Journal of Cognition and Development

ISSN: 1524-8372 (Print) 1532-7647 (Online) Journal homepage: https://www.tandfonline.com/loi/hjcd20

# Urban Thinkscape: Infusing Public Spaces with STEM Conversation and Interaction Opportunities

Brenna Hassinger-Das, Itai Palti, Kathy Hirsh-Pasek & Roberta Michnick Golinkoff

**To cite this article:** Brenna Hassinger-Das, Itai Palti, Kathy Hirsh-Pasek & Roberta Michnick Golinkoff (2019): Urban Thinkscape: Infusing Public Spaces with STEM Conversation and Interaction Opportunities, Journal of Cognition and Development, DOI: 10.1080/15248372.2019.1673753

**To link to this article:** https://doi.org/10.1080/15248372.2019.1673753

Published online: 20 Oct 2019.

JOURNAL OF COGNITION AND DEVELOPMENT
https://doi.org/10.1080/15248372.2019.1673753

Routledge
Taylor & Francis Group



# Urban Thinkscape: Infusing Public Spaces with STEM Conversation and Interaction Opportunities

Brenna Hassinger-Das [a], Itai Palti [b], Kathy Hirsh-Pasek [c,d], and Roberta Michnick Golinkoff [e]

[a]Pace University; [b]Human Metrics Lab, UK; [c]Temple University; [d]The Brookings Institution; [e]University of Delaware

**ABSTRACT**

How can we transform places where people gather or wait into hubs for interaction and playful learning? Bus stops offer one setting in which to test this idea. Urban Thinkscape reimagines an everyday bus stop in an under-resourced area as an interaction zone instead of merely a place to wait for a ride. Results suggest that embedding playful learning into architectural design is associated with increases in targeted types of caregiver interaction and child language use. Compared to pre-installation data as well as data from a control site (a neighborhood playground), Urban Thinkscape suggests that we can build public spaces in ways that invite the kinds of interactions known to support later learning in language and STEM.

Children from under-resourced communities often lag significantly behind their higher-income peers on academic outcomes (Reardon & Portilla, 2016). This achievement gap persists over time and results in lower school completion and college attendance, perpetuating long-standing cycles of poverty (Duncan, Kalil, & Ziol-Guest, 2017). To prepare children for school and life success we must create opportunities and experiences that foster their academic (e.g., math, language, literacy, and science) and 21st century learning skills (e.g., communication, collaboration, critical thinking, creative innovation, and confidence; Golinkoff & Hirsh-Pasek, 2016).

In Western countries, roughly only 20% of a child's waking time is spent in the classroom (Meltzoff, Kuhl, Movellan, & Sejnowski, 2009). The other 80% of children's time is largely spent at home or in community public spaces, both of which can support children's informal learning and development. In fact, it is well established that experiences that encourage increased conversation among caregivers and children in low-income environments and that target literacy or mathematics can foster better cognitive outcomes (Gunderson & Levine, 2011; Pruden, Levine, & Huttenlocher, 2011; Sheridan, Knoche, Kupzyk, Edwards, & Marvin, 2011). Yet, to date, many of these spaces – especially community spaces – are underutilized. Additionally, lower-income families are more likely to use public transportation than their higher income counterparts (PEW Research Center, 2018) – and as such, visit bus stops and other public spaces where people spend time waiting. We asked whether we could transform these places into hubs for caregiver-child engagement and conversation in support of learning. By melding the science of learning with new work in the development of

**CONTACT** Brenna Hassinger-Das bhassingerdas@pace.edu Psychology Department, Pace University, 41 Park Row, Fl 13, New York, NY 10038

Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/hjcd.

the Conscious Cities movement (Palti & Bar, 2015), we attempted to enhance caregiver-child engagement and interaction through play in everyday spaces. Urban Thinkscape reimagines a bus stop (and an adjacent area) as a place for playful engagement and learning.

Started by architect Itai Palti and neuroscientist Moshe Bar in 2015, the Conscious Cities movement aims to create architecture and urban design that is responsive to the needs and desires of its users, artificial intelligence, and technology. Researchers involved in Conscious Cities are investigating ways in which learning and development are influenced by the built environment (Brekke, 2016). Play has been identified as one way to bring people together to use public spaces and interact in ways that are lacking in current designs (Sumerling, 2017). In a UK-based study, researchers discovered that placing a Playbox in a park – a shipping container used for creative workshops and events – allowed people to reimagine the uses of a park space and also be enticed to enter the park and talk with other community members (Sumerling, 2017). Designed in collaboration with Palti, Urban Thinkscape has similar goals of altering public space to bring families together and to spark playful interaction and conversation in ways known to promote STEM learning and vocabulary.

