Engaged Second Language Research: Studying Stakeholders’ Perspectives on Preschool DLLs’ Science and Language Learning

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1. Introduction

Over the past 15 years, researchers, practitioners, and policy makers in the U.S. have paid increasing attention to dual language learners (DLLs), children who are birth to 6 years old who are still in the process of acquiring basic language skills in their home language(s) while at the same time acquiring English as an additional language. This interest is motivated in part by demographic shifts in that the population of children entering school in the United States who are growing up with two or more languages has increased 40% since the turn of the millennium, and nearly a third of all children participating in Head Start are DLLs (Espinosa, 2013; Park, Zong, & Batalova, 2018). In turn, research in this area is concerned with equity, seeking to understand and address the persistent differences between DLLs and their English-speaking monolingual peers in terms of school readiness and academic achievement. Thus, a focus on early learning environments and the experiences provided for DLLs are a key concern (Espinosa, 2013; Gutiérrez et al., 2010).

For many years, research on DLLs has primarily centered on bilingual settings, particularly Spanish-English, and has been concentrated in traditional immigrant-receiving states such as California, Florida, New Jersey, and Texas. Although research on some dual language educational contexts has gained clarity in recent years (Umansky & Reardon, 2014; Thomas & Collier, 2012), diversity has continued to rise across the country, often under superdiverse conditions where demographic change is simultaneously rapid, multifaceted, and prone to year-to-year shifts, leading to a need for research in a wider range of settings, with more diverse populations, and in classrooms where multiple languages and cultures are represented (Park, Zong, & Batalova, 2018).

In this article we describe and present preliminary findings from a research project that examines early science learning environments and experiences for DLLs and their families from diverse linguistic and cultural backgrounds who are living in Central Ohio. The Expanding Repertoires of Practice project is a collaboration between researchers at The Ohio State University (OSU) and informal science educators at the Center of Science and Industry (COSI). This museum-university partnership, funded by a National Science Foundation Advancing Informal STEM Learning (AISL) Pathways grant (DRL #1420724), was formed to begin the work of systematically studying museum programs and practices for preschool DLLs, their families, and the community organizations and early childhood education (ECE) professionals who serve them. The partnership also includes local ECE providers, seven other museums and their community partners who are engaged in innovative work with preschool DLLs, and two key professional organizations, the Association of Children's Museums (ACM) and the Association of Science-Technology Centers (ASTC).

This pairing of preschools and science centers/children’s museums is intentional in that both institutions have significant assets and knowledge to address the separate but related issues of simultaneously supporting DLLs and advancing science learning. On the one hand, science centers and children’s museums are seeking to engage more effectively with children and families who have a primary language other than English (ASTC Dimensions, 2009) at the same time that they expand their...
traditional focus on the K-12 age ranges to include preschool children and support school readiness (ASTC Dimensions, 2004). On the other hand, early childhood education contexts are also seeking to support DLLs in addition to developing science, technology, education, and math (STEM) skills and dispositions in preschool. However, these trends, both in IS and early childhood, face significant gaps in the relevant knowledge bases that could inform their practices. To date, research on science education for English language learners has focused on children in third grade and older, and there is very little published research on science education for preschool DLLs (Moore & Smith, 2015). Thus, practitioners of (and authors of practitioner-oriented publications on) science education for young DLLs must extrapolate from research on first-language early childhood science education, science education for linguistically diverse K-12 students, and English language and literacy development for children learning English as an additional language (also mostly K-12). This gap in the research leaves science centers and children's museums without a firm research base on which to build their programs and practices for improving informal science learning experiences and school readiness for preschool DLLs.

The Expanding Repertoires is an attempt to address these gaps through engaged second language research, by which we mean investigations conducted in real-life contexts and informed by direct dialogue and collaboration between university-based researchers and community partners to expand our understanding of second language learning-teaching processes. This approach has great promise to narrow the gap between scientific research and direct benefit to community partners as they address critical issues, promote the sharing and development of knowledge and skills among participants, and lead to improved, evidence-based practices. Moreover, engaged research is on the rise in U.S., and there is increasing support from universities and funding agencies for such work (National Science Foundation, 2015).

In this article, we begin by discussing the intersection of efforts to support DLLs as well as promote early science learning in informal science and ECE environments. Then, we define an overarching theoretical and demographic construct, superdiversity, that is relevant to Central Ohio specifically and complicates the issues our partners are addressing. Next, we present the overall study methods and data corpus before turning to some preliminary results drawing on the perspectives of DLL caregivers experiencing both informal science and ECE contexts and, on the perspectives of informal science and ECE staff who, amongst their various concerns, are seeking to support DLL families language and science learning. We then present an example of interactional data from video-recordings of one ECE center’s visit to COSI, thus putting these two contexts and concerns into direct conversation. The article concludes with a discussion of the various ways these perspectives and contexts inform and support each other while also acknowledging that certain gaps remain in meeting the goals of these communities.

2. Theoretical background: DLLs, early science learning, and superdiversity

In this article, we employ the label dual language learner because it is specific to young children and widely used in ECE settings and by national organizations such as Head Start and the National Association for the Education of Young Children. Using this term signals that DLL children as potentially bi- or multilingual, rather than simply lacking English language proficiency with other often used labels such as Limited English Proficient or English Language Learner. Moreover, this term supports the manifold family assets available to support children’s education through home language and cultural practices.

