

COMMENT



WILEY

Young children co-constructing science: The importance of their families and cultural communities

Christine M. McWayne¹  | Gigliana Melzi²

¹Eliot-Pearson Department of Child Study
and Human Development, Tufts University,
Medford, Massachusetts, USA

²Department of Applied Psychology, New
York University, New York City, New
York, USA

Correspondence

Christine M. McWayne, Tufts University,
Medford, MA, USA.

Email: christine.mcwayne@tufts.edu

Abstract

There is considerable agreement among scientists, educators, and policymakers about the need to broaden participation in science, technology, engineering, and math (STEM) education. Yet, equity requires much more than increasing STEM access for marginalized groups of children. In this invited commentary, we raise two critical points for the field to continue to grapple with as we investigate ways to engage young minds in STEM learning. It is critical that research with young children focuses on the process of doing science, while appreciating that the process of scientific thinking and learning are culturally constructed and situated. Specifically, as researchers and educators, we must do better at contextualizing children's scientific thinking process as it unfolds in their daily lives—with their peers, families, and in their cultural communities. Specific studies highlighted throughout this essay seek to document and promote family, community, and teaching practices that are effective for supporting young children's learning and explorations in STEM across our increasingly diverse society. We propose opportunities for future researchers to focus their efforts, including the following: more multi-disciplinary work that includes synthesis across disciplines and methodological traditions; more diverse samples and investigative teams, such that cultural insiders are full participants; more descriptive studies focusing on the everyday experiences in children's lives that promote the



development of scientific thinking and practices; and practice-informed research.

KEYWORDS

early childhood, sociocultural research

1 | INTRODUCTION

As part of a newly National Science Foundation-funded collaborative research project (DRL #2055382) on family science in Latine homes of preschoolers, Melzi and colleagues are interviewing primary caregivers about science everyday practices. What emerges from these ongoing conversations with Latine caregivers is that families are engaging in rich and varied forms of everyday science with their young children, including discussions about which cooking pans conduct heat better, about the needs of growing plants, or why and how ice melts, as well as testing out if toys sink or float during bath time. Yet, when they ask caregivers to reflect on the word “science” and to think about the science in their lives, caregivers pause, and many draw blanks. Thus, there is an incongruence between families’ everyday science practices and their recognition of these practices as science. We argue that this incongruence is a result of how we, as a society, relate to science—how it is defined, talked about, studied, and taught. In short, science is inaccessible and unfamiliar to many people. Most relevant for this commentary is the role that the research community plays in maintaining this status quo through viewing science, technology, engineering, and math (STEM) learning as an acultural and acontextual endeavor. In doing so, researchers are complicit in alienating a large portion of families and their children and in perpetuating an incomplete and biased picture of how children learn and develop scientific understanding.

Sociocultural scholars across disciplines have underscored the fundamental role of culture and context in young children’s learning, and there have been calls for “reimagining disciplinary learning” by breaking down traditional academic silos and recognizing “canon building as a process of exclusion, erasure, and onto-epistemic violence” (as per Warren et al., 2020, p. 277). In applied and basic developmental science research, specifically, constructs and metrics have largely (often implicitly) centered the experiences and practices of dominant cultural groups, mainly US-born European American, monolingual English-speaking, middle-class families. All too often, the resultant knowledge is applied to all children, ignoring the substantial variability in their lived experiences (Medin et al., 2017). Centering learning research on culturally dominant groups perpetuates a view of science universality, manifestly devaluing potential cultural variations in learning processes (Hall et al., 2016). Quite effectively, research has excluded the experiential knowledge of children and families from racially, culturally, and linguistically diverse communities (Bang et al., 2012; Yosso, 2005). Most damaging is that this approach has generated deficit-based narratives about a large portion of children and their families (Spencer, 2021), reflecting and reproducing larger systemic inequities.

To engage in equitable scientific inquiry, therefore, our research efforts must disrupt the devalorization of nondominant families’ knowledge and practices. These efforts need to value and incorporate diverse perspectives, voices, knowledge, and practices into the very constructs and metrics used in the scientific enterprise (Hall et al., 2016; McWayne et al., 2008, 2014). STEM researchers in the education and learning sciences are calling for an expanded set of theories and onto-epistemic heterogeneity, which recognize the legitimate epistemologies of cultural communities historically marginalized, such as Indigenous communities and those in the Global South.

“By onto-epistemic heterogeneity we mean to highlight two key ideas. First, that knowing and being are inextricably tied; and second, that liberatory education ought to be deeply rooted in the pasts, presents, and futures that sustain and imagine multiple values, purposes, and arcs of human learning.

This viewpoint is distinct from equity efforts organized by access paradigms that position the disciplines themselves as settled and exempt from reproach or historicity. In short, greater access to settled forms of disciplinary knowledge is not only insufficient, but functions as the newest form of assimilation and domestication into Western supremacy, perhaps more insidiously through a veneer of liberal inclusion (Melamed, 2011).”—Warren et al., 2020, p. 278.

This point of view necessitates a different approach to knowledge generation than most of us, who have been “brought up” in western schools of thought and disciplinary traditions, espouse. It requires different thinking about how we develop and pose research questions, the people we look to for information, the ways we design research studies, how we interpret and make sense of the resultant information, and how and to whom we disseminate the learning. Yet, one point of fact seems clear—to broaden our conceptualizations of children's scientific thinking and ways of supporting it, we must recognize the power associated with understanding children's STEM learning as inherently embedded within their everyday family and community experiences, lived experiences that are unequivocally contextually and culturally situated (Melzi & McWayne, 2023). Doing so promises to broaden and inform, as well as necessarily complicate, a way forward.

2 | PROBLEMATIZING WHAT WE MEAN BY EQUITY IN STEM

There is considerable agreement among scientists, educators, and policymakers about the need to broaden participation in STEM education to groups typically underrepresented. Yet, as promulgated above, equity requires much more than increasing STEM access for vulnerable groups of children (Montañez, 2023). As Bang et al. (2012) assert, “Deficit discourses operate to control the scope of what constitutes an acceptable [scientific] explanation, argument, or analysis; what ‘smart’ looks and sounds like; whose narratives and experiences are valued and for what purposes...tend[ing] to restrict the intellectual and expressive opportunities youth have in school and thereby reproduc[ing] the privileging of whiteness.” (p. 303). Therefore, it is crucial for researchers concerned with increasing equity to grapple with questions of who gets included in our scientific investigations, who defines what legitimate science is, and who interprets the research findings and determines their applications, including how resulting information shapes the field.

