, 48.6% had completed high school, 25.7% had between 8 and 12 years of schooling, 18.2% had between 4 and 8 years of school, and 7.5% had 4 or fewer years of school. Maternal participation in the cultural practice of school has far reaching implications for children of the next generation, as mothers may organize interactions with children in ways that reflect the organization of school (Laosa, 1980; LeVine, LeVine, Richman, Tapia Uribe, Correa, & Miller, 1991; Moreno & Valencia, 2002; Richman, Miller, & LeVine, 1992; Rogoff et al., 1993).

Mayan mothers with more years of schooling tended to organize child interactions through turn taking and subdivision of activities in ways that resembled school more so than Mayan mothers with fewer years of schooling (Chavajay& Rogoff, 2002). Mexican immigrant mothers with more years of schooling tended to provide more verbal explanations during a visit to a science museum compared to Mexican immigrant mothers with fewer years of schooling (Tenenbaum, Callanan, Alba-Speyer, & Sandoval, 2002). When teaching children, Mexican

American mothers with more years of schooling tended to rely more on question and answer interactions if they had many years of schooling, Mexican American mothers with fewer years of schooling relied more on modeling (Laosa, 1981, 1982; Moreno, 2000).

Children whose mothers have more years of schooling also tend to exhibit forms of interaction and group organization common to school. US Mexican heritage children whose mothers averaged 7 grades of school tended to rely more on observation as a source of information, and attended simultaneously to multiple ongoing events more often than US Mexican heritage children whose mothers had 12 or more years of schooling (Correa-Chávez, Rogoff, & Mejía-Arauz, 2005; Mejia-Arauz, Rogoff & Paradise, 2005). Mayan children whose mothers averaged 3 grades of schooling attended more to information directed to others compared to Mayan children whose mothers averaged 12 or more years (Correa-Chávez & Rogoff, 2009). Similarly Mexican heritage children in the US whose mothers averaged 7.5 years of schooling paid attention to third party activity more than US Mexican heritage children whose mothers had more than 12 years of schooling (Silva et al., 2010; López et al., 2010).

Although participation in school may familiarize people with the forms of teaching and learning common in school, it is important to point out that increased participation in school is accompanied by a number of other demographic changes (see LeVine, LeVine, & Schnell, 2001). In Indigenous communities of Mexico and Central America participation in Western schooling is associated with a number of behaviors and experiences that may be related to child teaching and learning such as a decrease in number of children in the family, more limited involvement in the extended family, migration, urban experience, and occupations requiring credentials (LeVine et al 1991; LeVine et al 2001; Richman et al, 1992; Rogoff et al., 2005). Therefore in this study school experience is used a proxy for increased familiarity with European

American middle class cultural patterns of child rearing and child learning and not seen as the sole or "active ingredient" in changing community patterns.

Present Study and Hypotheses

This study examines how US Mexican heritage siblings of differing cultural backgrounds organize joint activity when they are working together at constructing a three dimensional puzzle. Based on previous comparative and ethnographic data it was expected that 1) there would be differences in the patterns of coordination, with the sibling pairs whose families have more recent immigration from rural areas of Mexico and less extensive experience with school (pueblo group) engaging collaboratively more and the sibling pairs from families more familiar with middle class ways through extensive schooling and related cultural practices (high schooling group) engaging more in solo work and being off task more. It was also expected that 2) children from the pueblo families would organize their collaborative interactions relying more on nonverbal and multiple means of communication compared to children from the high schooling families. Based on research showing the benefits of collaboration in a novel task it was also expected that 3) higher levels of collaboration would be related to success on the puzzle task.

Method

Participants and their Communities

The sibling pairs were recruited through afterschool clubs at three public elementary schools in the Los Angeles area. All of the children were receiving their schooling in the United States. Two of the schools were in the southern area of Los Angeles and one was in East Los Angeles. All three of the schools were in areas that have large Latino populations and where the schools serve almost exclusively Mexican heritage children. Almost all of the schools' students

(93%) participated in a free or reduced-price lunch program. The majority of the children's families (46 of the 50 sibling pairs) had historical roots in Mexico, 2 of the sibling pairs' families were from Guatemala and 2 from El Salvador (which were included because of a similar history of Indigenous practices and access to schooling). Parents provided family demographic information in responding to the permission slip sent home from school.