Indeed, it is important to keep in mind that these children are not only using and learning (in) more than one language, but also participating in more than one cultural community. A child brings to museums and other educational settings not only the language(s) learned at home, but also knowledge and strategies for learning that are valued and practiced in his/her family and home community. Recognition, appreciation, and incorporation of these linguistic and cultural resources into institutional practice are key to providing equitable learning opportunities (Lee & Buxton, 2010; Rosebery & Warren, 2008). More specifically, schools and their community partners, including science centers/children's museums, need to expand their repertoires of practice in order to work more effectively with preschool DLLs and their families.

In turn, early science learning is an important goal across these contexts, often embedded in controversial notions of “school readiness.” We agree with the National Association for the Education of Young Children (NAEYC, 2009) position statement that the concept of school readiness includes
much more than children's social-emotional, physical, and cognitive readiness to perform kindergarten work. Science knowledge and process skills are important components of school readiness, as are the dispositions central to scientific inquiry, including persistence, creativity, communication, cooperation, and curiosity. Early childhood science education is important for the development of scientific thinking and positive attitudes toward science, enhanced concept development as a result of scientific language use, and increased understanding of science concepts at a later age (Brenneman, Stevenson-Boyd, & Frede, 2009; French, 2004). High quality early childhood science education may also contribute to other domains of school readiness; for example, researchers on the NSF-funded project ScienceStart! found that using science as a curriculum base for preschool students led to significant gains in language and literacy for those students (French, 2004).

Thus, the Expanding Repertoires project examines the roles that science centers and children's museums and ECE contexts play—and have the potential to play—in supporting and increasing school and science readiness for DLLs. Science centers and children's museums see themselves as uniquely positioned to improve preschool DLLs' early science learning environments and experiences because these institutions specialize in the kinds of hands-on and multimodal science experiences that several studies (with school-age children) have shown to support DLLs' participation, science learning, and, in all-English educational contexts, their understanding and use of English (Moore & Smith, 2015). In turn, high-quality early childhood experiences have long been concerned with the well-being of linguistically or culturally minoritized children, and efforts to support their development, including but not limited to science learning, have both yielded positive outcomes and exposed areas for further growth (McNamara, 2016). Across these contexts, research has supported that providing young children with stimulating and supportive opportunities to develop awareness, interest, motivation, social competencies, habits of mind, and identities set them on a trajectory to learn more science (NRC, 2009) and to enter school ready to learn and to become lifelong learners (French, 2004).

Although supporting DLLs in learning science is a clear goal of the field, some relevant challenges remain, specifically related to rapid demographic change. Specifically, Central Ohio has been experiencing a rapid demographic shift from relatively homogenous to “superdiverse,” a concept we employ to emphasize a kind of demographic complexity among immigrant and ethnic minority groups that surpasses what the region has previously experienced (Vertovec, 2007). A key element of superdiversity is that it is not simply “more diversity” but rather a region must experience rapid demographic shifts over a compressed time frame to be considered “superdiverse,” which is captured in Blommaert's (2013) “mobility, complexity, and unpredictability” (p. 5) or Meissner and Vertovec's (2015) “spread, speed, and scale” (p. 546). In the U.S., this has occurred especially since the 1980s due to the 1965 changes to migration policy. These shifts first impacted the traditional migration centers along the Mexican border, Florida, or New York particularly urban, but have, since the early 2000s, been more intensely impacting areas such as the Midwest, the focal region for this article.

Beyond the speed of change, the complexity of the diversity itself is critical. Although home language is one of the key dimensions here (Arnault et al., 2016; Blommaert & Rampton, 2011), superdiversity also points to multiple intersections with race/ethnicity, country of origin, migration history, level of education, and socioeconomic status (Vertovec, 2007). Thus, it is possible and indeed increasingly common and necessary for institutions to simultaneously support people with multiple home languages, vast differences in educational backgrounds, uncertain legal statuses, and income/wealth. Moreover, the final point, unpredictability, is quite difficult particularly in local settings in that this diversity can shift rapidly from one demographic group to another. For example, one ECE context we researched had a predominantly Somali population one year and made appropriate shifts to staffing and training only to have the population be dominated by Spanish-speakers the next year, requiring further changes.

Thus, although bilingual educational approaches have generally demonstrated the best outcomes (Baker, 2011; Collier & Thomas, 2004; Crawford, 2004; García, 2008; Umansky & Reardon, 2014), superdiversity complicates the picture considerably beyond contexts with two or three (target) languages, challenging institutions and people animated by a commitment to supporting young students’ and families’ home languages and cultures to recognize the rapidly shifting demographic ground, understand the learners they have before them, and plan for the uncertain future (McNamara, 2016).
3. Methods: Project design

The overarching goal of the Expanding Repertoires project is to advance our knowledge and awareness of needs and practices related to science education for preschool DLLs. Thus, this project has three core questions:

- What are science centers and children's museums currently doing and/or want to do to improve informal science learning experiences and school readiness for preschool DLLs?
- What do science centers and children's museums identify as needs with respect to reaching and serving preschool DLLs, their families, and the ECE professionals who serve them?
- Which programs and practices hold the most promise in terms of potential to improve science learning experiences and school readiness for DLLs and to be adapted for use in diverse contexts?