To illustrate, equity scholars in mathematics education have issued calls to reconsider what counts as mathematics and the types of math valued in formal education settings, as these forms are rooted in histories of discrimination and marginalization (Aguirre et al., 2017; Civil, 2016; Gutiérrez, 2018). Although research has identified the rich ways children engage in math in their homes and communities, such as while engaging in household chores or assisting in family businesses (Booker & Goldman, 2016; Civil & Andrade, 2002; Civil & Quintos, 2022; Civil et al., 2008), these experiences are undervalued, or even blamed, for contributing to students' misconceptions (Aguirre et al., 2017; Civil, 2016). Indeed, Civil and Andrade (2002) documented that students who were most successful in math were those who adapted readily to school math practices rather than those who used their home-based experiential knowledge as a springboard. Similarly, family math initiatives for younger children typically focus on predefined standard-based math skills to ensure kindergarten readiness and encourage parent-child engagement practices such as games, play-based activities, or storybooks (e.g., Berkowitz et al., 2015; Eason et al., 2022), which are more common among families from culturally dominant groups (Melzi et al., 2022). Traditional research approaches leave little room for the inclusion of the experiential knowledge and practices of families from nondominant communities to inform both STEM research literature and school curriculum. We argue that this must change for true equity to be attained.



3 | CONTEXT AND MOTIVATION FOR THIS COMMENTARY

In this invited commentary, we use the occasion of the publication of the premiere text, *Constructing science: Connecting causal reasoning to scientific thinking in young children* (MIT, 2022) by authors Deena S. Weisberg and David M. Sobel (2022), as an opportunity to enrich what the *Science Education* readership appreciates about the potential for equity within early childhood STEM education. Specifically, we raise two critical points for the field to continue to grapple with as we investigate ways to engage young minds in STEM learning. First, the authors of this book, as documented across more than a decade, explore systematically and methodically children's process of scientific thinking. The field has gained important insights from this work and the traditions from which it flows. We agree with the authors that it is critical that research with young children focuses on the process of doing science. As the authors state, much research has been focused upon increasing children's science content knowledge rather than promoting young children's understanding of the foundational aspects of scientific thinking/practice. Education researchers, such as Hammer and Elby (2003), have shown how children are making sense of scientific concepts and practices in the naturalistic setting of the classroom. We need more studies that lift up children's thinking for researchers and educators who seek to understand it.

However, one should guard against separating young children from their most proximal learning environments—the early care and education setting and their family/community. Investigations into youngsters' scientific thinking and learning must consider the contexts and the cultural practices reflected therein (Rogoff, 2003). Thus, a second theme we wish to explore with the reader is the idea that the process of scientific thinking and learning are culturally constructed and situated, a point with which many STEM researchers only marginally engage. Far too much foundational developmental science views “cognitive activity as separate from life” (Warren et al., 2020, p. 284). We hope to persuade the reader that this separation operating in much of mainstream science is, at best, providing incomplete knowledge and, at worst, harmful for young children and older students alike, from both dominant and nondominant groups. We must do better at contextualizing children's scientific thinking process as it unfolds in their daily lives—with their peers, families, and in their cultural communities. Their scientific learning does not occur in a vacuum. Yet, by investigating children's scientific thinking as acultural, decontextualized, and displaced, so much important learning is being neglected (Hirst & Vadeboncoeur, 2006). These are not new ideas. Sociocultural theorists and researchers have long been advocating for us to attend to the role context has on learning as “cognition in practice” (Lave, 1988). Yet, mainstream developmental and educational research practices have failed to consistently incorporate this perspective.

It is important to acknowledge our positionality and concede that our work is very much in process—growing and evolving as we engage with and learn from children, families, and educators across diverse ethnocultural communities in the United States and abroad. Christine is a white, monolingual English-speaking, researcher and educator who, though she grew up in a working-class family, would now be considered upper-middle income by most standards today. She has worked for 25 years in low-income Head Start and public-school communities as an applied developmental scientist, with training as a school, community, and clinical child psychologist. Her graduate training in partnership-based, community-engaged research has evolved into a co-constructive, participatory approach in recent years, though the implementation of a full participatory approach is still very much in process. As an educator at New York University and now Tufts University, two elite private institutions in the United States, she has taught courses on research methods, introduction to psychology, family-school connections, early childhood education history and theory, community-based participatory research, and theories of human development from a sociocultural perspective. All of her work has been conducted in communities that are different from her own racially, socioculturally, and often linguistically. This has meant that Christine has needed to partner with cultural informants and guides in her research, working intentionally and diligently to help ensure the voices, perspectives, and conceptualizations of families and communities are centered.

Gigliana is a bicultural and Spanish-English bilingual researcher and educator. She was born and raised in an upper-middle income family in Lima, Peru, and came to the United States to pursue her undergraduate and graduate

studies in psychology. Her experiences as a Latina immigrant to the United States, and as a literacy teacher to Central American immigrant parents from a low-income community in Boston, were critical in inspiring her decision to engage in research that centers and elevates Latine families' ways of thinking and doing. Her empirical work, conducted mostly with Spanish-speaking and bilingual Latine families of preschoolers, uses a sociocultural framework and a collaborative partnership approach to investigate how caregivers support their children's early learning and development. Her work draws from Latine cultural heritage knowledge and practices to forefront families' strengths and challenge implicit deficit-based views about Latine families from immigrant, low-income communities.

Acknowledging the strengths and limitations inherent given our own positionalities, an overarching purpose of this essay is to propose ideas for how the field of early science education could think differently and more expansively about how studies are designed to examine scientific thinking in young children consonant with the two themes outlined in the previous section, with particular emphasis on developing strong collaborations with families and communities. We use our own work and the work of sociocultural and critical researchers to illustrate these two key points.

4 | INTEGRATING THE NOTIONS OF SCIENCE PRACTICES AND LEARNING AS CULTURALLY SITUATED

If science is a set of practices (National Academies of Sciences, Engineering, and Medicine [NAS], 2022) and early STEM learning, as all learning, is culturally situated, then a necessary first step in STEM inquiry is to uncover the STEM knowledge, processes and practices of children and families from culturally and linguistically diverse communities, to both broaden and challenge our current understanding of how children learn science and think scientifically, as well as the “best” practices to support this learning.