All of the 24 mothers in the "**pueblo group"** were born outside the United States. Twenty-one were born in Mexico (primarily in the states of Jalisco, Michoacán and Guerrero), 1 was born in El Salvador and 2 in Guatemala. Among the fathers in this group 17 were born in Mexico (again primarily in the states of Jalisco, Michoacán and Guerroro), and 3 were born in Guatemala (4 declined to provide information) [i]. All of the mothers in this group completed their education outside of the United States, primarily in the Mexican states of Guerrero, Jalisco, Michoacán. Typical occupations for the mothers included cook, garment worker, and housekeeper. Schooling information was available for 16 of the fathers in this group (no information on 8 fathers). Of these 16 fathers, the majority had 9 or fewer years of schooling (14 fathers), one had completed 11 grades and one had completed 12 grades. All of the fathers that reported schooling information completed school in Mexico, primarily in the states of Michoacán and Jalisco, and in Mexico City. Typical occupations for the fathers included gardener, busboy, mechanic, and cook.[ii]

At the time of the study 8 families in the pueblo group had only the two children that participated in the study, 10 families had three children and 6 families had 4 children. Seventy percent of the children in the pueblo group reported speaking mostly Spanish at home and 46% reported having visited Mexico. Twelve of the sibling pairs were of the same gender (5 pairs of

sisters, and 7 pairs of brothers). In the 12 mixed gender sibling pairs, 7 had a sister as the older sibling. Average ages of the siblings were 9 and 7 ½ years (See Table 1.)

In the "**high schooling**" group, 16 of the 26 mothers were US born (primarily in California), 9 were born in Mexico (in the sates of Jalisco, Oaxaca, and Baja California), and 1 in El Salvador. Eighteen of the mothers in this group completed their schooling in California (4 in Jalisco, 1 in Oaxaca and 1 in Baja California). Typical occupations for the mothers in this group included teacher, home maker, nurse, and office manager. Nine of the fathers were born in the US (primarily in California), 11 in Mexico (again mostly in Jalisco and Oaxaca), 1 in Guatemala, and 1 in El Salvador (4 declined to provide information). Schooling information was available for 19 of the fathers in this group (no information on 7 fathers). Of these 19 fathers, 3 had 9 or fewer years of schooling, 7 completed high school, and 9 attended school beyond high school. Like the mothers, the majority of the fathers (14) completed their schooling in California (3 in Jalisco, 1 in Oaxaca, and 1 in Colima). Typical occupations for the fathers included customer service representative, graphic designer, salesman, and teacher.[iii]

At the time of the study 8 families in the high schooling group had only the two children that participated in the study, 11 families had 3 children, 3 families had 4 children, and 2 families had 5 children. Forty percent of the children in the high schooling group reported speaking Spanish at home and 23% reported having visited Mexico. Seventeen of the siblings in this group were same gender (10 pairs of sisters, and 7 pairs of brothers). In the 9 mixed gender sibling pairs, 5 had a girl as the older sibling. Average ages of the siblings were 9 and 7 years.

--------------- Table 1 about here ----------------

Chi-square analyses showed that there were differences between the groups in how likely they were to speak Spanish at home (X^2 (1) = 5.27, $p < .05$) and how likely the children were to

have gone to Mexico to visit (X^2 (1) = 3.93, $p < .05$). Among the 35 sibling pairs who provided both maternal and paternal schooling information, there was a .82 correlation between maternal and paternal schooling ($p < .01$) such that the more schooling the mother had, the more school the father tended to have. Among the 19 parents from the high schooling families the correlation was .75 ($p < .01$). However there was no correlation among the 16 parents in the pueblo families where fathers schooling tended to cluster around either 6 or 9 grades regardless of maternal schooling.

Procedure

As part of a larger study the sibling pairs were invited to work together to construct a three dimensional honey bee puzzle. The children were seated together at a long rectangular table opposite the video camera. The female Research Assistant (RA) then brought an already completed honey bee model that had been glued together and placed it in front of the children on the table. “Now you are going to work together to make a puzzle that looks like this (hands them the model). You can look at this one and touch it and move it around as much as you want. Here are all of the pieces you need to make another one (lays out all of the parts on the table in front of the children). I have to go outside for a little while, but if a piece breaks you can go outside and let me know and I’ll get you another piece. You can be as loud as you want while you are here.”