To answer these questions, the project is comprised of three interconnected activities:

- A national needs assessment1 of science centers and children's museums that focuses on work with DLLs and bi-/multilingual families,
- Virtual and in-person convenings that bring together science center and children's museum professionals and their community partners who have developed programs and practices to serve DLLs, and
- An exploratory study of COSI's early childhood programs, practices, and partnerships with local ECE providers.

Through these activities, we seek to discover current needs and priorities related to IS education for preschool DLLs, the range of programs and practices used to reach and serve this audience, and what is currently known and unknown in the informal science education community with respect to effective programs and practices for DLLs. A holistic view of trends and needs is necessary to identify foci for future study, improvement, and expansion of museum practice to improve science learning experiences and school readiness for DLLs.

This article presents data from the exploratory study, including data and analysis from three different aspects of the study: Interviews/focus groups with informal science and ECE staff, interviews/focus groups with caregivers, and video recording with DLL families at COSI.

4. Exploratory study

The exploratory study examines the intersection of COSI's current programs and practices related to the support of access, participation, and learning for preschool DLLs and their families. The goals of the study were to

- Gain insight into the experiences and perspectives of participants and stakeholders in COSI's early childhood programs that serve preschool DLLs—that is, children, their families, early childhood professionals, and the COSI team,
- Identify needs, challenges, and opportunities related to reaching and serving preschool DLLs in Central Ohio, and
- Establish an empirical basis on which to develop new and/or adapted programs and practices to improve science learning experiences and school readiness for DLLs.

COSI is a productive site in which to study programs and practices that serve preschool DLLs in linguistically complex educational settings where linguistic diversity is on the rise and only recently receiving attention. COSI serves a community that is experiencing the kind of superdiverse demographic

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1 The national needs assessment was a survey of science centers and children’s museums. Neither early childhood education providers nor bi-/multilingual families were included in the survey.
shifts that are underway in much of the Midwest and the South. Central Ohio's superdiversity manifests with rapid changes in the past 20 years with its population’s language background and language proficiency, ethnicity and race, cultural values and beliefs, economic resources, experiences with literacy and schooling, and (im)migration history. COSI seeks to understand these populations in order to attract and engage them in IS learning. In parallel, COSI has invested in improving ECE and serving children from low-and-moderate-income households, developing programs and environments designed specifically for the youngest learners. These include a large exhibit area, the little kidspace, designed for children birth through first grade, multiple on-site programs for families with young children, and outreach programs that serve more than 4,000 preschoolers each year in Head Start classroom and other Title XX eligible childcare programs. The outreach programming includes professional development for ECE professionals working in these classrooms, providing them with Ohio-approved training in a variety of inquiry-based learning topics. As part of Expanding Repertoires project, we have developed and delivered three new workshops for preschool teachers that include training on how to support young DLLs’ science learning.

Thus, in order to better understand the informal science learning experiences of preschool DLLs and their families, we are studying how their experiences at COSI and in COSI outreach programs are organized and how that organization is shaped by participants' beliefs, values, and circumstances. Research has shown that cultural groups vary with respect to how they socialize their children and what expectations and norms they have for language use, social interaction, and teaching-learning activities with young children. Research also shows that these cultural patterns are influential in how children and family members approach and respond to specific learning activities (Rogoff et al., 2014) and that many practices, goals, values, and expectations typical of IS and ECE settings may be discontinuous with those of many DLLs' homes and communities (Bell et al., 2009). If not recognized and addressed with understanding, such discontinuities can negatively impact the early science learning experiences of DLLs.

The exploratory study is informed by language socialization theory and methodology (Duranti, Ochs, & Schieffelin, 2012), which means that we combine ethnographic methods (participant observation, interviewing, documentation of artifacts, and collection of documents) with analysis of video-recorded interactions in order to identify and illuminate patterns in participants’ use of language, gesture, artifacts, and structure in the physical environment. Data collection for the exploratory study is completed, and the data corpus includes:

- Participant observation field notes from 110 hours on the COSI floor and 19 hours at COSI outreach sites
- Audio-recorded interviews/focus groups with DLL families: 43 interviews/focus groups at COSI and 16 at ECE outreach sites.
- Audio-recorded interviews/focus groups with IS and ECE staff: Three at COSI and five at ECE outreach sites.
- Video-recorded naturalistic interaction: 5 hours of fixed-zone video recording in COSI's little kidspace, 15 hours of mobile recording at COSI with DLL families, 10 hours of COSI outreach visits at three different ECE centers.

In examining interactional patterns in and participants' reflections on science teaching-learning experiences at COSI and outreach sites, we seek to understand how existing practices support or hinder DLLs and others (family members, early childhood educators) in scientific meaning-making, as well as to explore potential changes to increase support.

5. Findings

5.1. Perspectives of caregivers in informal science and ECE contexts

Interviews with caregivers at COSI and at ECE partner sites had guiding questions related to

- Their home language practices, their own experiences with language and learning, and their desires/goals for their children’s language development and learning
• Their home science teaching-learning practices and their desires/goals for their children’s science learning
• Their experiences in and views on the ECE and IS spaces (including COSI) in which they and/or their children have participated
• Their perceptions of language policies and practices in these spaces and how they might be improved to better serve their children and family.