The work of Melzi and colleagues on Latine family early literacy practices provides an example of how we can move from research that seeks to identify culturally situated family practices to research intended to apply these practices in preschool classrooms to support children's learning. Traditional research and intervention efforts on early literacy family engagement have generally targeted everyday print-based dyadic practices, in particular caregiver-child storybook reading as the gold standard context for supporting early literacy development. The overreliance on storybooks does not align with the lived experiences of young US Latine children as their families rely frequently on oral practices rather than on book sharing to convey world and community knowledge to their young children (Melzi et al., 2019; Reese, 2012). These efforts also encourage particular ways of reading and engaging with children as best practices for supporting early literacy development that also do not align with the practices in Latine homes. In a series of studies with diverse groups of Latine caregivers (from lower-income immigrant communities in the United States and affluent Spanish monolingual communities in Latin America), Melzi and collaborators (e.g., Caspe, 2009; Caspe & Melzi, 2008; Melzi, 2000; Melzi et al., 2011) showed that, regardless of educational experiences, SES, or nationality, Latine caregivers did not engage in the back-and-forth language exchanges described in the larger literature as best across print-based and oral story interactions. Rather, Latine dyads' discourse features reflected the social roles inherent in the interactions. As such, caregivers encouraged children to assume the role of narrator in the personal oral story context and the role of an engaged audience during book sharing. Interestingly, the language features of caregivers shown to predict early literacy outcomes (i.e., use of questions) were more salient during oral stories as compared to book sharing, underscoring the central role of orality in Latine families (Dyson & Labbo, 2003; Reese, 2012).

Capitalizing on these culturally grounded practices, Melzi and colleagues (Melzi et al., 2018, 2019, 2023; Schick et al., 2023) collaborated with Latine families and early childhood teachers to develop a classroom storytelling program, Reading Success Using Co-Constructive Elaborative Storytelling Strategies (R-SUCCESS) to support foundational reading skills. In a series of studies, they provide empirical evidence for the benefits of drawing from



these culturally informed practices to promote the development of early literacy skills. Melzi et al. (2023), for instance, worked with a local Head Start program serving mostly children from Latine households, and trained half of the teachers in the oral storytelling program, asking them to diversify their regular classroom routines by sharing oral stories they created, whereas the other half of teachers were trained to enhance their storybook reading practices. To assess the effectiveness of the storytelling program, they compared the language environment and narrative skills of children across the two conditions ($n = 185$). Their results showed that, in comparison with children in the storybook reading classrooms, children in the storytelling heard richer language input from teachers and had more developed narrative skills, with respect to productive language and story organization measures. In a follow-up study with 160 Latine public school kindergarten children, Schick et al. (2023) showed that, compared with peers in the business-as-usual classrooms, kindergarteners in R-SUCCESS classrooms showed significantly more growth in their story comprehension skills.

In newer work, Melzi and colleagues (referenced in the introduction, but see Haden et al., 2023) expand this work to STEM domains by examining stories and other oral practices as potential cultural resources for science learning among Latine families. For example, *adivinanzas* (i.e., riddles) are complex rhyming oral puzzles used with children in homes and classrooms across Latin America with the purpose of entertaining them and supporting their learning. For example, a common *adivinanza* for preschool-aged children would be: *cuando llueve y sale el sol, todos los colores los tengo yo* (when it rains and the sun is out, all the colors I have). The adult marks the beginning of the speech event with *Adivina*, *adivinator* (Guess, guesser) followed by the riddle. The child begins offering possible solutions and the adult asks the child to explain why they think it is that solution. Sometimes adults give clues to children to reduce the possibilities and to help them get the right answer (i.e., you find it in the sky). This back-and-forth exchange continues until the child guesses or gets tired. If the child does not guess, then the adult explains why the right answer is *arco iris* (rainbow). Thus, this common oral practice requires children to analyze, infer, identify, interpret, and explain ideas (Montalvo-Castro, 2011), thereby fostering critical and creative skills. Sharing *adivinanzas* is inherently a dialogic collaborative experience between adults and children that includes making guesses and predictions, identifying connections, and considering properties of and causal relations among objects, thereby providing powerful opportunities for talk about science practices (Arreguín-Anderson & Ruiz-Escalante, 2018).

In addition to uncovering practices overlooked because of cultural biases, it is of critical importance to examine assumptions about and biases toward children's learning, especially within STEM (Rogoff et al., 2017). Science learning within dominant developmental paradigms is assumed to be a process that requires activity—the child needs to do. As such, best practices for learning are dominated by an expectation that the adult's role is primarily to provide children the space to engage in this action. Rogoff et al. (2015) who worked in various indigenous communities in Mexico and Central America, as well as with Mexican American communities in California, dispute this paradigm of learning. In these communities, children learn through observation and pitching in (LOPI) through an active process of observing and, once ready, of helping out (without being asked). These cultural differences lead to different ways of enacting collaboration. In contrast, within dominant learning spaces (especially schools), collaboration is conceptualized as “divided roles” to achieve a common goal. In communities that rely on LOPI, collaborative learning is “fluid” and enacted as “shared thinking” (Ruvalcaba & Rogoff, 2022).

Failing to recognize the culturally nuanced ways that children engage in scientific inquiry is consequential for their own and others' learning. In their 2012 paper titled, “Desettling expectations in science education,” Bang et al. (2012) describe how an African American male student distinguishing between living and nonliving things was rebuffed because his thinking was not aligned with the dominant view taught in the mainstream science curriculum of the classroom. In the example, a seventh-grade class is engaging in an activity, where students sort pictures of various objects and organisms into the categories of living and nonliving (a common activity in science curricula, even among our youngest STEM learners). The discussion about the category for the sun is when this student raised a conundrum: if the sun is nonliving, then “how does it help another thing out?,” referring to the fact that flowers need the sun to grow. As the discussion continued, a white female student's analogy to humans needing water, also a nonliving thing according to the traditional paradigm, became the accepted explanation, even when the first student pushed back against this human-water

explanation stating that it raised the exact logical conundrum he had identified. What this teacher failed to acknowledge was the sophistication of this student's thinking about the dynamic relations between the sun and organisms on earth, seeing the overall system as living—a view much deeper and closer to contemporary scientific thinking. It is a poignant example of how students' novel questioning of long-revered explanations gets dismissed in service of upholding a dominant view, and lays bare the potential dire consequences of dismissal for student engagement and advancement of scientific thinking and discovery (Warren et al., 2020).

As the researchers in this study state, “most epistemology research makes the assumption that the epistemologies that students come to classrooms with are inferior, or less productive, compared with the one(s) that researchers and educators are trying to assist students in learning. Some researchers have claimed that successful science education will require students to learn or replace the personal epistemologies they bring with them with an epistemology that is aligned with a Western scientific epistemology” (Bang & Medin, 2010, p. 1015). This is the view against which we are explicitly pushing. However well-intentioned, it is deficit-based. Beginning any scientific inquiry with the premise that certain children are inherently lacking and in need of intervention, we risk harm in the form of epistemological violence. Furthermore, this misses an opportunity to capitalize on the critical knowledge learners bring to the conversation.