The RA left the room for 10 minutes to ensure the children would feel comfortable talking, gesturing, and being loud with one another as they worked on the puzzle. This was also done to emphasize to the children that they would be figuring out how to construct the puzzle on their own without the help of the RA. After 10 minutes the RA walked back into the room and sat in a corner doing some “work” in her notebook until the children finished. If the siblings had not finished by 15 minutes, the RA checked on them asking them if everything was OK and if

they wanted to continue. If any pair wished to stop at this point they were allowed to do so, otherwise the RA went back to "work" and waited for the siblings to finish. Once they were done, they were taken back to their after school club by the RA.

Coding

The coding scheme was adapted using categories that had been developed in previous research (Chavajay & Rogoff 2002; Mejia-Arauz et al., 2007; Najafi, 2006). The videotape record was divided into 10 second segments during which a bilingual coder unaware of the hypothesis of the study identified how the pair was organized as they completed the puzzle: either jointly engaged, checking in, solo, or off task. Only one form of interaction was coded per segment. In order to not miss any segments involving collaboration, any segment that contained joint engagement and any other form of social organization, for example "checking in," was coded as joint engagement. This approach was conservative in that it was possible that it slightly reduced the possibility of finding differences between the groups. If any segment contained checking in and either solo or off task, it was coded as checking in, and if any segment contained solo and off task it was coded as solo. Again, this may have led to fewer segments coded as off task. Additionally, when coding, if the form of organization was coded as jointly engaged the coder also identified if the children were coordinating with one another primarily through talk, primarily through nonverbal joint activity, or through multiple means of communication.

Jointly engaged. A segment was coded as jointly engaged if it was evident both children were coordinating with one another in a cohesive fashion as they contributed to their overall progress on the puzzle. Often this meant both children were working together on the same part of the puzzle. It was possible for one child to be in observing or supportive role if it seemed that it was part of helping or contributing to the other child's efforts and the children seemed aware of

one another's actions. Body position was especially important in coding a segment as jointly engaged, the children tended to be oriented to each other in a way that was consistent with working together. Figures 1 and 2 provide examples of the children's body orientation. The siblings on the left are oriented towards each other and visibly working on the same part of the puzzle. The children to the right are also working on the puzzle but from their position and body posture it is not evident that they are supporting one another as they work. Body position was not the only indicator of joint engagement. Coders took note of what the children did in previous or following segments to see how the sibling's activities built or did not build on each other's. As a subcategory of joint engagement, coders also identified if the engagement was done primarily through talk, through nonverbal joint activity, or through multiple means of communication.

-------- Figures 1 and 2 about here -----------

- Jointly engaged primarily with talk included segments where the coordination between the siblings was primarily evident in the talk between them. For example a child could say, "I don't think we should start with the head. We should do it some other way," or "why don't you look for the small legs and I'll look for the big legs," or "let's try to figure out where these go."
- Jointly engaged through nonverbal joint activity included segments where the siblings were communicating with each other by engaging in joint activity. For example a child could hand his sister a piece of the wing she had been looking for without the sister asking for it, or they could both be working together to get a piece into a slot by helping one another rotate that piece. In these segments there was no talk about how to continue with the puzzle. The talk (if there was any) was limited to a word or two, for example saying a name to call attention. However the coordination between the

siblings was organized primarily through joint activity and close observation to one another and to the task.

- Jointly engaged through multiple means included segments where the collaboration was organized both through joint activity and talk. For example the siblings are working at putting two pieces together and *as they work* together one says, "I don't think this is where it goes, let's try the other one you have." The second sibling then holds up the piece and looks questioningly at the first. The first sibling nods and together they work together at placing the piece. For a segment to be coded as "jointly engaged through multiple means" neither the joint activity nor the talk seemed to be primary in the 10 seconds, rather both seemed to play an equal role in organizing joint activity.

Checking in. A segment was coded as "checking in" if both children were checking in with each other as they worked on different aspects of the puzzle. They did not appear to be coordinating their actions with one another, but they were not working completely independently from one another as evidenced by the questions about what the other one was doing, or brief glances to check in on the other sibling. For example as one child was working on the tail and the other on the wings one sibling asks, "what are you doing now?" Or one sibling pauses her work to assess what the other is doing. In segments coded as checking in it did not appear that the siblings were aware of what the other was doing already, but they were finding out. However this did not mean they were working together as in jointly engaged.

Solo. A segment was coded as solo if both children were working solo on the puzzle, side-by-side but not coordinating or communicating with each other.