In our interviewing at ECE partner sites, ECE staff identified DLLs and their parents for us to interview individually or in focus groups. In our interviewing at COSI, we spoke with families that were monolingual English and families who spoke languages other than English because (1) we wanted to avoid profiling people and instead give them the opportunity to self-identify as bi/multilingual and (2) we were interested in the perspectives of monolingual English caregivers on bi/multilingualism and the use of languages other than English at COSI. Our conversations with English monolinguals were brief and are not the focus of the research. However, none of these participants expressed resistance to languages other than English being used at COSI by guests and several expressed hope that their own children might learn an additional language.

Across both contexts, all the DLL caregivers interviewed expressed a strong support for bilingualism for individuals and for communities. Some caregivers came from countries with strong bilingual programming and were highly bilingual themselves as a result. Some arrived in the U.S. more or less monolingual and were experiencing the challenge of being an emergent bilingual as adult learners. In terms of their children, few labeled their emergent bilingualism as a deficit but rather as an educational opportunity in that the home language would remain strong while the school language developed. Caregivers expressed strong desire for their children to be bilingual and invested in that goal, whether through their own home language policies, supplemental schooling, regular travel to countries where the home language is dominant, or intentionally seeking contact with monolingual speakers of the home language (e.g. grandparents).

Caregivers recognized that their strategies for home language maintenance produced varying results, and they described their children’s language proficiency on a continuum from home language dominance to home language/English balance to English dominance. Families newly arrived in the U.S. or with strong monolingual home language policies felt that their children were still quite home language dominant, and many of these children were reported to be either not yet enrolled in or new to ECE spaces (e.g. 0-3 months). On the other hand, caregivers with children enrolled in ECE spaces were experiencing their child’s shift to a preference for English or even English dominance, even to the point of resisting speaking the home language. Very few caregivers described their children as moving towards type of “balanced bilingualism” evinced by the child being able to communicate with peers in the home language and (often more importantly) older speakers such as grandparents at the same time that the child was performing well socially and academically with English in the ECE space. In short, these young children were demonstrating aspects of emergent bilingualism along a bilingual continuum, and the often dramatic shifts between home language and English dominance and/or preference were of some concern to the caregivers.

On the other hand, no parents expressed fear that the children would experience a complete language loss in terms of an inability to understand the home language, but many were concerned about the overall trajectory of the child’s home language ability in the absence of more sustained attention in the home or community and the reality that the child’s future schooling was likely to only become more English-focused.

Caregivers described the ECE and informal science environments they had experienced as generally positive, fun, and engaging spaces. When asked about why they brought their young children to COSI, caregivers reported that they wanted their children to play, have fun, and interact with other children. Caregivers who had visited COSI reported doing so as children, as field trip chaperons (the COSI outreach program included 1 or 2 field trips), and/or when they had received free tickets for a Family Friday Night (COSI regularly distributes tickets via social service organizations). In terms of children’s science learning, caregivers, particularly those at ECE sites, reported some experience with science learning activities at home or facilitated at school by their children’s teachers. They expressed great appreciation for the COSI outreach and a desire for more classroom visits and more opportunities for families to visit COSI.
With regard to language policies and practices, most caregivers at COSI reported that they hadn’t given much thought about the role of language in the space in that they considered COSI to be primarily focused on play and science learning, not language. On the other hand, caregivers expressed greater awareness of language practices in ECE spaces, where children spend many hours in activities where language development is an instructional focus. Caregivers expressed recognition that the overarching goal of both spaces is learning with and through English but also pointed out that staff, in ECE environments especially, were caring, accommodating of their children’s language development, and even investing in bilingual teachers or assistants to support the children. Such support was more pronounced with languages such as Spanish where more bilingual staff were available. In a few cases, classrooms had become de facto dual language spaces with, for example, roughly 50/50 English and Spanish, and this seemed to be appreciated by the caregivers of DLLs in these classrooms.

The majority of the caregivers expressed a desire for a shift to more bi/multilingual pedagogies in ECE and COSI and had many ideas about how this could be achieved, while they also expressed awareness of the complexity of supporting home languages in an increasingly diverse metropolitan area. In terms of COSI, caregivers recommended hiring more bilingual staff, making that more visible to guests, making sign translations, and developing temporary or permanent exhibits focused on language and diverse cultures. Caregivers expressed the view that ECE environments could be enhanced through more strategic and flexible hiring, dedication of some curricular time/space to languages beyond English, and broader use of materials that reflect their home language and culture. All caregivers expressed the view that it was necessary for their children to learn English in pre-K, and none expressed support for a shift to a primarily home language focused ECE experience for their children. The following section from a focus group with Spanish-speaking caregivers reflects many of the tensions above.