### *Why promote playful learning through caregiver-child conversations?*

Our conceptualization of play as activity that is fun, voluntary, and flexible, with active engagement and no extrinsic goal (Lillard et al., 2013; Rogoff, 2003) draws on decades of previous research. The science of learning documents compelling relations between play and developmental outcomes (Fisher, Hirsh-Pasek, Golinkoff, Singer, & Berk, 2011; Hassinger-Das et al., 2017; Weisberg et al., 2016). Thus, infusing playful learning, a broad pedagogical approach featuring child-directed play methods including free play, guided play, and games (Weisberg, Hirsh-Pasek, Golinkoff, Kittredge, & Klahr, 2016), into city design might organically stimulate the kinds of engaging and vocabulary-rich conversations and interactions known to enhance learning potential. Free play is child-initiated and child-directed, while guided play is adult-supported, because an adult scaffolds the play experience and infuses it with learning opportunities while the child leads the direction of the play (Weisberg et al., 2016). In games, the fun and engaging elements of the gameplay help support children's intrinsic motivation and interest in learning (Hassinger-Das et al., 2017).

Playful learning interactions are ideal contexts for fostering the kinds of caregiver-child communication that have been associated with strong outcomes in spatial, math, and language learning (Han, Moore, Vukelich, & Buell, 2010; Toub et al., 2018). Research demonstrates that playful learning affects not only the child but also the intergenerational interactions that support development. For example, there is ample literature suggesting that caregiver-child conversations in language, mathematics, and socioemotional areas (Adamson, Bakeman, Deckner, & Nelson, 2014; Hirsh-Pasek et al., 2015; Gunderson & Levine, 2011; Hoff, 2013; Levine, Suriyakham, Rowe, Huttenlocher, & Gunderson, 2010; Pruden et al., 2011) fuel advanced developmental outcomes for children. Indeed, just using number words in conversations with young children can support their later understanding of mathematics (Pruden et al., 2011).

On the whole, children from low-income families are at higher risk for learning less language as compared to their higher income peers, yet there is a great deal of variability in their individual language outcomes (Song, Spier, & Tamis-LeMonda, 2014). Specifically, research has demonstrated that there are significant within-SES level differences in joint engagement and that the quality of caregiver-child conversations matters more than the quantity of those conversations (Hirsh-Pasek et al., 2015). In fact, the quality of the communication foundation that caregivers and children construct together includes the kinds of engaging and responsive interactions that contribute to language growth both in and out of school (Adamson et al., 2014; Hirsh-Pasek et al., 2015; Perry et al., 2018; Romeo et al., 2018).

Further, language in young children is a strong predictor of later growth in language, literacy, math, and social development (Pace, Alper, Burchinal, Golinkoff, & Hirsh-Pasek, 2018). One example comes from Han et al. (2010) who demonstrated that guided play for preschool children helped them learn and extend the meanings of new words. Similarly, Toub et al. (2018) demonstrated that guided play combined with storybook reading with preschoolers led to greater gains in vocabulary than a similarly fun flash card review activity. Play-based interventions that included story enactment also improved children's understanding of existing storylines (Pellegrini, 1984) and the complexity of child-generated novel stories (Nicolopoulou, McDowell, & Brockmeyer, 2006).

Urban Thinkscape was co-created with members of the local community to ensure as much ecological validity as possible. To do this, we drew on community-based participatory action research (CBPR) methods (Collins et al., 2018) to create a collaborative approach to include community members and other stakeholders in the research process from the very beginning. CBPR is a common research approach in the health fields, but it is not often employed in developmental psychology (Collins et al., 2018). Local community leaders and members participated alongside researchers in the design, research, and dissemination phases of the project, which are detailed in the method section of this manuscript.

This preliminary evaluation examined whether conversation could indeed be increased between caregivers and children relative to the amount of conversation that occurred prior to the installation and asked whether caregivers and children would use specific language targeted in each installation. The elements of the installation were designed to spur conversations on topics associated with children's school readiness, including science, technology, engineering, and mathematics (STEM) skills like number and shape knowledge and literacy talk – all in ways that might mirror what children get in cognitively stimulating environments and that might augment some of the experiences children have in preschool. Simple signs give guidance on how the installations can be used. For example, the sign for the design that supports narrative development asks, "Can these pictures tell a story?" With this basic signage, caregivers can scaffold children's play to help them in pursuit of telling a story and building their literacy skills. Urban Thinkscape is thus designed as a rich placemaking initiative created to increase caregiver-child discourse related to content areas by engaging with the activities. Urban Thinkscape offers an architectural invitation to parents and children to have the kinds of conversations that relate to cognitive outcomes.

## The present study

Drawing on a past literature showing clear connections between conversational language and later language, literacy, and STEM development, we sought to compare the behavior of caregivers and children before and after the installation of Urban Thinkscape when the site was a bus stop with just a bench and an adjacent empty lot. We first hypothesized that Urban Thinkscape would generate more verbal engagement and physical interaction for families with preschool through elementary-aged children, in comparison to the site when the installation was not available and that there would be more interactions at Urban Thinkscape than at a control site playground. Secondly, we hypothesized that caregivers and children at Urban Thinkscape would have more conversations that reflected the specific topics highlighted in the installations, namely spatial, mathematics, and literacy content.