Off task. A segment was coded as off task if both children were engaged in something other than building the puzzle such as flying the model bee around, engaging with something else in the room, or goofing off for the camera. Because the focus was on the *pair's* coordination if only one child was off task the segment was not coded as off task, but rather as solo.

Off task talk. Any segment in which the children engaged in talk about something other than constructing the puzzle was coded as containing off task talk. Unlike other coding categories off task talk could co-occur with any of the coded forms of engagement (although it almost always occurred in solo and off task segments).

Reliability. One third of the data was also coded by the author for reliability purposes. Pearson's correlations between the two coders were as follows: jointly engaged $r = .98$; checking-in $r = .95$; solo $r =.99$; off task $r = .99$; off task talk $r = 1.0$; jointly engaged with talk $r = .94$; jointly engaged nonverbally $r = .90$, joint engaged multiple means = .94. Although the questions in this study only involved the total use of the forms of collaboration for each pair, segment by segment agreement was also examined and was good.

Results

Analyses focused on the first 15 minutes of interaction. This was done because half the children in each cultural group finished within the first 15 minutes (12 pueblo and 14 high schooling group), and many who had not finished by then tended to become increasingly frustrated and uninterested after that time (as evidenced by an increase in the segments coded as "off task" after 15 minutes) and some pairs requested to stop at that point in time. Proportion of time segments were used to analyze the data because sibling pairs varied in how long they took to complete the puzzle. However although the individual pairs varied, there were no significant differences in amount of time spent on the puzzle between the cultural groups. The average time

coded was 13.5 minutes for the pueblo group (range 7.5 -15 mins) and 13.8 minutes for the high schooling group (range 7.8 -15 mins). No significant gender differences were found across the sample or within each background group for any of the analyses reported.

Hypothesis 1: Different forms of Interaction in Siblings from Mexican Pueblo and Mexican High Schooling Families

As expected, the sibling pairs from pueblo families engaged jointly while constructing the puzzle in proportionally more time segments (58.0%) than children from the high schooling families (39.6%), F (1, 48) = 8.11, $p < .01$. Confidence intervals for one standard deviation indicated that children from pueblo backgrounds engaged jointly for 49.1% to 66.9% of the time segments compared with children from the high schooling backgrounds, for 29.8% to 49.4% of the time segments; effect sizes of Cohen's $d = .81$ and $r = .38$.

Also as expected, the siblings in the high schooling group worked separately from each other in solo activity proportionally more often (45.3% of time segments) than the siblings from the pueblo families (31.1% of time segments), F (1, 48) = 4.52, $p < .05$. Confidence intervals for one standard deviation indicated that children from high schooling backgrounds worked solo for 36.1% to 54.5% of the time segments compared with children from the pueblo backgrounds, for 23.6% to 38.6 % of the time segments; effect sizes of Cohen's $d = -.69$ and $r = -.33$.

There were no differences between the groups in the percentage of segments organized by checking in with each other. The children in the pueblo group organized by "checking in" in 10.4% compared to 13.2 % of the time segments for the high schooling group.

It was also more common (proportionally) for the siblings from the high schooling families to be off task in 1.9% of the time segments compared to 0.4% for the siblings from pueblo families, F (1, 48) = 4.32, $p < .05$. Confidence intervals for one standard deviation indicated that children

from high schooling backgrounds were off task for 0.5% to 3.2% of the time compared with children from the pueblo backgrounds who were off task for 0.0% to 0.8 % of the time; effect sizes of Cohen's d = -.57 and r = -.28.

The sibling pairs from the high schooling families were also proportionally more likely to engage in off topic discussion or chat while building the model, in 6.7% vs. 1.5% of the session's time segments, $F(1, 48) = 3.14$, $p < .05$. Confidence intervals for one standard deviation indicated that children from high schooling backgrounds engaged in off topic chat in 1.0% to 12.5% of the time segments compared with children from the pueblo backgrounds who engaged in off topic chat in 0.44% to 2.5% of the time segments; effect sizes of Cohen's d = -.51 and r = -.25.

Table 2 shows the means and standard deviations for each form of organization and for off topic chat.