1. Researcher: *Qué piensas que tus hijos necesitan para mejorar español, inglés y la educación en las ciencias?* (What do you think your children need to better their Spanish, English, and science education?)
2. Female participant 1: *Todo, porque si no hablan nada!* (Everything because they don't speak at all!)
3. Female participant 1: She said everything.
4. Researcher: Then what can we do for your children?
5. Male participant: *Què es lo que ellos pueden hacer para nuestros hijos? Poner unos maestros que hablen inglés y español?* (What could they do for our kids? Hire some teachers that speak English and Spanish?)
6. Female participant 1: *Pero mi niño tiene uno. Abajo hay uno que...* (But my child has one. Downstairs there's one who...)
7. Male: *sí, sí, está bonito, ah? Está bueno. Pero los míos no. Hay que tener otra arriba.* (Yes, yes, that's great, at? That's good. But mine don't. There should be another one upstairs)
8. Female participant 3: *El mío está arriba también. Sí, si estamos perdidos. Él le hable y no...* (Mine is upstairs as well. Yes, yes, we are a little lost. He speaks and doesn't...)
9. Male: *Pero los niños no, para los niños, ellos van a aprender.* (But the kids, no. For the kids, they're going to learn)
10. Female participant 3: *Si pero, tarde. No, es pura...* (Yes, but later. No, it's just...)
11. Male: she's lucky because her child is, the lady in there, she's Puerto Rican. So she speaks both. She's the lucky, I don't.

This section encapsulates several issues that caregivers face. First, they recognize that their children are still learning their home language and that putting them in an English-centric environment is difficult for them even if it might be necessary in the long run. Second, they realize that a more structured space with home language support for learning English similar to transitional one-way or two-way dual language programming would be preferable. Third, they find themselves in a position where the provision of these services is less determined by clear language policy, staffing, and allotment of resources but rather a kind of “luck of the draw” if their children will have a teacher or assistant who speaks the home language. In the case of Spanish, caregivers might have “better odds” in a sense, but as
the quote here shows, it certainly not a given, and for home languages such as Kabyle, Twi, or even Arabic, the chance that a caregiver will find ECE centers ready to meet their children’s languacultural needs is less likely.

5.2. Perspectives of informal science and ECE staff

This second locus of research focuses on the perspectives of informal science and ECE staff who are serving the DLL caregivers and children. We conducted interviews and focus groups with staff in these two contexts. In COSI, only team members who sometimes worked in little kidspace and/or ECE outreach programming whereas general ECE staff were included, although we did focus somewhat on bi/multilingual staff members to ensure that their perspectives were included.

5.2.1. Focus on informal science staff

The interviews or focus group conversations with COSI staff focused largely on staff members’

- Training to work with young children and families who speak languages other than English
- Experiences working with linguistically diverse guests at COSI or during outreach
- Ideas they have for making COSI more welcoming and engaging for DLLs and their families

Nearly all of the COSI team members we interviewed identified themselves as having limited knowledge about or training to work with DLLs and their families. One team member had had formal ECE training that included coursework on working in linguistically diverse classrooms and a student placement in a classroom with many DLLs. Nearly all the focus group participants identified as monolingual English. However, participants linked linguistic diversity to cultural diversity and expressed interest in learning more about how to communicate across different cultures. There was considerable variation across groups and individuals with regards to how pressing an issue they found linguistic diversity to be, but all participants expressed the view that COSI could and should do much more to be more inclusive and supportive of children and families that speak English as an additional language.

Several participants described and discussed experiences in which they tried to communicate across a “language barrier” at COSI, most frequently about essential topics such as how little kidspace works in terms of rules/norms, where things can be found, and other exhibits and activities throughout COSI. To overcome the barrier, they described strategies they used, such as gesture, mime, using older children as interpreters, using digital technology tools to translate, finding another team member to interpret, and learning some basic vocabulary in Spanish to use with guests. Team members discussed their use of visuals, repetition, exaggerated affect while speaking, and hands-on learning activities as effective ways to communicate with all young children and particularly helpful with DLLs on the science center floor and during outreach visits.

Participants who worked regularly in little kidspace observed that were cross-cultural differences in how parents interacted with their children at COSI. The COSI team members articulated the institutional hope and expectation that parents engage with their children in play and exploration while visiting little kidspace, and they described patterns of conduct they had observed among bi/multilingual families that diverged from the institutional ideal. In particular, Somali women were critiqued for not attending to their children, but instead sitting and chatting in small groups and/or talking on their cell phones.

In terms of improvements to COSI’s approach, participants discussed steps COSI might take to enhance communication with speakers of languages other than English on the COSI floor, including “cheat sheets” that provide team members with translations of little kidspace rules and answers to frequently asked questions, audio recordings for guests of key texts in languages other than English, and revision of signage to use more visuals and less text. Similarly, team members engaged in outreach visits discussed the possibility of developing home language materials to send home with children that highlighted critical aspects of the target material (e.g. the concept of “force”). On the other hand, participants expressed some reluctance about multilingual signage or hiring more team members who speak languages other than English, specifically referencing the superdiverse challenges of making linguistic accommodations in Central Ohio, where so many different languages are spoken. When asked
about professional development focused on working with DLLs and their families, most participants expressed interest, but a few expressed concern about the use of time and other resources for this and felt that their prior training was sufficient. COSI staff referenced budgetary constraints as an important factor in institutional decisions about support for languages other than English.

Beyond these improvements, COSI staff felt that the nature of their approach to science learning itself was an opportunity, both at COSI and during outreach activities. This view was predicated on the notion of science learning as hands-on, interactive, and exploratory, which was often achieved, in the view of one COSI staff member involved with outreach activities, as being “not necessarily led by verbal instruction” and therefore more visual in nature and relatable to other interactional forms DLL children might experience in ECE sites.