This preliminary evaluation of Urban Thinkscape is a first step toward the goal of increasing playful interactions for families in public spaces (as part of an initiative called Playful Learning Landscapes). By examining the types of conversations and interactions sparked by playful learning installations, we can see whether it is possible to increase the learning potential of public spaces. Should we find that our hypotheses bear out, we will next be in a position to evaluate whether children actually learn from participating in these and like experiences if we increase the density of these structures throughout a neighborhood.

## Method

### *Location and participants*

Data were collected at our Urban Thinkscape location as well as at a control site playground chosen for its relative proximity to the Urban Thinkscape site in the West Philadelphia Promise Zone. The goal was to select an existing play location in the same general neighborhood (approximately a 20-minute walk) where we might capture caregivers and children interacting naturally around play. However, the control site was not the closest playground to the Urban Thinkscape site, which was just a seven-minute walk away. The distance allowed us to avoid drawing from the same population of people visiting both sites. Importantly, the control site playground was also adjacent to another unadorned bus stop and located along the same major road as the Urban Thinkscape site, likely attracting similar kinds of groups. This assertion is supported by demographic data from both areas of the city – demonstrating similar median income levels ($20,536 versus $23,929) and with the populations of both areas being predominately Black (City-Data, 2016). It was also one of the only playgrounds open to the public in the vicinity that featured typical playground equipment, including slides and monkey bars (Figure 1).

Participants were 165 caregiver-child groups who visited Urban Thinkscape site and 115 caregiver-child groups who visited the nearby playground (see Table 1 for demographic information obtained through observation). Children aged approximately 1–10 were included and their older siblings (10–14) as well, although conversational turns for the older group were not counted in the caregiver-child interaction. Older teenagers (approximately 15 years or older) were treated as caregivers in the caregiver-child interaction. We selected approximately age 15 as the cutoff given that adolescents were of an age to escort their younger siblings, or they may have been teen parents. Importantly, as this was an observational study, it was not possible to collect exact but rather only approximate ages.

### *Project organization*

With a poverty rate of over 26%, Philadelphia is the poorest large city in the United States (PEW Charitable Trusts, 2018) making it an ideal city for a project like Urban Thinkscape. Neighborhood selection for Urban Thinkscape were based on three criteria: 1) more than

**Figure 1.** Control site playground.

**Table 1.** Demographic characteristics of sample, number of groups observed, and time at location.

| | Pre-test | | | | Post-test | | | |
|---|---|---|---|---|---|---|---|---|
| | Urban Thinkscape | | Control | | Urban Thinkscape | | Control | |
| Number of groups (observations) | 90 | | 53 | | 75 | | 62 | |
| Mean time at location (minutes) | 2.4 (SD 4.8) | | 17.8 (SD 15.0) | | 17.1 (SD 9.9) | | 15.6 (SD 11.0) | |
| | Caregiver | Child | Caregiver | Child | Caregiver | Child | Caregiver | Child |
| Total number of individuals | 109 | 172 | 81 | 235 | 88 | 120 | 68 | 93 |
| Mean number of individuals per group | 2 | 2 | 2 | 4 | 2 | 2 | 2 | 2 |
| Mean approximate age (years) | 31 | 6 | 27 | 5 | 26 | 6 | 23 | 5 |
| Gender | | | | | | | | |
| Female | 87 | 68 | 57 | 32 | 68 | 65 | 57 | 45 |
| Male | 21 | 68 | 18 | 44 | 17 | 51 | 11 | 45 |
| Relationship to child | | | | | | | | |
| Mother | 57 | - | 26 | - | 34 | - | 24 | - |
| Father | 14 | - | 14 | - | 6 | - | 4 | - |
| Other relative | 26 | - | 13 | - | 13 | - | 8 | - |
| Other caregiver | 7 | - | 21 | - | 6 | - | 1 | - |
| Race/ethnicity | | | | | | | | |
| White | 7.8% | 7.8% | 9.4% | 9.4% | 10.7% | 10.7% | 14.5% | 12.9% |
| Black | 75.6% | 75.6% | 84.9% | 84.9% | 66.7% | 66.7% | 64.5% | 67.7% |
| Latinx | 10% | 10% | 5.7% | 5.7% | 16% | 16% | 12.9% | 12.9% |
| Asian | 3.3% | 3.3% | 0% | 0% | 6.7% | 6.7% | 3.2% | 3.2% |
| Other/Multiple races | 2.2% | 2.2% | 0% | 0% | 0% | 0% | 0% | 0% |

50% of resident families living below the poverty line; 2) identifying a geographic area based on the need for accessible play spaces; and 3) the presence of community organizations. The West Philadelphia Promise Zone area fit these criteria. Due to the Promise Zone designation, there was a cross-sector effort to organize entities around building neighborhood capacity. This Promise Zone area of the city includes 35,315 residents with an overall poverty rate of 50.78%, nearly double the city's rate of 25.7%. Thus, the first Urban Thinkscape installation was placed in a chronically under-resourced community.