-------------- Table 2 about here ----------------

Hypothesis2: Different amounts of Talk, Nonverbal Joint Activity, or Multiple Means of Communication in Collaboration

Due to differences in rates of joint engagement between the two cultural groups, proportions were used to examine what percent of the sibling's collaborative joint engagement was organized through talk, through nonverbal joint activity, or through multiple means of communication. Six sibling pairs that were jointly engaged less than 10% of the time segments were excluded from the analysis. This was done because their numbers were so low that including their data would have been misleading. One pair only jointly engaged for one segment overall (1% of the time segments). Whichever way the siblings communicated in that one segment would have resulted in 100% of those sibling's collaborative interactions being categorized as either involving talk, nonverbal joint activity, or multiple means of communication. At the highest end of those excluded were 2 sibling

pairs who engaged jointly for 6 segments, but again a score of 50% for them would have only reflected 3 segments out of the entire activity. Excluding these 6 pairs resulted in 24 pairs from the pueblo group and 20 pairs in the high schooling group being included in the analysis.

Consistent with prior research (Mejia-Arauz et al., 2007) when the sibling pairs from the pueblo families were engaged jointly they used proportionally more nonverbal joint activity (30.2% of the time) compared to the pairs from the high schooling families (21.0%) of the time, $F(1, 42) = 4.34$, $p < .05$. Confidence intervals for one standard deviation indicated that children from pueblo backgrounds engaged in nonverbal joint activity 23.5% to 37.0% of the time compared with children from high schooling backgrounds who coordinated through nonverbal joint activity 15.1% to 27.0 % of the time; effect sizes of Cohen's $d = .64$ and $r = .31$.

The siblings from the pueblo group were also proportionally more likely to use more multiple means of communication when jointly engaged, 43.7% vs. 36.2% of the time, $F(1, 42) = 3.94$, $p < .05$. Confidence intervals for one standard deviation indicated that children from pueblo backgrounds used multiple means of communication while coordinating 37.2% to 50.3% of the time compared with children from high schooling backgrounds who used multiple means of communication 32.8% to 39.7% of the time; effect sizes of Cohen's $d = .63$ and $r = .30$.

Also consistent with previous research (Maynard, 2004, Mejia-Arauz et al., 2007) siblings from the high schooling families were proportionally more likely to coordinate their joint engagement through talk, 42.6% of the time vs. 26.4% for pueblo siblings , $F(1, 42) = 12.40$, $p < .01$. Confidence intervals for one standard deviation indicated that children from pueblo backgrounds used only talk in coordination 20.4% to 32.8% of the time compared with children from high schooling backgrounds who used only talk 35.7% to 49.4% of the time; effect sizes of Cohen's $d = 1.05$ and $r = .47$.[iv]

Hypothesis 3: Relationship Between Forms of Social Organization and Completing the Puzzle

Contrary to expectations, there were no significant differences between the cultural groups in how likely there were to finish the puzzle in the first 15 minutes. Twelve pueblo and 14 high schooling pairs finished in 15 minutes, and 12 pueblo and 12 high schooling pairs did not finish the puzzle in 15 minutes.

Therefore in order to examine the relationship between collaboration and puzzle completion the 26 sibling pairs that finished the puzzle (regardless of group membership) were compared to the 24 that did not complete the puzzle. The sibling pairs that finished the puzzle in 15 minutes engaged jointly in proportionally more time segments (60.1%) than the pairs that did not finish the puzzle (35.8%), $t\ (48) = 4.02$, $p <.01$. Confidence intervals for one standard deviation indicated the children that finished the puzzle engaged jointly in 51.1% to 69.0% of the time segments compared with children that did not finished who engaged jointly for 27.3% to 44.4% of the time segments; effect sizes of Cohen's $d = 1.16$ and $r = .50$. Additionally the more that the siblings engaged jointly, the more likely they were to finish. This was true among all 50 of the sibling pairs ($r_{pb} = .50$, $p <. 01$) and within each of the cultural groups: pueblo $r_{pb} = .50$, $p <. 01$; high schooling $r_{pb} = .60$, $p <. 01$.