5.2.2. Focus on ECE professionals at outreach partner sites

In general, the ECE teachers and classroom aides we talked to described themselves as having limited experience working with or teaching DLLs prior to their current positions. Most of the teachers identified as monolingual English speakers, although there were a number of bilingual staff, whether hired as classroom aides or lead teachers. Beyond this group, a few had limited experiences in high school world language classes or with study abroad trips in college, but most of these exceptions were quick to assert they only spoke English.

Thus, two narratives about bi/multilingualism emerged from the ECE staff interviews:

- Bi/multilingualism is good and to be promoted: Teachers explicitly expressed the view that bi/multilingualism is an asset, and many educators talked about their desire to preserve and promote their students’ home languages. As one teacher stated, “I always encourage families to continue their home language because I think that’s really important. It's a gift to give their children.” Educators also shared that they felt bi/multilingualism was valuable not only for the DLLs, but for all children, citing perceived social, academic and economic benefits of knowing multiple languages in today’s world.

- Bi/multilingualism presents challenges in the classroom: In contrast to the former point, teachers discussed challenges to student participation and engagement in various domains, ranging from social relationships with peers, to following classroom routines, to academic content learning. Teachers often positioned these issues chronologically and developmentally in that many students come to ECE contexts unused to the routines and demands of preschool. However, they pointed out that some, but certainly not all, DLL children experience significant stress as evidenced by difficult separation time from parents, extended periods of crying, social isolation, and confusion when responding to the mainly English instructions. All teachers felt that bilingual teachers and support for the children was critical to ease these challenges and, without them, these stressors could manifest regularly up to six months before the child acquired the English language ability to participate. Thus, educator’s descriptions of how English-only language practices mediated these day-to-day classroom events included words such as: Barriers, challenges, difficulties, problems, and issues. However, educators insisted that a generally positive and caring environment can mitigate these challenges, especially when bilingual supports were available, in which case these were almost eliminated.

While educators were consistent in expressing their view that multiple language presented challenges to their teaching, it is important to note that educators located the problem not in children, but instead in the larger classroom context or school structure, or in themselves as teachers. Rather than discussing students or parents through a deficit mindset or ascribing the challenges they encountered to students’ language skills, teachers cited their own lack of preparation or the availability of helpful resources for supporting DLLs as problematic. Thus, two narratives about DLLs as learners emerged from the interviews:

- Educators repeatedly expressed the view that DLLs are just like every other child in their classroom, that “kids are kids” regardless of language abilities. Many teachers cited the shared age and content knowledge of all the children in their classroom across language abilities as the basis of this claim of “sameness.”
On the other hand, many educators also expressed the view that DLLs are quite different from their English as home language speaking peers and that DLLs have unique challenges with respect to language proficiency and familiarity with American norms and culture. These challenges were often explicitly linked to caregivers but many of the requirements of ECE spaces, particularly Head Start, such as family home visits helped caregivers to see and partially understand the DLL home language and cultural practices.

When talking about instructional strategies and science education for DLLs, teachers described using many “multimodal” strategies in the classroom such as using pictures, visuals, gestures, movement, and modeling to communicate content as well as classroom procedures to DLLs. Many teachers reported that they used such strategies in their classrooms before they had DLLs but that they perhaps relied on these strategies more heavily when working with DLLs. Teachers also talked about the use of translation and interpretation both in the form of people and technology (especially Google Translate) in working with DLLs and their families.

In general, educators across ECE partner sites talked about “wanting more resources,” where resources seemed to represent everything teachers felt they lacked when it came to promoting the success of DLLs, including language support in the forms of interpretation and translation, cultural background knowledge, and classroom materials specific for DLLs. Teachers, particularly monolingual English speakers, expressed a strong desire to better connect with DLL families, and again cited their own lack of language abilities and cultural knowledge as a barrier to this goal.

In terms of science learning for DLLs, educators, invoking a perspective similar to the COSI staff above, described science as interactive, hands-on, fun, “natural,” and thus perfect for engaging all preschoolers. Educators said that science is particularly advantageous for working with DLLs because science can promote language learning, and yet, because science is “hands on” and experiential, it doesn’t necessarily require language for participation. As one teacher stated, “I really don’t see much challenge with science. Actually, that’s where I see the DLLs really find themselves really a part of their learning.” Perhaps most revelatory here was the notion of the language of science as a leveling mechanism between DLL and English as home language children in that both were facing the task of acquiring unfamiliar vocabulary. As one ECE educator stated:

I don’t see much challenge with science. Actually that’s where I see the DLLs really find themselves…we’re all experiencing it together so they don’t feel that all these other children have this prior knowledge and prior vocabulary…because it’s starting from zero with everybody.

Across the different centers, in formal interviews and casual conversations, educators expressed the position that they were “doing the best we can,” and were “making it work.” Teachers expressed the belief that they were taking a positive, proactive approach by looking at themselves and at their students, taking inventory of their available resources, and figuring it out on a day-to-day basis. A quote from one Head Start teacher expresses this succinctly: “You can’t just dismiss somebody because they speak a different language. We try to understand each other, we make it work.”