Bang and her colleagues have shown the importance of validating and incorporating diverse knowledges and multiple epistemologies in science education. Their stance is a direct pushback to prevailing notions of “folk science” as inherently inferior to academic science as well as to the view that community-derived knowledge is an impediment to learning academic STEM content (Bang & Medin, 2010). These researchers contend that “learning involves more than cognitive processes—identity and affect are intertwined” (p. 1010) and, through their careful studies of Indigenous youth in informal STEM learning settings, have expanded our understanding of the ways diverse epistemologies interplay with students' STEM engagement and cognition.

The examples, thus far, have focused mostly on Pan-Latine and Mexican American populations, as well as Indigenous communities in the United States. In recent collaboration with Head Start programs in the metro Boston area, McWayne and colleagues have set about the work of fostering cultural inclusion in preschool science curricula. The Readiness through Integrative Science and Engineering (RISE) Project (McWayne, Greenfield et al., 2021) includes both direct and indirect engagement with a highly diverse community of Head Start families (see McWayne, Mistry, Brennenman, et al., 2020; McWayne, Mistry, Hyun, et al., 2020), providing an illustration of taking a strengths-based, home-to-school approach (see McWayne et al., 2019) into an experimental research design in which Head Start teachers learned about science-relevant experiences in and around students' homes to incorporate objects and activities familiar to children to support learning of science and engineering concepts. An important contribution of the RISE approach is shifting early childhood educators' role with respect to their work with families, while also challenging negative assumptions about curriculum-relevant resources in children's homes (McWayne et al., 2022). Teachers worked together, and with families, to create learning experiences that built on children's familiar knowledge (see McWayne, Mistry, et al., 2018).

In one classroom, an artifact from everyday life (bamboo) was brought into the classroom curriculum on living and nonliving things. This same material resource was used during engineering design to reinforce the concept of stability. The curriculum happened around community Lunar New Year celebrations, when bamboo is often given as a gift. The teacher encouraged children to represent their observations of “lucky bamboo” using recycled objects, masking tape, and paint. First, children had to understand something about the properties of bamboo. Then, they had to find materials and design the parts for the replica of bamboo; they had to make green paint; they used masking tape to represent the joints in the bamboo stalks. Next, they had to consider how to make a stable structure, so their replicas of the bamboo plant would stand. Children applied their knowledge about stable structures, learned earlier in the school year, to find creative ways to make their bamboo designs stand upright. There were many examples of how children solved this engineering design problem (e.g., using cardboard from single or multiple paper towel and toilet paper rolls or using plastic bowls) to hold the stalks upright.



Through intentional and ongoing joint activities among adults in the RISE project, parents became comfortable and empowered to engage with teachers and share information about their experiences and their communities. In a Parent-Teacher Discussion Group in a Latine-serving Head Start program, parents and teachers shared recipes for soups they made in their homes, which connected to concurrent classroom science and engineering activities concerning states of matter and the cross-cutting concepts of stability and change. The teachers used the activity of making a culturally familiar soup with the children to learn together how vegetables and water change during the cooking process—vegetables get softer and can change color, whereas the water goes from cool to boiling and changes form as it goes from liquid into steam. Highlighted over these activities was the parents' knowledge. They contributed expertise to the curriculum, representing a different approach to parental engagement—not just as a reinforcer of what happens within the curriculum but also as a generator of curriculum implemented in classrooms. The RISE Project has reframed early STEM education across ethnoculturally diverse, low-income communities by:

- (1) assuming that rich sources of knowledge and practice reside in children's homes and cultural communities, and
- (2) co-creating with educators and families rich and meaningful STEM learning experiences that build on children's familiar knowledge.

What started out seeming like an insurmountable obstacle to overcome for many of our teachers—how to be inclusive of so many different children's and families' experiences—brought us all to a place of creativity in our family outreach and recognition that being inclusive is primarily about fostering a sense of belonging among children. This begins with both acknowledging and demonstrating to them, in very concrete ways, that what they already know and are familiar with is worthy of classroom discourse and are resources to support their science learning.



5 | APPLYING THESE PERSPECTIVES IN EARLY CHILDHOOD SCIENCE EDUCATION PRACTICE AND RESEARCH

Applying sociocultural and critical perspectives to this work foregrounds the need for researchers and practitioners to gain an insider understanding of how families and communities construct their roles and share their knowledge and values with children within science learning (McWayne et al., 2022). Importantly, however, culturally inclusive STEM inquiry necessitates more than diversifying our study samples. It also requires more than increasing sensitivity to the views of families and children historically excluded from foundational research. It requires self-reflection and recognition that educators and researchers are cultural beings with beliefs, values, and experiences, which inevitably shape learning. As researchers we must grapple with the hidden assumptions that guide the questions we ask, whom we access and include in our work, the methods we choose, the interventions we design, and the interpretations of our findings. Inclusiveness also requires interrogation of what is normative in both classrooms and research. Too often, educational processes default to the dominant values, beliefs, and practices. Viewing educational settings and learning processes as sociocultural spaces will help us avoid such cognitive biases and equity traps (McKenzie & Scheurich, 2004), even as we are more deliberate about examining our implicit frames of reference (Pufall-Jones & Mistry, 2010).

The tendency to equate effective learning with adopting the norms and practices of schools runs counter to principles of inclusive academic excellence. Importantly, how we interact with children who are perceived as violating norms has profound implications for their participation and development around science (Bang et al., 2012). A preschooler using a culturally familiar form of storytelling that deviates from mainstream education norms, might be viewed as in need of remediation or be sanctioned for their inappropriate behavior. An educator in an inclusive preschool classroom notices and values various storytelling traditions, as well as seeks to build bridges across home and school. Likewise, an inclusive researcher would seek to document and understand unfamiliar practices to provide the field with an expanded view of successful learning.

A small but growing community of researchers are reimagining science education that is inclusive of nondominant normative family practices and honors multiple ways of knowing across ethnoculturally diverse families to codevelop classroom learning experiences. Further, such culturally sustaining dispositions are informing research designs to build on cultural heritage, family strengths, and children's familiar knowledge. Taking such an approach centers a community's values and practices in creating the descriptions that will then be used in the research process (McWayne & Melzi, 2014). Bang et al. (2012) implore us to "[imagine] multivoiced meanings of core phenomena as open territory for sense-making in the science classroom, similar to the kinds of meaning-making opportunities that are available to scientists in the field" (p. 308). Privileging "insider" perspectives in our frameworks, constructs, measures, and methods is not a new idea (see Berry, 1969; Jahoda, 1977), but it is grossly underutilized as a strategy for increasing the potential contributions of our research. To successfully build bridges across diverse knowledge bases and lived experiences and to create culturally inclusive educational settings and research spaces, "we must adopt conceptual frameworks and methods that make visible what is currently invisible" (McWayne et al., *in press*, p. TBD). In the words of Warren et al. (2020):

"[t]here is an undercurrent of extending what the field has learned to date that combines with an urgency to generate understandings and practices that inform science education in ways that are more inclusive and participatory. We also see educators taking up the [STEM] disciplines as open, living entanglements with historical, present, and future heterogeneities. They wrestle with settled disciplinary namings and framings to change the terms of the conversation and engage critically with the political and intellectual histories that have shaped them. Their efforts to conjure new language and new worlds reverberate at multiple scales at once locally meaningful and world-making" (p. 290).