Additionally the sibling pairs that finished the puzzle (and engaged collaboratively more than 10% of the time) engaged in proportionally more multimodal and nonverbal means of communicating multimodally and nonverbally for 40.6% vs. 29.5% of their collaborative segments, $t\ (42) = 5.6$, $p <. 05$. Confidence Intervals for one standard deviation were 33.7% to 47.6% for those finished and 23.1% to 35.9% for those that didn't. Again the more that the siblings used multimodal and nonverbal means of communication in their collaboration the more likely they were to finish. This was significant among all of 44 sibling pairs that engaged

collaboratively over 10% of the time (r_{pb} = .31, p <. 05) and in the high schooling group, r_{pb} = .53, p <. 01. In the pueblo group this was a trend, r_{pb} = .32, p =. 06.[v]

Conversely among all the siblings, those that did not finish the puzzle in 15 minutes worked solo in proportionally more time segments (25.2%) compared to the siblings that did complete the puzzle (10.6%), t (48), = 4.34, p <.01. Confidence intervals for one standard deviation indicated the children that did not finish worked solo in 19.0% to 31.4% compared to 7.3% to 14.0 % of the time segments for the children that finished; effect sizes of Cohen's d = 1.25 and r = .53. Additionally, the more siblings worked solo, the less likely they were to finish. This was true among all 50 of the sibling pairs puzzle (r_{pb} = -.53, p <. 01) and within each of the cultural groups: pueblo r_{pb} = -.40, p =. 05; high schooling r_{pb} = -.66, p <. 01. There was no relationship between either checking in or being off task and finishing the puzzle. Table 3 gives the means and standard deviations for the forms of organization among the siblings that finished and did not finish the puzzle and Table 4 gives the correlations between the form of organization and finishing the puzzle among the cultural groups.

Given these results it is unclear why more siblings from the pueblo group did not complete the puzzle in the first 15 minutes compared to children in the high schooling group. However a possible explanation may lie in the fact that the puzzle was extremely difficult and coding focused only on the first 15 minutes of activity. A comparison of the sibling pairs that completed the puzzle anytime before or after 15 minutes and the sibling pairs that gave up anytime before or after 15 minutes supports this conjecture. Twenty-one of the pueblo siblings completed the puzzle compared to 16 of the high school siblings. Conversely 3 of the pueblo siblings gave up at any point before or after the 15 minute mark, and 10 of the high schooling siblings gave up at any point before or after the 15 minute mark, and these differences were significant (X^2 (1) = 4.37, p < .05). However we do

not know if the sibling pairs used the same patterns of collaboration and coordination after 15 minutes that they used in the first 15 minutes of activity.

-------------- Tables 3 and 4 about here ----------------

Discussion

Consistent with previous work showing collaboration as important in the social organization of groups with Indigenous histories, Mexican heritage siblings from pueblo families were proportionally more likely to organize their interactions collaboratively through joint engagement where the siblings worked with one another and built off one another's efforts. Joint engagement was the most common form of social organization for the children from the pueblo families. Conversely, the Mexican heritage children from the high schooling families were proportionally more likely to work solo on the puzzle, and this was the most common form of social organization in this cultural group.

The results of this study are consistent with the ethnographic literature which suggests that as children participate in the important activities of their communities and families they may be learning the skills of engaging with others in joint activity. School (which is also important in children's lives) has traditionally emphasized individual activity and achievements and forms of engagement with children that are often modeled on school tend to emphasize individual rather than joint or group accomplishments (Dixon et. al.1984; Morelli et al. 2003; Rogoff, 2003). The forms of interaction seen in this study seem to be related to intergenerational patterns of participation in community institutions and activities particularly in school and in Intent Community Participation.

It would be of interest in future research to see if the cultural patterns of collaboration found in this study were amplified due to the fact that the participants were siblings. Although

there were differences in how much the siblings collaborated in the different cultural groups, there was still a good deal of collaboration among the siblings in the high schooling group. This is consistent with the research showing more collaboration, and more multimodal collaboration among siblings compared to peers (Azmitia and Hesser, 1993). It might also be fruitful in future research to see if the patterns are similar to those found among European American siblings who presumably have less familiarity with the ways of organizing learning through Intent Community Participation. Previous research comparing children of Indigenous heritage and children of European American heritage has tended to find a more stark contrast between children from pueblo families and European American children (Correa-Chávez et al., 2005; Mejia Arauz et. al, 2007). It would be interesting to see if the patterns found among the siblings in the high schooling group would be similar to what one would find among European American siblings, or if they would be different than both European American and Mexican Pueblo siblings.

Patterns in the Use of Talk and Nonverbal Means of Communication in Interaction

The results of this study also showed cultural variation in the ways of organizing collaboration with the children from the pueblo families using proportionally more nonverbal joint activity and multiple means of communication in organizing their joint engagement and the sibling from the high schooling family using proportionally more talk. These findings are consistent with prior work showing Mexican triads from pueblo families organized collaboration through nonverbal conversation more often than European American triads who organized collaboration more through talk (Mejia-Arauz et al., 2007). The finding are also consistent with the idea that in communities where children are expected to observe and pitch in they may do so in ways that do not disrupt ongoing activity (for example by talking about things that are obvious to the participants). Additionally if siblings in the high schooling families were less familiar with

Intent Community Participation and engaged in many child focused activities that privilege talk over joint activity, they may be less attuned to one another and less accustomed to communicating through joint activity.