5.3. Vignette: Bridges

This project explores the intersection of two significant contexts—informal science and ECE—through the lens of DLL concerns and early science learning. However, in parts of the research above such as the interviews/focus groups above, these contexts were not directly in communication. Thus, this section displays data from an event putting these contexts together—a visit by one of the ECE partner site’s field trip to COSI held during 2017’s Week of the Young Child. During this time, we video-recorded using four cameras and followed a number of DLL families through their COSI visit, which lasted from approximately 9am-1pm with a lunch break in between. These various DLL families spoke a variety of languages including Spanish, Somali, Arabic, French, Kibembe, Twi, Kabyle, and Oromo, demonstrating the linguistic diversity present even in a small sample of families in Central Ohio. As mentioned above, the majority of the signage in COSI is in English, with only a number of other signs such as “No Smoking” or “No Food or Drink” translated into Spanish. However, COSI does often have traveling exhibits with bi/multilingual signage, and for this section, we present data from a Spanish-English bilingual family to demonstrate how changes in the linguistic landscape shape a family’s
engagement with a child’s science learning. In this family, the mother identified as an experienced bilingual in Spanish and English whereas the father was conversant in English but preferred to speak Spanish. The mother stated that their two sons—Julio (all names pseudonyms), who had just turned five, and Marco, who would soon turn three—understood Spanish but preferred to speak English. The conversation about language practices at home emerged while a team researcher and the family were visiting a section of COSI focused on Media and radio/television production. In this space, all signs are in English, and the focal family interacts with a few other Spanish-speaking families on the trip.

1. (Julio is wearing a headset and wanting to say something at microphone)
2. Mom: *Haber, habla Español* la *algo* (speak something else in Spanish)
3. Julio: (taking off the headset)
4. Mom: *Habla* (speak), say something
5. Julio: (no response)
6. Mom: (hitting/pushing her son’s head very slightly)
7. Nanny of another family: (unintelligible) (pointing at two kids including Julio) *no saben inglés?* (they don’t know English?)
8. Mom: *Sí, inglés, que pero* (yes, English, but)
9. Mom2: *No habla Español?* (he doesn’t speak Spanish)
10. Mom: *Sí habla, pero no le gusta* (yes, he speaks, but he doesn’t like to)
11. Researcher: (to Julio) *Por qué no te gusta hablar Español?* (why don’t you like to speak Spanish)
12. Julio: (putting the headset on) I do
13. Mom: He understands it
14. Researcher: Okay, *pero no habla?* (but he doesn’t speak)
15. Mom: I don’t know
16. Researcher: (pointing at Marco) what about him?
17. Mom: He doesn’t try, I mean sometimes something he does try like *agua* (water). I say he tries, I don’t know. I don’t know
18. Researcher: Do they speak English each other?
19. Mom: (nodding her head)
21. Mom: (nodding her head)
22. Researcher: (pointing at dad) what about with him?
23. Mom: With his friend. That’s his baby sitter. She was saying like she only speaks English. And they speak only English each other.
24. Researcher: So, he understands
25. Mom: Yeah, he understands everything perfectly, so does he (pointing at Marco)
26. Mom: (to her husband) *Ellas le dije por que no te gusta Español? Que dije “I do”* (she said to him, “Why don’t you like Spanish” and he said “I do”)
27. Dad: (to Julio, smiling) *hablas Español?* (do you speak Spanish?)
28. Julio: Yeah
29. Researcher: Do you want them to learn Spanish?
30. Mom: Yes, I mean they know Spanish, but I don’t want them to forget it. I want them to practice it. But they don’t like to do anymore.
31. Researcher: But he said that “I do”
32. Mom: Yeah but no, he doesn’t. We put cartoons in Spanish at home, and he gets mad. The other one (pointing at Marco) says “that’s fake”
33. Researcher: That’s fake?
34. Mom: I think he means that’s different. He says, “Mom, that’s not real.” I say like “No, it’s real. Just sounds different.”

This section demonstrates some of the challenges this family faced with their young children. Both Julio and Marco, the former attending the ECE center, but the latter still too young, had started to shift to a preference for English, despite the family language practices of having a Spanish-dominant father and a mother who explicitly promoted Spanish language use in the home. When Julio refused to speak either in Spanish or in English, the other Spanish caregiver’s and even the researcher’s statement might
be interpreted as a criticism of both the child and the family. Although he expressed an emotional attachment to Spanish, his English-language answer in addition to his mother’s reference to his anger at Spanish cartoons on TV at home are evidence of the complicated relationship between English practices at school and the home language desires of the family context.

Throughout the trip, mother and father engaged in hands-on activities with the children in variable ways, sometimes with the mother leading and other the father. However, as the visit stretched into the late morning, the researcher noticed the father’s engagement with the children to be less direct, allowing the children to explore on their own. A noticeable shift occurred when the family approached the exhibit The Secrets of Circle, which was on temporary loan from the Children’s Discovery Museum of San Jose, one of this project’s institutional partners (www.cdm.org/visit/exhibits/secrets-of-circles). The key difference with this exhibit in the COSI context is that its signs are written in English, Spanish, and Vietnamese, in that order. Among the activities in this exhibit is a bridge-building activity, and Figure 1 below is a photograph of it.

