Neal, K. V., Zhou, M., Chen, Y., Johnson, L. R., & Kim, Y. (2019). Using robot-mediated activities to promote children's collaboration in culturally and linguistically diverse educational settings. *The Annual Conference of American Educational Research Association (AERA):* Toronto, Canada. April 5 - 9.

Objectives/Purposes

This purpose of this paper is to examine the use of robot-mediated communication activities to foster equitable and collaborative interactions between children from Spanish and English speaking families. This research was motivated by concerns about achievement gaps—referred to as opportunity gaps by some—that have positioned Latino/a and Spanish-speaking students as less academically successful than their white counterparts (Carter & Lerner, 2013; Gándara, 2017). This disparity is especially troubling given the dramatic growth in Latino/a and Spanish-speaking populations across the U.S., and the increasing diversity of the U.S. public school population (National Center for Education Statistics, 2017). This paper analyzed data collected through triadic interactions among a moderator-mediated robot and two kindergarten-aged children, one English-dominant, one Spanish-dominant. Research questions that guided the analysis of data include:

1) What are characteristics of interactions between robot and children? between moderator and children? between children? What role does each participant play in activity?
2) What topics/issues are discussed? What sorts of questions promote interaction among children?
3) What are affective features of interactions? How do these figure into collaborative interactions?

A primary objective of this study is to better understand technologically innovative instructional activities that can promote cross-cultural and linguistic interactions among linguistically and culturally diverse children. It is hoped that this study can inform the design of robot-mediated activities so as to enhance early childhood education and learning in multicultural settings.

Perspectives

This study is rooted in research that has examined how children's funds of knowledge (González, Moll, & Amanti, 2009)—or the rich repositories of knowledge and resources present in their family and community contexts—can be used to create supportive and culturally relevant learning settings for culturally and linguistically diverse children. Funds of knowledge approaches provide an antidote to deficit-oriented thinking, which has often viewed non-mainstream children's homes and communities as hindrances to their academic success. In contrast, funds of knowledge theories, and culturally responsive, or sustaining, pedagogy (Ladson-Billings 2009; Paris 2012) seek to employ children's distinct and diverse cultural, social, and linguistic experiences as a foundation for instruction, wherein children's knowledge and background are viewed as assets and opportunities rather than as deficits or obstacles.

In our view, robot mediated activities in small instructional groups can represent what researchers have identified as a "third space" (Bhabha, 2004; Gutierrez, Baquedano-Lopez, & Tejada, 1999; Moje et al., 2004), bearing the potential to bridge the "first space" of home, community, and peer networks with the "second space" of formalized

schooling, allowing for child-initiated conversations and interactions that integrate children's popular culture knowledge and unique cultural and linguistic resources with the formalized discourses of school. Activities with the robot also provide opportunities for children to engage in observation and experimentation, negotiate and collaborate with others, create and test hypotheses and theories, make inferences, and construct meaning (Gopnik, 2012; Vasquez et al., 2011).

In its examination of children's robot-mediated collaborative activities, this study adopts a socio-cultural perspective (Vygotsky, 1978), viewing these learning activities and communicative practices as situated and constructed within particular, varied, and malleable contexts that are shaped by social, cultural, historical structures and factors. Furthermore, as detailed within the ethnography of communication (Hymes, 1974), these contexts are populated by various speech events and acts, often governed by particular rules and expectations for communication and used to achieve specific objectives and ends. Therefore, in the design and implementation of activities in this study, designers and researchers did not take a "one size fits all" approach, and responded to children's interests, needs, linguistic and cultural resources, and communicative roles and practices—*in situ* as activities were taking place, as well as in the on-going refinement of activities. Analysis of data was informed by Corsaro's (2012) theory of interpretive reproduction, developed through his ethnographic research with children, which emphasizes the importance of peer culture and recognizes children's active contributions to the creation of cultural knowledge.

Methods

This study used qualitative and ethnographic methods (Spradley, 1980) to investigate the use of a humanoid robot to broker equitable interactions and communication between kindergarten-aged children from native English-speaking families and Spanish-speaking families. The activities used a mediation model wherein the robot invites children to participate in a series of collaborative learning opportunities with the aim of help children achieve three communicative goals: building 1) common ground 2) an equitable partnership, and 3) a co-cultural schema. Activities focused on 3 different topics/settings: school, animals, and birthdays.

Participants and setting

Twenty-four kindergarten children participated in this study; children were predominantly white English-speaking and Latino/a Spanish and English-speaking. All participants were identified as low performing by the school and attended a supplemental class to receive additional support for language and academic skills. The research setting was a public elementary school in a mountain-west state of the United States. The school had a high rate of families living near or below the poverty line.