The Role of Schooling in Organizing Interaction

The differences in joint engagement and patterns of communication between the children in the pueblo group and the high schooling group contribute to the body of work suggesting that participation in school may compete with traditional forms of organizing learning in communities of Indigenous heritage (Chavajay & Rogoff 2002; Correa-Chávez et al., 2005; Correa-Chávez & Rogoff, 2009; Dixon et al., 1984; Heath 1983; Laosa, 1980; López et al., 2010; Mejia-Arauz et al., 2007; Moreno, 2000; Silva et al., 2010). It is likely that parents who have spent 12 or more years in schools would interact with children in ways that are consistent with the interactional patterns common to school. Parents may replace more collaborative multiparty forms of engagement which often rely on multiple means of communication with child rather than community focused activity (Crago, Annahatak, & Ningiuruvik, 1993; Richman, et al., 1992; Rogoff, 2003).

However it is also important to highlight that different patterns of schooling were associated with a number of differences between the two groups including: recency of immigration to the US, parental occupations, fluency in English and in Spanish, and extent of experience in México. There are likely other values and practices that differ between the groups, such as extent of interaction with extended family, proximity to family, or involvement in extracurricular lessons that likely also contribute to children's experience with group interactions. It would be useful in future research to examine ways that people can build a broader repertoire of learning practices, or if it is usual for one form of interaction to compete

with (or replace) another. By building a broader repertoire of behaviors children might be better prepared to handle a larger range of future challenges, some of which may resemble school problems and others which may require more collaborative solutions.

Implications for Practice

Although there were no differences between the cultural groups in how likely they were to finish the puzzle (despite the group differences in collaboration) there were indications that joint engagement among the sibling was related to successfully completing the puzzle. When the children engaged jointly in the puzzle activity regardless of cultural group they were more likely to finish the puzzle whereas if they worked solo they were less likely to finish. The results also showed that multimodal and nonverbal means of communication were related to finishing the puzzle which is consistent with previous research showing nonverbal communication as important in some collaborative endeavors (Apedoe et al., 2010; Azmitia & Crowley, 2001; Azmitia & Hesser, 1993). These results along with previous research seem to suggest that collaboration in its multiple forms is a practice that may be useful to all children engaged in a difficult task in which it is possible to manipulate objects and build off one another's work.

The correlations with finishing the puzzle were significant for the siblings from the high schooling group as well as the siblings from the pueblo group which suggests that collaboration and multimodal collaboration may be useful in different groups, and not just for children familiar from rural Mexican communities or Indigenous communities. However children for whom this is a more common form of interaction and communication may benefit if teachers and administrators recognized the benefits of collaboration through multiple means. Research has shown that European American children have a difficult time recognizing nonverbal forms of

collaboration when shown videos of interactions (Roberts & Rogoff, 2011) however it is an empirical question whether or not adults can recognize it in schools.

Data from the 2000 US census showed that children from immigrant families made up 20% of all the children in the United States, and their numbers were the fastest growing in the nation. During this same time period children with at least one parent from Mexico made up the largest group of children from immigrant families in 26 states, and demographers predict that these numbers will increase (Hernandez, Denton, & Macartney, 2007). It would therefore be useful to know more about the ways of life of children from Mexican immigrant families, as well as the variation that exists in these families. This study provides both by examining the cultural patterns of participation in institutions and community traditions among families of Mexican heritage, and by examining how that participation is related to different forms of interaction and communication in children of Mexican heritage.

By knowing more about the strengths that children from rural Mexican immigrant families bring with them to the school context we might be able to design educational spaces that make use of and build on these strengths. However, learning the skills of fluid collaboration might be a beneficial skill for all children to learn (not just children from Mexican backgrounds). As the population of the United States changes and as workplaces increasingly rely on teamwork and collaboration it would be useful for all of the children in the United States to have a repertoire of practices that they can draw from across situations including, among others, the skills of collaboration and multiple forms of communication.

Table 1.