The project leadership team identified potential members for the Project Advisory Committee (PAC) to help determine site selection, provide guidance on navigating local politics, and develop and enact a community engagement plan to ensure community buy-in and participation in the design and implementation of Urban Thinkscape. The PAC was comprised of community leaders with a variety of perspectives who were invested in fostering learning and engagement in the Philadelphia Promise Zone, and who were involved in organizations that directly relate to the Promise Zone area or the goals of the project. The PAC had four specific goals: 1) finalize community site and specific design cluster location; 2) provide feedback and commentary on designs; 3) publicize Urban Thinkscape; and 4) facilitate the implementation of Urban Thinkscape. The members of the PAC were drawn from local early childhood and education entities, community-based/development organizations, university representatives focused on community initiatives, city offices and agencies including the Office of Community Empowerment and Opportunity, City Planning Commission, Department of Public Health, Treasurer's office, Streets Department, architects, urban planners, designers, museums, community members, and the project funder.

## Community, site, and design selection

The Director of the West Philadelphia Promise Zone Initiative helped to identify active neighborhood associations and community groups within the Promise Zone. These groups included the Belmont Alliance Civic Association, West Powelton/Saunders Park RCO, and the Mantua Civic Association. An overview of the proposed Urban Thinkscape project was shared with these groups, and interest gauged among leaders of the associations.

Leaders of neighborhood associations and community groups who had expressed interest were invited to attend two meetings that were facilitated by project leadership team. The goal was to introduce community leaders to the project and assess buy-in. The following topics were covered across several meetings: what do you want to see happen for children and families in your community, introduction to the broad concept of Urban Thinkscape, questions and comments about Urban Thinkscape, ideas about where installations could be placed, and feedback on proposed designs.

Additionally, two community focus groups were set up by the Action for Early Learning Program at Drexel University in collaboration with a local community development organization, People's Emergency Center. The meetings were hosted at the local community development organization. Each participant received a pizza dinner and a $20 VISA gift card. The goal of the focus groups was to elicit feedback on site selection and designs and gain an understanding of community needs and interests.

The feedback received from the community leaders' meetings and focus groups was given top priority during the Site Selection and Design Feedback meetings of the PAC. As a result, 4001–05 Lancaster Avenue, Philadelphia, PA 19104 – located in the Belmont neighborhood – was selected as the location of the first cluster of Urban Thinkscape designs. Ms. Bettye Ferguson, the President of the Belmont Alliance Civic Association, was a strong advocate for the selection of Belmont as the location for Urban Thinkscape. She joined the project leadership team and worked with the lead author to secure the use of the chosen site, which was owned by a local church. The lot is situated near the location where Martin Luther King, Jr. led the "Freedom Now" rally on August 2, 1965 – a site that was critically important to the neighborhood and that is in the heart of the community.

The decision to group designs in a cluster was based on the previously mentioned findings from the Ultimate Block Party (Grob, Schlesinger, Pace, Golinkoff & Hirsh-Pasek, 2017).

## *Urban thinkscape designs*

Designs installed in the Philadelphia, Pennsylvania pilot cluster included: Puzzle Bench, Jumping Feet, Stories, and Hidden Figures (Figure 2). For this study, the unit of analysis was the entire cluster of activities. The designs were created to tap into active, engaged, meaningful, and socially interactive learning contexts (Hirsh-Pasek, Zosh et al., 2015) while also targeting specific types of language, such as spatial, literacy, and mathematics-related talk. design. Each design, informed by the current literature in the science of learning (Meltzoff et al., 2009), was created to be supportive of children's in-school and at-home learning experiences. Puzzles were selected as an activity because they can foster caregiver and child use of spatial language, which is related to children's development of early spatial skills. These skills are key predictors of both later mathematics and literacy abilities (Claessens & Engel, 2013; Verdine, Golinkoff, Hirsh-Pasek, & Newcombe, 2017; Verdine, Irwin, Golinkoff, & Hirsh-Pasek, 2014). The activity Puzzle Bench used the back wall of a bus stop to challenge waiting passengers to complete four different puzzles, each