Data collection and analysis

For data collection, children were divided into twelve pairs. Researchers and assistants visited the same class two days a week from mid-February through mid-May, 2017. A

Wizard of Oz technique (Reik, 2012) was employed for activities, wherein a researcher acts as a wizard, controlling the robot, named Scusi, from a corner of the room; a bilingual research assistant acted as a moderator to clarify instructions or intervene if needed, which became less necessary over time. All sessions were video-recorded and later typed into English and Spanish-language transcriptions. A researcher also took ethnographic field notes of each activity, recording them in a researcher journal (Glesne 2016).

Data was analyzed using an inductive open coding approach (Bogdan & Biklen, 2007); research team members separately coded a few transcripts in order to generate a list of codes and then achieved consensus regarding codes to be used for entire data corpus. Second cycle coding methods such as pattern coding (Saldaña, 2016) were employed to identify thematic patterns and researchers prepared analytical memos (Emerson, Fretz, & Shaw, 2011) to refine these themes and patterns.

Findings/Results

A number of findings have emerged from data analysis. First, within scenarios children made important connections between topics and their own lives and experiences. These self-initiated topics further engaged them in the activity and helped personalize the activities for them. For example, in the school setting, the children discussed their own classroom learning, instances of teacher help, and cafeteria experiences. In the birthday setting, the children referred to specific past birthday celebrations, decorations, and shopping experiences with their family members and friends. In the animal setting, the children talked about their own pets, discussed how to take care of them, or imagined their future pets, as illustrated in following example:

> **ROBOT**: ¿*Te gustaría tener una mascota*? (Would you like to have a pet?)
> **BWLA**: I have- I have a dog.
> **. . .**
> **BWLA:** Yeah. She's a bossy dog.
> **Moderator**: Oh.
> **BWLA**: She's a naughty dog. She barks. Ever since she got-
> **. . .**
> **BWLA**: 'Cause we used to have a big dog then it died and then we had a small dog and it died one time but we had two big dogs and died different times.

When children were able to talk about own lives and interests, their responses were more extensive. In addition, children enjoyed discussing popular culture, as well as symbols which were culturally relevant. For example, in the birthday setting, children expressed enthusiasm about the use of piñatas for birthday parties, which are associated with Mexican traditions and thus likely hold specific cultural significance for children from Latino/a families in this study:

GLNI: (gasps pointing at new picture on the robot) Piñata!
BWOL: Yes you can totally do piñatas!
. . .
BWOL: Piñatas are so fun! You just want to (robot cuts BWOL off)
. . .
ROBOT: Where can you get a piñata?
GLNI: At the grocery store.
BWOL: No- you- no, you make the piñatas.
GLNI: Oh, and you can make the piñatas too.
BWOL: On my birthday-
. . .
BWOL: - I made a piñata so bad. (BWOL lies back)

As evidenced above, the topic of the piñata sparked an impromptu conversation between the children and the robot about their own experiences with piñatas.

A second finding related to the type of questions that promoted student engagement: participants exhibited higher levels of student engagement when the robot asked "how" questions. While the participants' responses to "what" questions were more tied to identifying or recalling concepts/ideas, the participants' responses to "how" questions were more tied to explaining or illustrating concepts/ideas. When the robot asked "how" questions, it allowed the children to generate responses that included gestures, sounds, mimics, and drawings which appeared to be particularly fun for this group of kindergartners. The following example shows the participants responding to a "how" question:

ROBOT: How big is a dinosaur?
GLGL: Really big. (indicates size with her hands)
GWAV: Really big.
ROBOT: I hear you. *Te escucho*. (I hear you.)
GWAV: And it's taller than the school.
GLGL: And it has a long neck.
ROBOT: Really? *Si*. (Yes.)

In this example, the children's responses incorporated not only a description, but also a hand gesture, along with a comparison to an object similar in size and a physical attribute of the dinosaur. Each child resorted to different strategies to help them provide a clear illustration of the size of a dinosaur, which suggested a high level of student engagement.