Maternal Schooling Paternal Schooling, Gender, and Age of Siblings

	Mexican-heritage Pueblo 24 sibling pairs (48 children)	**Mexican-heritage High Schooling** 26 sibling pairs (52 children)
Average maternal schooling (Information available on all 50 mothers)	7.3 grades (range: 4-11grades) SD = 2.1	14.3 grades (range: 12-16 grades) SD = 1.8
Average paternal schooling (Information available on 35 fathers)	8.3 grades (range 6-12 grades) SD = 1.9	13.0 grades (range 8-16 grades) SD= 2.6
	Older Sibling	
Gender	12 girls, 12 boys	15 girls, 11 boys
Average age	9.3 years (range 8-10 years)	9.1 years (range: 7-11 years)
	Younger Sibling	
Gender	10 girls, 14 boys	14 girls, 12 boys
Average age of focal child	7.4 years (range: 6-10 years)	7.0 years (range: 6-10 years)

Table 2.

Means Percent (and Standard Deviations) of Session's Time Segments Using Different Forms of Social Organization

	Mexican-heritage Pueblo	**Mexican-heritage High Schooling**
Organization of Interaction		
Engaged Jointly	58.0 (21.0)**	39.6 (24.2)**
Checking In	10.4 (8.6)	13.2 (7.6)
Solo	31.1 (17.6)*	45.3 (22.9)*
Off Task	0.4 (.9)*	1.9 (3.3)*
Off Task Chat		
	1.5 (2.4)*	6.7 (14.2)*
Communication Used While Jointly Engaged		
Nonverbal Joint Activity	30.2 (3.2)*	21.0 (2.8)*
Multiple Means of Communication	43.7 (15.5)*	36.2 (7.4) *
Talk Only	26.4 (14.6)**	42.6 (15.4)**

Table 3.

Means and Standard Deviations for Joint Engagement and Solo Activity among Sibling Pairs that Completed and Did Not Complete the Puzzle

Form of Engagement	**Pairs completed puzzle (N =26)**	**Pairs did not complete puzzle (N = 24)**	**All Pairs (N = 50)**
Percent of session jointly engaged	60.1 (22.2)**	35.8 (20.3)**	48.4 (24.4)
Percent of session working solo	10.6 (8.3)*	25.2 (14.7)*	17.7 (13.8)

Form of Communication	**Pairs completed puzzle (N =25)**	**Pairs did not complete puzzle (N = 19)**	**All Pairs (N = 44)**
Percent of coordinated segments using nonverbal and multiple means of communication	40.6 (16.8)	29.5 (16.1)	32.4 (17.8)

Table 4.

Correlation Between Finishing the Puzzle and Form of Organization

Correlation with Finishing Puzzle	Pueblo Group (N = 24)	High Schooling Group (N = 26)	All Pairs (N = 50)
Joint Engagement	*r* = .50**	*r* = .50**	*r* = .60**
Solo	*r* = -.40*	*r* = -.66*	*r* = -.53*

Correlation with Finishing Puzzle	Pueblo Group (N = 24)	High Schooling Group (N = 20)	All Pairs (N = 44)
Joint Engagement with multimodal communication	*r* = .32†	*r* = .53**	*r* = .31*

Figures 1 and 2. Siblings Constructing the Puzzle through Joint Engagement or Solo Work

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Endnotes

[i] Other maternal places of birth included the Mexican states of Oaxaca, Yucatán, Tlaxcala, Nayarit, Zacatecas and Mexico City. For fathers, birth places also included Nayarit, Oaxaca, Puebla, Sinaloa, Yucatán, Zacatecas and Mexico City.

[ii] Other mothers in the pueblo group reported their jobs as fast food restaurant worker, hotel housekeeper, bus driver, custodian, and housewife. For fathers other jobs included custodian, factory worker, construction worker, house painter, and unemployed.

[iii] Other mothers in the high schooling group reported their jobs as analyst, business manager, customer service representative, receptionist, clerk, and student. For fathers other jobs included office manager, police, and construction worker.

[iv] Including the 6 sibling pairs that were excluded from analysis revealed similar patterns for talk and multimodal communication. However in this a different pattern emerged for nonverbal joint activity, with no differences between the groups. This was because the few segments (1-6) that these pairs engaged jointly tended to involve nonverbal joint activity.

[v] So as not to misrepresent the data only the 44 sibling pairs that engaged jointly more than 10% of the time were included in the analysis, but the patterns were the same when all the siblings were included.