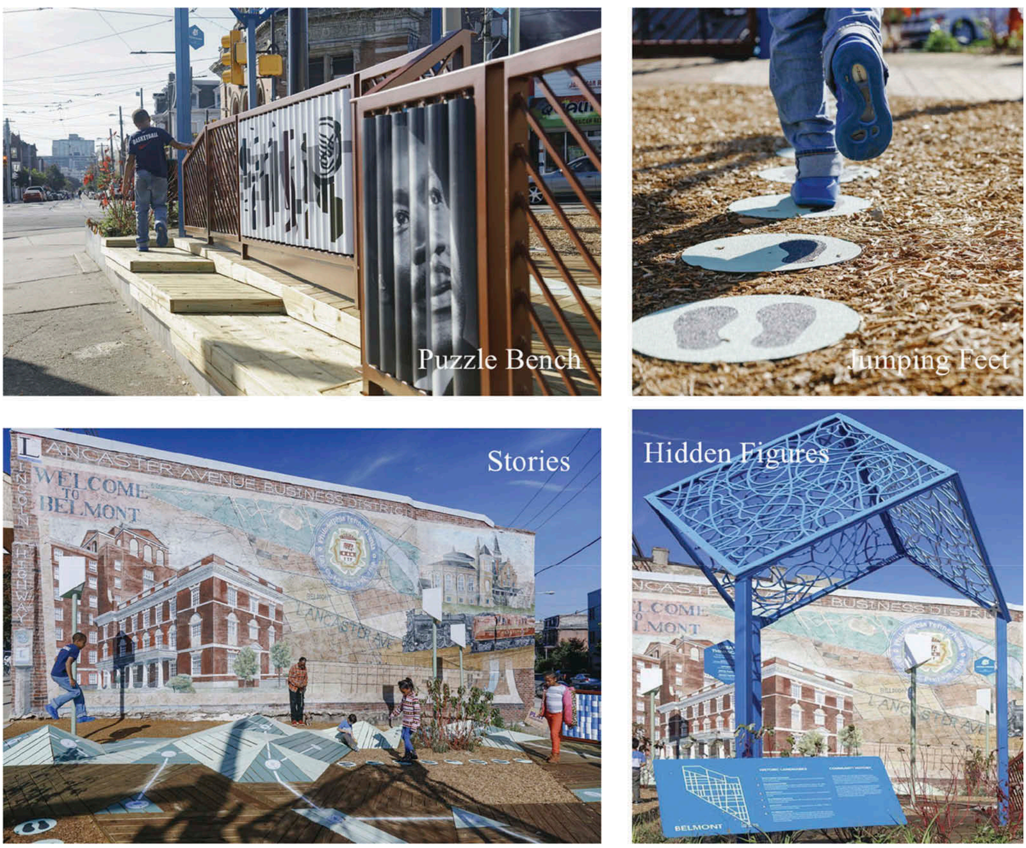


**Figure 2.** Urban Thinkscape installations.

printed onto tubes that turn around metal rods. Each puzzle has two different sides that can be solved separately. Note that by having more than one puzzle and multiple designs in each puzzle, there are always fresh and new opportunities at the bus stop.

*Stories* is a wooden deck made of pyramid-like facets of varying heights. This allows for children to be physically active while balancing and climbing their way across the installation to move from one narrative cue to another to create a story. Stories fosters the development of narrative skills, which impact children's literacy outcomes (Tabors, Snow, & Dickinson, 2001). The Stories icons were based on a standardized set of picture symbols used with children with speech, language, hearing, and developmental delays. This selection was made to ensure that all children would be able to access this activity. For example, a child starting on the sun icon might begin a story by saying, "Today I went outside and it was bright and sunny." Then, they could walk across the white lines to the next icon – the book – and build on their story by saying, "So I took my book and went to sit outside at the park." With younger children, caregivers can ask them to identify the objects in each narrative cue, building vocabulary and language skills – both precursors to narrative development.

The third design, *Jumping Feet*, morphs everyday hopscotch into an executive functioning activity that was based on the pattern used in the Happy Sad Task – a Stroop-like assessment used to gauge children's executive functioning skills (Lagattuta, Sayfan, & Monsour, 2011). "Executive functioning" is an umbrella term for the control of cognitive processes, including working memory, flexibility, and planning. Children's executive functioning abilities in early childhood predict later reading and mathematics achievement better than IQ scores (Blair & Razza, 2007). In the Jumping Feet activity, shoe prints encourage children to jump following a pattern – some featuring one shoe print and some with two, developing their ability to flexibly vary their jumping and to inhibit doing the same thing again. Jumping Feet also may elicit numerical language as caregiver-child groups discuss the pattern of shoe prints. Signage encourages children to put one foot where they see two and two where they see one.

Finally, *Hidden Figures* activates children's curiosity by placing figures within a high standing metal sculpture that reflects onto the ground as shadows. Searching in the metalwork or in the shadows sparks scientific curiosity by introducing a level of uncertainty about how the design creates different images at different times of day. As the sun moves across the sky, different shapes are revealed on the ground below. Building curiosity leads to the kinds of exploratory behavior that helps children become strong problem solvers (Bjorklund & Gardiner, 2010). This installation was designed to foster caregiver and child spatial and numerical language, which relates to children's development of skills in these areas (Levine et al., 2010).

## Data ambassadors

As we interacted with community members during the design phase of the project, one of the main requests we received was that community members wanted more research projects to offer employment opportunities to people from the neighborhood as well more involvement in research to create a sense of ownership in the process. We therefore employed neighborhood residents to be data collectors. As a result of a community open house and attendance at Belmont Alliance Civic Association meetings, the lead author recruited several interested persons. After an interview process, two Data Ambassadors were hired for the pre-test phase. Later, an additional Data Ambassador was hired for post-test. The Data Ambassadors were all women living within the same general area as Urban Thinkscape. They were between 40–60 years of age and their highest education level ranged from high school diploma to graduate degree, with two of the Data Ambassadors identifying as African-American and one as Asian American.