So, then, where do we go from here? What do we recommend for early childhood science education? How can we make our approaches to science accessible, so families see the science already present in their everyday lives? Below, we use learnings from our own and others' work as illustrations for how to reconceive research designs to uncover culture-contextualized knowledge and practices relevant for understanding the nature of young children's science learning as it unfolds within their rich cultural and social contexts.

6 | RECOMMENDATIONS FOR MORE CULTURALLY INCLUSIVE STEM EDUCATION RESEARCH

For the remainder of this essay, we propose opportunities for future researchers to focus their efforts. First, to foster more effective science learning, the field would benefit from more multidisciplinary work. During a Presidential Panel discussion at the 2023 Biennial Meeting of the Society for Research on Child Development, a group of scholars representing different methodological traditions, disciplines, and racial/ethnic backgrounds discussed the future of the developmental sciences with particular emphasis on how we can better reflect the diversity of knowledges and lived experiences represented. Bringing together people with different theoretical, methodological, and disciplinary lenses generated a vibrant conversation among the panel and the audience. In a related response to the need for more synthesis across fields, a recent call has invited papers in the *Review of Research in Education* special issue, "The science of learning and development", Eds. Vivian Gadsden (General Editor), David Osher (General Editor), Carol D. Lee (Editor, Volume 2023), and Richard Lerner (Editor, Volume 2023). This special issue promises insights "on how we can examine the affordances of cultural variation in terms of learning in academic content areas, within and across different settings, from schools to community settings, families, and extended social networks." We look forward to the conversation this special issue will inspire.

There is still much to do to design more just learning environments for young children's STEM inquiry and it can begin with understanding how our theoretical and design traditions could be reconfigured in the service of educational equity. We need to talk with each other and allow the boundaries between our intellectual traditions to be more permeable. What would it look like for the field if cognitive psychologists collaborated more consistently on experimental research designs with sociocultural and critical ethnographic education researchers? What would it mean if ethnographers more regularly collaborated on the design of large, national studies concerning STEM education and career pipelines? What potentially powerful studies could emerge!

In addition to the need for more synthesis across disciplines and methodological traditions, the second opportunity we propose to science education researchers is to diversify our investigative teams such that cultural insiders are full participants. This aligns with participatory approaches to research in the social and health sciences (Wallerstein & Duran, 2018). In creating an emically derived, culture-contextualized measure of family engagement in preschool children's education based on parents' own conceptualizations, McWayne, Melzi, and colleagues (2013, 2014, 2016, 2018) captured important within-group variability in low-income Latine/x families' role construction and engagement behaviors. Further, by taking a home-to-school approach (McWayne et al., 2019), they provided the field with a new lens for informing family-school connections in support of Latine/x preschool children's educational success. The series of studies conducted not only provided culturally relevant dimensions of family engagement for the field, but also provided an example for how researchers can better incorporate families' own words and funds of cultural knowledge directly into large-scale, empirical study.

Yet another example comes from the Head Start research collaboration, Project PEARLS (McWayne, Mattis et al., 2016), rooted in a foundational understanding that Black parents are the experts on Black parenting. To center parents' experience, these researchers worked against the all-too common traditions of surveillance that position families as objects of study. They embraced the humility of a partnership model where Black Head Start Directors, Black parents, Black scholars, and Black research team members co-created every aspect of the work. The work on a parent-child observational measure (Kumari et al., 2021) began with a 10 min videotaped interaction

between parents and their preschool-aged children. The research team then asked parents to sit with them to review and analyze the videos, so that the researchers could understand their parenting intentions, choices, and successes through their eyes. Using the narratives from the review sessions, the team then identified together more granular information about the various styles with which parents enacted each parenting practice (e.g., in the context of physical play, structured play, inventive play). The result of this approach was a parent-derived observational measure that offers a complex picture of positive Black parenting that attends to the domains and manifestations of behaviors that matter to parents, and that use the heuristics they employ to discern what positive parent-child interactions look like from their perspectives. Clearly, more diverse samples in early childhood STEM research are needed, including more expansive and participatory within-group work with nondominant groups.

We also need more descriptive studies focusing on the everyday experiences in children's lives that promote the development of scientific thinking and practices, as well as the diverse ways (doing, talking, observing, collaborating) in which children are encouraged to learn about science topics and encouraged to engage in science practices (Rogoff, 2017). As Bang and Medin (2010) called for, based on their work with Indigenous education communities, "there is serious work and opportunity at the level of design and moment-to-moment classroom interactions that have yet to receive the close study they demand" (p. 1013). Moreover, the use of emic approaches could also uncover how families define science, what it means to them, and how science-related knowledge is transmitted in their family and community. Depicting families' everyday science knowledge and practices will generate the foundational knowledge needed to decenter the dominant lenses we currently use to define and approach the study of science. This knowledge can also guide the development of culturally informed measures of science family engagement, as well as, children's skills, a necessary step to move inquiry beyond description.

Finally, there are important opportunities for practice-informed research. In the RISE Project, for example, McWayne and colleagues have sought to understand how teachers (especially those from minoritized groups) think about science exploration in preschool by asking: how can we better support teachers to leverage their own lived experiences and funds of knowledge (Hong, 2019)? In research focused on these same preschool teachers of STEM, Mistry et al. (2023) in a qualitative, partnership-based study advance the field's understanding about what it takes to create the conditions for paradigm shifts in teachers' thinking about how to engage families' funds of knowledge (and children's familiar knowledge) into classroom curriculum. Melzi and colleagues also described lessons learned from their work with teachers on incorporating Latine family narrative styles—representing a strikingly different approach to creating intervention—one that centers families' practices with their young children while being responsive to teachers' ecologies in urban schools. These lessons from working closely with teachers have informed the future of the R-SUCCESS program of research (see McWayne et al., 2022).