A final finding was that students were more engaged when questions entailed tasks. Initially, when the robot posed a question, children were inclined to answer robot individually as if they were alone with the robot. However, as the session progressed, children were becoming more comfortable with each other's presence because they shared personal experiences and perspectives with each other before answering the

robot's simple questions such as "what are pets?" Moreover, they developed into a team while being involved in task-based activities and having the same goal in mind, in which they usually communicated more effectively and more frequently than just answering simple questions separately. This was evident in the school scenario where children were required to place pictures representing different locations of the children's school and lead the robot to these locations one after another. Below is an example that illustrates peer interaction when children collaborated with each other to direct robot:

> **GWVI**: Yes. (Skusie turns too far left) Now go left. Now go left. (pointing to Skusie's right) Go left Skusie. (BLJE gives points to GWVI and gives a thumb up as he moves the pictures around) (Skusie turns to the right and stops)

As described in this vignette, GWVI and BLJE worked together to direct the robot to the same destination. They divided task duties beforehand and when BLJE helped to place pictures to provide convenience for GWVI and robot, GWVI responded with an affirmation.

Similarly, a birthday scenario in which children were suggested to help the robot choose and wrap a birthday gift also stimulated peer interaction:

> **Robot**: Can you two talk and choose one for me?
> **BWOL**: Blue robot. (both point)
> **GLNL/BWOL** (Simultaneously): Bicycle. (both point)

In this activity, the children negotiated and compromised with each other to come up with the same selection in the end as shown here both pointed bicycle.

Significance

The research findings demonstrate how certain types of speech events and acts within robot-mediated activities could lead to increased engagement of and collaboration between students participating in the activities. Students also demonstrated that they were integrating knowledge from their families and communities in order to create hybrid knowledge and understandings (Moje, et al., 2004). These findings can greatly inform our understandings of how we might design robot-mediated activities to build on children's knowledge and enhance collaboration among culturally and linguistically diverse students. This research can also add to scholarship in the area of how innovative technologies and pedagogies can be used to improve students' learning.

References

Bhabha, H.K. (2004). *The location of culture*. London, GB: Routledge.

Bogdan, R. C., & Biklen, S. K. (2007). *Qualitative Research for Education* (5th ed.). Boston, MA: Pearson.

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Carter, P.L., & Welner, K.G. (Eds.) (2013). *Closing the opportunity gap: What American must do to give every child an equal chance.* New York, NY: Oxford University Press.

Corsaro, W.A. (2012). Interpretive reproduction in children's play. *American Journal of Play, 4*(4), 488-504.

Emerson, R.M., Fretz, R.I., & Shaw, L.L. (2011). *Writing ethnographic field notes*. Chicago, IL: University of Chicago Press.

Gándara, P. (2017). The potential and promise of Latino students. *American Educator*, Spring 2017, pp. 4-11, 42-43.

González, N., Moll, L., & Amanti, C. (Eds.) (2009). *Funds of knowledge: Theorizing practices in households, communities, and classrooms.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Gutierrez, K.D., Baquedano-Lopez, P., & Tejada, C. (1999). Rethinking diversity: Hybridity and hybrid language practices in the Third Space. *Mind, Culture, and Activity*, *6*(4), 286-303.

Gopnik, A. (2012). Scientific thinking in young children: Theoretical advances, empirical research, and policy implications. *Science, 337*(6102), 1623-1627.

Glesne, C. (2016). *Becoming qualitative researchers* (5th edition). Boston, MA: Pearson.

Hymes, D. (1974). *Foundations in sociolinguistics: An ethnographic approach*. Philadelphia, PA: University of Pennsylvania Press.

Ladson-Billings, G. (2009). *The dreamkeepers: Successful teachers of African American children (second edition)*. San Francisco, CA: Jossey-Bass.

Moje, E.B., Ciechanowski, K.M., Kramer, K., Ellis, L., Carrillo, R., & Collazo, T. (2004). Working toward third space in content area literacy: An examination of everyday funds of knowledge and Discourse. *Reading Research Quarterly, 39*(1), 38-70.

Paris, D. (2012). Culturally sustaining pedagogy: A needed change in stance, terminology, and practice. *Educational Researcher, 41*(3), 93-97.

Riek, L. D. (2012). Wizard of Oz studies in HRI: A systematic review and new reporting guidelines. *Journal of Human Robot Interaction, 1*(1), 119-136.

Saldaña, J. (2016). *The coding manual for qualitative researchers*. Thousand Oaks, CA: Sage Publications.

Spradley, J.P. (1980). *Participant observation.* Belmont, CA: Wadsworth.

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Vasquez, E. I., Lopez, A., Straub, C., Powell, S., McKinney, T., Walker, Z., . . . Bedesem, P.L. (2011). Empirical research on ethnic minority students: 1995-2009. *Learning Disabilities Research & Practice, 26*(2), 84-93.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.