Over the course of several weeks, the lead author met with the Data Ambassadors for four 2.5-hour training sessions. During these sessions, she reviewed the observation and survey measures and gave many opportunities for practice, both using videos and real-life situations. Data Ambassadors were not exposed to the specific hypotheses of the study during training. Free YouTube videos of caregiver-child interactions as well as videos created by the lead author were used for training. Since the observations were not video-recorded, Data Ambassadors watched the videos one time through, and then discussed agreements and challenges. After each training meeting, Data Ambassadors were asked to independently code three new videos, which the lead author then compared to her own coding for agreement on measures. Then, the group reviewed these videos together and addressed disagreements in coding. After the fourth training session, the observers were required to observe at a local playground to practice in real-time. All data ambassadors also went through human subjects research training to ensure that they would adhere to all relevant protocols.

## Measures

### Naturalistic observation

Naturalistic observation was used to answer the question of how caregivers and children interacted and talked with each other at Urban Thinkscape and at the control site playground. The coding instrument was based upon observation protocols developed by Ridge et al., (2015) and Suskind (2016), which have been used in previous studies to collect similar naturalistic observation data. The observation protocol includes both child behaviors and caregiver behaviors related to conversational content (i.e., uses spatial language, numerical language, or talks about colors, letters, or sounds); the nature of the verbal interactions (i.e., asks questions, provides description or explanation); and non-verbal engagement features (i.e., laughs, points, touches, follows caregiver's focus, follows child's focus) (see Table 2 for an outline of the measure and the items that compose each dependent variable). Numerical language involved language related to numbers, numerical order, or sorting. Spatial language referred to any talk in the four spatial talk categories identified by Cannon, Levine, and Huttenlocher (2007): size (e.g., big, small, tall, short), features (e.g., heavy and light, bent, curvy), directions (e.g., above, under, over, through), or shapes (e.g., triangle, hexagon).

Additionally, we included measures of conversational turns, valence – or affect – of the interaction, caregiver communication style, technology use, and overall amount of physical activity. We received Institutional Review Board (IRB) approval from Temple University to collect these live observations. The observation protocol was used in both pre- and post-observations in the Urban Thinkscape study to measure if and how installations affected interaction between parents and children. The total interaction score for a caregiver-child group ranged from 2– 33. The observation protocol was used

**Table 2.** Observation protocol items and dependent variable composition.

| Dependent Variable | Items |
|---|---|
| **Overall Verbal and Physical Interaction Scores** | |
| Caregiver Interaction Score | • Stop in the area (yes = 1 point)<br>• Point to the play space (yes = 1 point)<br>• Ask about the play space (yes = 1 point)<br>• Provide information about the play space (yes = 1 point)<br>• Use numerical language (yes = 1 point)<br>• Use spatial language (yes = 1 point)<br>• Talk about colors (yes = 1 point)<br>• Talk about letters and sounds (yes = 1 point)<br>• Laugh (yes = 1 point)<br>• Physically interact with the space (yes = 1 point)<br>• Engage in physical activity (somewhat active = 0 points; moderately active = 1 point; very active = 2 points)<br>• Follow the child's focus (0 times = 0 points; 1–3 times = 1 point; 4–6 times = 2 points; 7+ times = 3 points)<br>• Uses technology (yes = − 1 point) |
| Child Interaction Score | • Ask to stop in the play space (yes = 1 point)<br>• Point to the play space (yes = 1 point)<br>• Ask about the play space (yes = 1 point)<br>• Provide information about the play space (yes = 1 point)<br>• Respond to the caregiver (yes = 1 point)<br>• Use numerical language (yes = 1 point)<br>• Use spatial language (yes = 1 point)<br>• Talk about colors (yes = 1 point)<br>• Talk about letters and sounds (yes = 1 point)<br>• Laugh (yes = 1 point)<br>• Physically interact with the space (yes = 1 point)<br>• Engage in physical activity (somewhat active = 0 points; moderately active = 1 point; very active = 2 points)<br>• Follow the caregiver's focus (0 times = 0 points; 1–3 times = 1 point; 4–6 times = 2 points; 7 + times = 3 points)<br>• Uses technology (yes = − 1 point) |
| **Specific Language Scores** | |
| Caregiver Language Score | • Ask about the play space (yes = 1 point)<br>• Provide information about the play space (yes = 1 point)<br>• Use numerical language (yes = 1 point)<br>• Use spatial language (yes = 1 point)<br>• Talk about colors (yes = 1 point)<br>• Talk about letters and sounds (yes = 1 point) |
| Child Language Score | • Ask to stop in the play space (yes = 1 point)<br>• Ask about the play space (yes = 1 point)<br>• Provide information about the play space (yes = 1 point)<br>• Respond to the caregiver (yes = 1 point)<br>• Use numerical language (yes = 1 point)<br>• Use spatial language (yes = 1 point)<br>• Talk about colors (yes = 1 point)<br>• Talk about letters and sounds (yes = 1 point) |

in both for pre- and post-observations to measure if and how the Urban Thinkscape installations affected interaction between children and caregivers, and in comparison to the control site playground.