7 | CONCLUDING THOUGHTS

It is humbling to consider how we might take to scale in public educational settings the rich ideas from critical and ethnographic traditions that have influenced us. Initial results from our own work show the possibilities and, most importantly, the potential for positive impact on teaching young children science. The obstacles are also real, especially in relation to representation. Most teachers in the U.S. are white and monolingual and do not mirror the racial/ethnic composition of the diverse student population they serve. This problem of compositional representation and ethnic/racial mismatch between students and teachers begins early. Although less than half (44%) of children in Head Start are White, more than half (62%) of their teachers are (Office of English Language Acquisition [OELA], 2020). A growing body of research is showing us that cultural/ethnic match matters, both for student engagement and school success (e.g., Easton-Brooks, 2019), as well as for family engagement in their children's early school experiences (e.g., Mundt et al., 2015).

Importantly, even when teachers have common racial/ethnic backgrounds to their students, they are vulnerable to perpetuating mainstream ideologies since they were professionally trained in systems that were



formed by and continue to rely upon dominant ideologies and approaches. Researchers acknowledge that equity efforts organized by “access paradigms” function as the newest form of assimilation into Western White supremacy (Warren et al., 2020). Therefore, teachers might not know how to identify and incorporate STEM-relevant practices of minoritized groups; they need specific supports for doing so (McWayne, Mistry, et al., 2018). Representation is about more than compositional diversity and ethnic matching between teachers and their students. It is fundamentally about belonging. The fact of the matter is that our dominant paradigms (lenses) do not work for everyone. They are not reflective of the lived experiences of many children and families, and there is a warranted and undeniable call in our field to do better.

We have to dismantle preconceived ideas about how to study early STEM-related development and learning (Melzi & McWayne, 2023) by reframing our understanding of children and families from nondominant communities. Specifically, we must abandon assumptions about learning gaps and underperformance, and steer away from interventions that aim to “fix” families and children (Adair, 2019). Instead, we need to see the STEM-based knowledge and practices of children and families from traditionally and historically marginalized cultural groups as legitimate. Future directions for ensuring cultural inclusion and equity in early science education research and practice must continue to call out and work to disrupt deficit-based narratives by including critical theoretical perspectives and participatory methodological approaches that bring together the expertise of families, educators, and researchers (Adair, 2019; Doucet, 2019; Kirkland, 2019). Researchers must attend to the “...ways [that] dominant-culture communication (re)produces marginalization of disenfranchised populations... [and] prevent[s] people's experiences from being seen as valid” (Wallerstein & Duran, 2018, p. 56).

As basic and applied developmental researchers, we can resist the tendency to accept mainstream knowledge construction paradigms that fail to respect the lived experiences of minoritized children and families and make room for different perspectives to guide our work. We have much to gain by doing so. Together, the specific studies highlighted throughout this essay seek to document and promote family, community, and teaching practices that are effective for supporting young children's learning and explorations in STEM across our increasingly diverse society. A culturally inclusive approach to research and practice holds great promise for creating truly equitable STEM inquiry and pedagogical efforts in early childhood (NAS, 2022).

ORCID

Christine M. McWayne  <https://orcid.org/0000-0001-8885-856X>

REFERENCES

- Adair, J. K. (2019). The role of humility in working with families across international contexts. In C. M. McWayne, S. M. Sheridan, & F. Doucet (Eds.), *Family-school partnerships in international contexts and implications for research in ethnocultural communities in the United States* (pp. 109-122). Springer Publishers. https://doi.org/10.1007/978-3-030-14957-4_1
- Aguirre, J., Herbel-Eisenmann, B., Celedón-Pattichis, S., Civil, M., Wilkerson, T., Stephan, M., Pape, S., & Clements, D. H. (2017). Equity within mathematics education research as a political act: Moving from choice to intentional collective professional responsibility. *Journal for Research in Mathematics Education*, 48(2), 124-147. <https://www.jstor.org/stable/10.5951/jresmetheduc.48.2.0124>
- Arreguín-Anderson, M. G., & Ruiz-Escalante, J. A. (2018). Adivinanzas and dichos: Preparing prospective educators to teach science by incorporating culturally responsive tools. *Journal of Latinos and Education*, 17, 84-91. <https://doi.org/10.1080/15348431.2016.1257427>
- Bang, M., & Medin, D. (2010). Cultural processes in science education: Supporting the navigation of multiple epistemologies. *Science Education*, 94, 1008-1026. <https://doi.org/10.1002/sce.20392>
- Bang, M., Warren, B., Rosebery, A. S., & Medin, D. (2012). Desettling expectations in science education. *Human Development*, 55, 302-318. <https://doi.org/10.1159/000345322>
- Berkowitz, T., Schaeffer, M. W., Maloney, E. A., Peterson, L., Gregor, C., Levine, S. C., & Beilock, S. L. (2015). Math at home adds up to achievement in school. *Science*, 350(6257), 196-198. <https://www.science.org/doi/10.1126/science.aac7427>
- Berry, J. W. (1969). On cross-cultural comparability. *International Journal of Psychology*, 4, 119-128.