Figure 1. Image of bridges exhibit at The Secrets of Circles
In this activity, the explicit scientific focus, demonstrated in Figure 2, is about the strength and efficiency of circles, visually warranted through the images of various arches, bridges, and domes from a number of cross-cultural and temporal contexts.

Figure 2. Text and image from the top of the bridge activity

In terms of interaction and application of this principle, the activity asks the visitor to construct an arch from the wood/rubber blocks and invites them to walk over it. Figure 3 shows the text on the middle right of the overall activity.

Figure 3. Instructions for the bridge building activity

Again, this is one of very few multilingual signs at COSI, and it was the first Spanish exhibit that the family had encountered. When the family arrived at this activity, the mother and researcher had a conversation about the need for multilingual signs at COSI and the dad approached the two children and spoke with them in Spanish explaining the activity.
In this section, the shift in the father’s participatory structure is attributed to language by the mother with the statement, “Now he knows what's going on,” indicating that the father may have been less engaged in activities with the children previously because of the linguistic landscape. However, once he had a linguistic resource to draw on with the Spanish-language signs, he stepped in to do the hands-on activities with his children, explaining the task to the children and assisting. He read the instructions on the sign several times, discussed them with his wife, and approached his children, saying in both English and Spanish, “Mira (look), I’ll show you.” Thus, this multilingual sign may have enabled the father to participate more directly in his children’s education through the home language. Figure 4 demonstrates this family’s engagement with the activity and signage.

Figure 4: Still image of the mother and father reading signs while older child builds bridge
In the end, both the mother and father collaborate to complete the bridge and their two children in addition to several other COSI children walk over the bridge. Thus, the sequential unfolding of speech and action strongly suggests that the available linguistic and paralinguistic (e.g., pictures on signs) meaning-making resources at COSI are a critical factor that shapes a DLL family’s engagement with science learning.

What we want to highlight here is the potential impact on parental engagement of signs in the home language. As many IS centers have the goal of parents and children engaging in collaboration, constructing meaning together, and doing hands-on activities together, what we observed was that when the father had access to the exhibit’s explanation, he did what the science museum wants parents to do whereas his behavior was less directly engaged absent that linguistic resource. This example demonstrates that linguistic resources at informal science centers are critical; however, bi/multilingual signs at COSI are rare and not part of the general environment. On the other hand, as mentioned above and briefly with the mother’s invoking of Somali as a critical language for the local region, the challenge of choosing which languages to support is difficult.

6. Discussion

The perspectives of staff and caregivers above and the vignette itself reveals a nexus of tensions and possibilities in expanding ECE and informal science repertoires of practice with DLL families. On the one hand, ECE and informal science staff, ECE perhaps more so than informal science, recognize the languacultural superdiversity in the Central Ohio region. Some of them have enough experience and/or institutional memory to point out how this region has gone, in the space of 20-30 years, from a primarily white region with a sizable African-American minority to one that is generally more diverse and where the diversity itself is more heterogeneous, with Spanish, Somali, Nepali, Arabic, and Francophone populations dominant and many other languages extant throughout the region. ECE staff therefore are making their best faith efforts to communicate with and support the population, but many recognize that their own backgrounds as monolingual English speakers or the current affordances of languacultural learning opportunities are not providing the training they would need to fully embrace and support these families. This desire is reflected perhaps in the repeated statement that many ECE staff respond to the crying child, confused by a new experience in a new country, simply through touch, by holding the child, and trying their best to comfort them; even if they cannot connect through spoken language, this language of care and concern is the de facto solution to a difficult situation. In contrast, informal science staff at COSI and during ECE outreach perhaps avoid many of these challenges in that informal science contexts generally have families learning together and ECE outreach events occur infrequently and more animated by the fun of hands-on science learning than asking/requiring DLL children to engage directly and verbally with informal science staff.

On the other hand, caregivers, despite their general appreciation of IS and ECE contexts, have manifold recommendations for supporting them and their children more directly. The Expanding Repertoires project is therefore about identifying some of these opportunities and amplifying the voices and experiences of caregivers to informal science and ECE staff and leadership. Specifically, caregivers, through their statements and behaviors, are requesting a nexus of supports in informal science and ECE contexts including: More bilingual staff, bilingual pedagogical materials, organization of events where languacultural diversity is at the forefront, and shifts to the arrangement of time/space to make the students home languages more present and visible. It is our view that these requests are reasonable and needed at the same time that we understand that the superdiverse conditions of Central Ohio and many regions of the U.S. and world today make meeting these more complicated in many ways.

7. Conclusion

Informal science and ECE spaces and educators play a crucial role in national efforts to achieve equity and diversity in participation in science (NRC, 2009), and the improvement of DLLs’ science learning experiences is an increasingly important part of these efforts. As this population grows, the significance of early science learning experiences for later achievement will become better understood and likely more critical. Science centers and children’s museums can raise awareness of DLLs needs and strengths and guide participants in exploring beliefs about languistic and cultural diversity and how they
shape educational practice in ways that can either limit or expand DLLs’ engagement with science content and process skills, families’ engagement with their child's science learning, and children’s bi-/multilingual language development. As second-language researchers, we continue to engage with children, families, and our partners in informal science and early childhood education in order to expand and deepen our understanding of early science and language learning processes and improve programs and practices to better serve and support dual language learners and their families.

References