To measure interrater reliability, Data Ambassadors went to a playground location in pairs. Each pair observed the same five caregiver-child groups for a total of five minutes per group. Then, the lead author compared their observations to determine agreement. All coders achieved at least 93% agreement on the total observation score for each group observed and were allowed to begin coding independently.

Pre-test observations took place over a 5.5-week period in the spring of 2017. The Urban Thinkscape installation was completed in October 2017, and post-test observations occurred over a 6-week period beginning just after the opening of Urban Thinkscape until December 2017. The decision was made to conduct post-test analyses at this time due to the desire to capture the public's initial reaction to Urban Thinkscape and how that reaction evolved over a 6-week period. A single Data Ambassador, assigned to either Urban Thinkscape or the control site (the assignments alternated by week), remained at the location for 60 minutes at a time and filled out an observation sheet for each caregiver–child group that stopped in the site area. When they completed observing one group because the group left the area, they would begin observing another group. Data Ambassadors pretended to be writing in a notebook while sitting on a bench or leaning against a fence, thus fitting into the activities of the outdoor spaces while they captured naturalistic interactions. This was done to increase the ecological validity of the data collection. By locating themselves in relatively close proximity to the caregiver-child groups without becoming intrusive, the Data Ambassadors were able to collect all of the information included on the observation protocol. The Data Ambassadors observed for approximately six hours a week across the two sites, with their observations spread out evenly across times of day, roughly between the hours of 9:00 a.m. and 6:30 p.m.

## Results

First, we analyzed the observation data based on our two initial hypotheses. Initial data diagnostics revealed that the data violated the assumptions of normality of residuals for the Group Interaction Score and Group Total Language Score. The normality issue was unable to be resolved by transforming the data, so non-parametric tests were used.

With regard to effect sizes, these analyses present Cohen's *d* effect sizes. For Cohen's *d*, values equal to or above .02 are considered small, values equal to or above .05 are considered medium, and values equal to or above .80 are considered large (Cohen, 1988).

**Hypothesis 1: Urban Thinkscape will spark more verbal engagement and physical interaction with the space for families with preschool through elementary-aged children, both from pre- to post-assessment, and compared to a control site playground.**

We examined how families interacted and engaged at Urban Thinkscape and at the control site playground, both before and after the installation of the Urban Thinkscape designs. Using the Mann-Whitney *U*-test with the Group Interaction Score as the dependent variable at pretest, results showed a statistically-significant difference and revealed that caregivers and children interacted more at the control site than at the future site of (i.e. pre-test) Urban Thinkscape ($z = -8.72$, $p = .001$). This obtained difference represents a large effect size (i.e., Cohen, 1988, $d = -2.13$). Scores at the control site decreased significantly from pre- to post-test while the scores increased at Urban Thinkscape. Using the Mann-Whitney *U*-test with the Group Interaction Score as the dependent variable, findings demonstrated a statistically-significant difference and revealed that caregivers and children interacted more at Urban Thinkscape than at the control site at post-test ($z = -2.69$, $p = .007$). This obtained difference represents a medium-to-large effect size (i.e., Cohen, 1988, $d = -.47$). One potential reason for the decrease in interaction at the control site is that the pre-test data were collected in the spring, while the post-test data were collected in the late fall and winter. It is likely that fewer interactions were taking place at the control site playground as a result of less daylight and colder temperatures – yet we still saw similar observation lengths at the control site at both pre- and post-test (see Table 1).

At the same time, Urban Thinkscape post-test scores almost reached the level of the pre-test scores at the playground even during the fall/winter (see Table 3 for means). We these post-test means from Urban Thinkscape with the pre-test means from the control site and found that there was no statistically significant difference between them ($z = -1.35$, $p = .176$). This indicates that the amount of interaction at Urban Thinkscape in the winter was similar to the amount of interaction taking place at the playground in the summer. Additionally, the time spent at site was similar for pre-test at the control site (17.8 minutes), post-test at Urban Thinkscape (17.1 minutes), and post-test at the control site (15.6 minutes), suggesting that people were spending fairly equivalent amounts of time at the sites (except for Urban Thinkscape at pre-test (2.4 minutes)), regardless of the time of year.

We were particularly interested in whether caregivers and children were asking questions regarding the playground and Urban Thinkscape spaces. Using Pearson Chi-Square tests, results demonstrated a statistically-significant relationship between question-asking and location at pre-test, with both caregivers ($\chi^2 = 23.711$, $df = 1$, $p = .001$) and children ($\chi^2 = 16.743$, $df = 1$, $p = .001$) asking questions more often at the control site than at the future Urban Thinkscape site. At post-test, caregivers ($\chi^2 = 12.601$, $df = 1$, $p = .001$) and children ($\chi^2 = 7.451$, $df = 1$, $p = .006$) were more likely to ask questions at Urban Thinkscape than at the control location. When comparing pre-test data from the control site to post-test results from Urban Thinkscape, findings demonstrate that both caregivers ($\chi^2 = 1.564$, $df = 1$, $p = .211$) and children ($\chi^2 = .072$, $df = 1$, $p = .788$) asked questions at similar rates, suggesting a comparable pattern to that found with the Group Interaction Score.