- Booker, A., & Goldman, S. (2016). Participatory design research as a practice for systemic repair: Doing hand-in-hand math research with families. *Cognition and Instruction*, 34(3), 222-235. <https://doi.org/10.1080/07370008.2016.1179535>
- Caspe, M. (2009). Low-income Latino mothers' booksharing styles and children's emergent literacy development. *Early Childhood Research Quarterly*, 24(3), 306-324. <https://doi.org/10.1016/j.ecresq.2009.03.006>
- Caspe, M., & Melzi, G. (2008). Spanish-speaking Latin American mother-child narrative discourse. In A. McCabe, A. Bailey, & G. Melzi (Eds.), *Spanish-language narration and literacy: Culture, cognition, and emotion* (pp. 6-33). Cambridge University Press.
- Civil, M. (2016). STEM learning research through a funds of knowledge lens. *Cultural Studies of Science Education*, 11(1), 41-59. <https://doi.org/10.1007/s11422-014-9648-2>
- Civil, M., & Andrade, R. A. (2002). Transitions between home and school mathematics: Rays of hope amidst the passing clouds. In G. de Abreu & N. C. Presmeg (Eds.), *Transitions between contexts of mathematical practices* (pp. 149-169). Springer.
- Civil, M., Díez-Palomar, J., Menéndez-Gómez, J. M., & Acosta-Irui, J. (2008). Parents' interactions with their children when doing mathematics. *Adults Learning Mathematics: An International Journal*, 3(2a), 41-58.
- Civil, M., & Quintos, B. (2022). Mothers and children doing mathematics together: Implications for teacher learning. *Teachers College Record: The Voice of Scholarship in Education*, 124(5), 13-29. <https://doi.org/10.1177/01614681221105008>
- Doucet, F. (2019). *Centering the margins: Re(defined) useful research evidence through critical perspectives*. William T. Grant Foundation. <https://wtgrantfoundation.org/library/uploads/2019/12/Fabienne-Doucet-2019-WTG-Digest.pdf>
- Dyson, A. H., & Labbo, L. D. (2003). Popular literacies and the "all" children: Rethinking literacy development for contemporary childhoods. *Language Arts*, 81(2), 100.
- Eason, S. H., Scalise, N. R., Berkowitz, T., Ramani, G. B., & Levine, S. C. (2022). Widening the lens of family math engagement: A conceptual framework and systematic review. *Developmental Review*, 66, 101046. <https://doi.org/10.1016/j.dr.2022.101046>
- Easton-Brooks, D. (2019). *Ethnic matching: Academic success of students of color*. Rowman & Littlefield.
- Gutiérrez, R. (2018). Political conocimiento for teaching mathematics. In S. E. Kastberg, A. M. Tyminski, A. E. Lischka, & W. B. Sánchez (Eds.), *Building support for scholarly practices in mathematics methods* (pp. 11-37). Information Age Publishing.
- Haden, C. A., Melzi, G., & Callanan, M. (2023). Science in stories: Implications for Latine children's science learning through home-based language practices. *Frontiers in Psychology*, 14, 1096833. <https://doi.org/10.3389/fpsyg.2023.1096833>
- Hall, G. C. N., Yip, T., & Zárate, M. A. (2016). On becoming multicultural in a monocultural research world: A conceptual approach to studying ethnocultural diversity. *American Psychologist*, 71(1), 40-51. <https://doi.org/10.1037/a0039734>
- Hammer, D., & Elby, A. (2003). Tapping epistemological resources for learning physics. *Journal of the Learning Sciences*, 12, 53-90.
- Hirst, E., & Vadeboncoeur, J. A. (2006). Patrolling the borders of otherness: Dis/placed identity positions for teachers and students in schooled spaces. *Mind, Culture, and Activity*, 13(3), 205-227.
- Hong, S. (2019). *Natural allies: Hope and possibility in teacher-family partnerships*. Harvard Education Press.
- Jahoda, G. (1977). In pursuit of the emic-etic distinction: Can we ever capture it? In Y. H. Poortinga (Ed.), *Basic problems in cross-cultural psychology* (pp. 55-63). Swetz and Zeitlinger B.V.
- Kirkland, D. (2019). *No small matters: Reimagining the use of research evidence from a racial justice perspective*. William T. Grant Foundation. <https://wtgrantfoundation.org/library/uploads/2019/12/David-E.-Kirkland-2019-WTG-Digest.pdf>
- Kumari, S., Mattis, J., Diemer, M., McWayne, C., & Smith-Bynum, M. (2021). August emic observational measure of positive parenting among Black, urban-residing, low-income families. *Poster presented at the American Psychological Association*. Virtual Conference.
- Lave, J. (1988). *Cognition in practice: Mind, mathematics and culture in everyday life*. Cambridge University Press.
- McKenzie, K. B., & Scheurich, J. J. (2004). Equity traps: A useful construct for preparing principals to lead schools that are successful with racially diverse students. *Educational Administration Quarterly*, 40(5), 601-632.
- McWayne, C. M., Doucet, F., & Mistry, J. (2019). Family-school partnerships in ethnocultural communities: Redirecting conceptual frameworks, research methods, and intervention efforts by rotating our lens. In C. M. McWayne, F. Doucet, & S. Sheridan (Eds.), *Research on family-school partnerships: Ethnocultural diversity and the home-to-school link* (pp. 1-18). Springer Publishers.
- McWayne, C. M., Foster, B., & Melzi, G. (2018). Culturally embedded measurement of Latino caregivers' engagement in head start: A tale of two forms of engagement. *Early Education and Development*, 29(4), 540-562.
- McWayne, C. M., Greenfield, D., Zan, B., Mistry, J., & Ochoa, W. (2021). A comprehensive professional development approach for supporting science, technology, and engineering curriculum in preschool: Connecting contexts for dual language learners. In S. T. Vorkapić & J. LoCasale-Crouch (Eds.), *Supporting children's well-being during the early childhood transition to school* (pp. 222-253). IGI Global.



- McWayne, C. M., Mattis, J. S., Green, L. E., Limlingan, M. C., & Harris, E. (2016). An emic, mixed-methods approach to defining and measuring positive parenting among low-income Black families. *Early Education and Development*, 28(2), 182-206. <https://doi.org/10.1080/10409289.2016.1208601>
- McWayne, C. M., Mattis, J. S., Ochoa, W., & Li, L. (In press). Bridging divides and making visible the invisible: Connecting parents, children, and teachers through cultural inclusion. In C. M. McWayne & V. L. Gadsden (Eds.), *Early Childhood Research for Educational Equity: Family-School-Systems Connections*. Paul H. Brookes.
- McWayne, C. M., & Melzi, G. (2014). Family engagement in children's preschool experiences among low-income Latino caregivers: The validation of a culture-contextualized measure. *Journal of Family Psychology*, 28, 260-266.
- McWayne, C. M., Melzi, G., Limlingan, M. C., & Schick, A. (2016). Ecocultural patterns of family engagement among low-income Latino families of preschool children. *Developmental Psychology*, 52(7), 1088-1102.
- McWayne, C. M., Melzi, G., & Mistry, J. (2022). A home-to-school approach for promoting culturally inclusive family-school partnership research and practice. *Educational Psychologist*, 57(4), 238-251. <https://doi.org/10.1080/00461520.2022.2070752>
- McWayne, C. M., Melzi, G., Schick, A. R., Kennedy, J. L., & Mundt, K. (2013). Defining family engagement among Latino head start parents: A mixed-methods measurement development study. *Early Childhood Research Quarterly*, 28, 593-607.
- McWayne, C. M., Mistry, J., Brennenman, K., Greenfield, D., & Zan, B. (2018). Culturally embedded measurement of Latino caregivers' engagement in Head Start: A tale of two forms of engagement. *Early Education and Development*, 29(4), 540-562.
- McWayne, C. M., Mistry, J., Brennenman, K., Zan, B., & Greenfield, D. B. (2020). A model of co-construction for curriculum and professional development in head start: The Readiness through Integrative Science and Engineering (RISE) approach. *Teachers College Record: The Voice of Scholarship in Education*, 122(11), 1-46.
- McWayne, C. M., Mistry, J., Hyun, S., Diez, V., Parker, C., Zan, B., Greenfield, D., & Brennenman, K. (2020). Incorporating knowledge from children's homes and communities: A home-to-school approach for teaching STEM in preschool. *Young Children*, 75(5), 20-26.
- McWayne, C. M., Owsianik, M., Green, L. E., & Fantuzzo, J. W. (2008). Parenting behaviors and preschool children's social and emotional skills: A question of the consequential validity of traditional parenting constructs for low-income African Americans. *Early Childhood Research Quarterly*, 23, 173-192.
- Medin, D., Ojalehto, B., Marin, A., & Bang, M. (2017). Systems of (non-)diversity. *Nature Human Behaviour*, 1(5), Article 0088. <https://doi.org/10.1038/s41562-017-0088>
- Melzi, G. (2000). Cultural variations in the construction of personal narratives: Central American and European American mothers' elicitation styles. *Discourse Processes*, 30(2), 153-177. https://doi.org/10.1207/S15326950DP3002_04
- Melzi, G., & McWayne, C. (2023). Introduction to building from strengths: Culturally situated early STEM learning. *Journal of Applied Developmental Psychology*, 86, 101543. <https://doi.org/10.1016/j.appdev.2023.101543>
- Melzi, G., Mesalles, V., Caspe, M., & Prishker, N. (2022). Spatial language during a household task with bilingual Latine families. *Journal of Applied Developmental Psychology*, 80, 101409. <https://doi.org/10.1016/j.appdev.2022.101409>
- Melzi, G., Schick, A., & Scarola, L. (2019). Intervention that promotes home-to-school links for ethnoculturally diverse families. In C. M. McWayne, F. Doucet, & S. M. Sheridan (Eds.), *Research on family-school partnerships: Understanding ethnocultural diversity and the home-to-school link*. Springer.
- Melzi, G., Schick, A., & Scarola, L. (2018). Building bridges between home and school for Latinx families of preschool children. Supporting young children of immigrants in PreK-3 [Special Issue]. *Bank Street Occasional Papers Series*, 2018, 39.
- Melzi, G., Schick, A. R., & Kennedy, J. L. (2011). Narrative elaboration and participation: Two dimensions of maternal elicitation style: Narrative elaboration and participation. *Child Development*, 82(4), 1282-1296. <https://doi.org/10.1111/j.1467-8624.2011.01600.x>
- Melzi, G., Schick, A. R., & Wuest, C. (2023). Stories beyond books: Preschool teachers' use of oral stories supports children's early literacy skills. *Early Education and Development*, 34, 485-505. <https://doi.org/10.1080/10409289.2021.2024749>
- Mistry, J., Segovia, J., Li, L. W., McWayne, C., Zan, B., & Greenfield, D. (2022). "I woke up to science": Teacher narratives of growth in a culturally sustaining preschool STEM program. *Journal of Applied Developmental Psychology*, 83, 101456. <https://doi.org/10.1016/j.appdev.2022.101456>
- Montalvo-Castro, J. (2011). Audiovisual riddles to stimulate children's creative thinking. *Comunicar*, 18(1), 123-130. <https://doi.org/10.3916/C36-2011-03-03>
- Montañez, S. R. (2023). Advancing equity through research: The importance of asset-based approaches and methods. *Journal of Applied Developmental Psychology*, 86, 101540. <https://doi.org/10.1016/j.appdev.2023.101540>
- Mundt, K., Gregory, A., Melzi, G., & McWayne, C. M. (2015). The influence of ethnic match on Latino school-based family engagement. *Hispanic Journal of Behavioral Sciences*, 37(2), 170-185. <https://doi.org/10.1177/0739986315570287>

- National Academies of Sciences, Engineering, and Medicine. (2022). *Science and engineering in preschool through elementary grades: The brilliance of children and the strengths of educators*. The National Academies Press. <https://doi.org/10.17226/26215>
- Office of English Language Acquisition (OELA). (2020). *Head start enrollment*. https://ncela.ed.gov/files/fast_facts/19-0108_DeL4.4_HeadStart_021220_508.pdf
- Pufall-Jones, E., & Mistry, J. (2010). Navigating across cultures: Narrative constructions of lived experience. *Journal of Ethnographic & Qualitative Research*, 4(3), 151-167.
- Reese, L. (2012). Storytelling in Mexican homes: Connections between oral and literacy practices. *Bilingual Research Journal*, 35, 277-293. <https://doi.org/10.1080/15235882.2012.734006>
- Rogoff, B. (2003). *The cultural nature of human development*. Oxford University Press.
- Rogoff, B., Coppens, A. D., Alcalá, L., Aceves-Azuara, I., Ruvalcaba, O., López, A., & Dayton, A. (2017). Noticing learners' strengths through cultural research. *Perspectives on Psychological Science*, 12(5), 876-888.
- Rogoff, B., Mejía-Arauz, R., & Correa-Chávez, M. (2015). A cultural paradigm—Learning by observing and pitching in. *Advances in Child Development and Behavior*, 49, 1-22. <https://doi.org/10.1016/bs.acdb.2015.10.008>
- Ruvalcaba, O., & Rogoff, B. (2022). Children's fluid collaboration versus managing individual agendas: Cultural differences in pair programming. *Journal of Applied Developmental Psychology*, 81, 101438. <https://doi.org/10.1016/j.appdev.2022.101438>
- Schick, A., Wuest, C., Lim, R., & Melzi, G. (2023). Supporting preschool teachers' use of culturally grounded practices: Factors that influence program fidelity. *Journal of Early Childhood Teacher Education*, 1-22. <https://doi.org/10.1080/10901027.2023.2223143>
- Spencer, M. B. (2021). Acknowledging bias and pursuing protections to support anti-racist developmental science: Critical contributions of phenomenological variant of ecological systems theory. *Journal of Adolescent Research*, 36(6), 569-583. <https://doi.org/10.1177/07435584211045129>
- Wallerstein, N., & Duran, B. (2018). Theoretical, historical, and practice roots of CBPR. In N. Wallerstein, B. Duran, J. G. Oetzel, & M. Minkler (Eds.), *Community-based participatory research for health: Advancing social and health equity* (pp. 52-64). Jossey-Bass.
- Warren, B., Vossoughi, S., Rosebery, A. S., Bang, M., & Taylor, E. V. (2020). Multiple ways of knowing: Re-imagining disciplinary learning. In *Handbook of the cultural foundations of learning* (pp. 277-294). Taylor Francis. <https://doi.org/10.4324/9780203774977-19>
- Weisberg, D. S., & Sobel, D. M. (2022). *Constructing science: Connecting causal reasoning to scientific thinking in young children*. The MIT Press.
- Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race, Ethnicity and Education*, 8(1), 69-91. <https://doi.org/10.1080/1361332052000341006>

How to cite this article: McWayne, C. M., & Melzi, G. (2023). Young children co-constructing science: The importance of their families and cultural communities. *Science Education*, 1-15. <https://doi.org/10.1002/sce.21823>