**Table 3.** Descriptive statistics for observation protocol total scores.

| | Pre-test | | Post-test | |
|---|---|---|---|---|
| | Urban Thinkscape | Control | Urban Thinkscape | Control |
| Group Interaction Score<br>Total possible points = 33<br>**Items included**: Caregiver Interaction Score + Child Interaction Score | 3.39 (SD 1.9) | 12.54 (SD 6.8) | 11.19 (SD 7.9) | 6.77 (SD 4.1) |
| Caregiver Interaction Score<br>Total possible points = 16 | 1.51 (SD 1.1) | 5.45 (SD 3.5) | 5.40 (SD 3.5) | 3.59 (SD 1.7) |
| Child Interaction Score<br>Total possible points = 17 | 1.90 (SD 1.1) | 7.09 (SD 3.6) | 5.78 (SD 4.5) | 3.17 (SD 2.6) |
| Group Language Score<br>Total possible points = 17<br>**Items included**: Caregiver Language Score + Child Language Score + Number of Conversation Turns | 0.77 (SD .85) | 5.22 (SD 4.3) | 5.30 (SD 5.3) | 1.96 (SD 2.5) |
| Caregiver Language Score<br>Total possible points = 6 | 0.06 (SD .44) | 1.33 (SD 1.9) | 1.52 (SD 2.1) | 0.35 (SD 1.0) |
| Child Language Score<br>Total possible points = 8 | 0.02 (SD .47) | 2.35 (SD 2.3) | 2.28 (SD 2.8) | 0.59 (SD 1.5) |

*Note*. The items included in the Caregiver Interaction Score, Child Interaction Score, Caregiver Language Score, and Child Language Score are noted in Table 2.

Technology use was examined using Pearson Chi-Square tests to see if caregivers and children changed how they used smartphones and tablets while at the control site or Urban Thinkscape from pre- to post-test. Results showed a statistically-significant relationship between technology use and location at pre-test, with both caregivers ($\chi^2$ = 26.925, *df* = 1, *p* = .000) and children ($\chi^2$ = 8.798, *df* = 1, *p* = .003) using technology more often at the control site than at the future Urban Thinkscape site. At post-test, caregivers ($\chi^2$ = 1.752, *df* = 1, *p* = .186) and children ($\chi^2$ = 1.336, *df* = 1, *p* = .248) using technology at similar rates at both locations. Means demonstrated that amount of technology use decreased from pre- to post-test at the control site while time increased at Urban Thinkscape. Yet, when we compare pre-test data from the control site to post-test results from Urban Thinkscape, findings suggest that caregivers used technology more often at the control site (z = 2.153, *p* = .031), while there were no statistically significant differences between locations regarding children's technology use (z = − .921, *p* = .357).

We also examined changes in physical interaction with the space at both locations over the course of the study. Coded here were activities such as climbing on the playground equipment or manipulating the Urban Thinkscape installations. At pre-test, results suggest that caregivers ($\chi^2$ = 44.483, *df* = 1, *p* = .001) and children ($\chi^2$ = 69.398, *df* = 1, *p* = .001) interacted more physically with the control site playground than the future Urban Thinkscape site. At post-test, caregivers interacted with both locations at similar amounts ($\chi^2$ = 1.466, *df* = 1, *p* = .226), while children had more physical interaction with the Urban Thinkscape installations than the control site playground ($\chi^2$ = 6.021, *df* = 1, *p* = .014). These results demonstrate that caregivers and children interacted with the physical space less at the control site playground at post-test than pre-test, while caregivers and children interacted more with the space at Urban Thinkscape at post-test. Again, the change at the control site playground may be a result of the time of year, but when looked at in the context of Urban Thinkscape – which had the same weather conditions – this is an interesting pattern.

To attempt to address the potential seasonal issue, we also examined pre-test physical interaction with the space at the control site with the post-test results from Urban Thinkscape. Both caregivers ($\chi^2$ = 13.856, *df* = 1, *p* = .001) and children ($\chi^2$ = 17.034, *df* = 1, *p* = .001) physically interacted with playground more than the Urban Thinkscape installations. This is not overly surprising since Urban Thinkscape is a playful learning space and not a playground in the traditional sense.

Finally, we examined the total number of conversational turns between caregiver-child groups at each site by time point. Conversational turns refer to exchanges in which a caregiver says something and the child responds, or vice versa. For example, the following example features two conversational turns: Child: "Look, mom – a bird!" Mother: "Oh, how pretty!" Mother: "What color is it?" Child: "It's red and brown." Conversational turns were coded as falling into the following ranges: 0, 1–5, 6–10, and 11 + .

At pre-test, caregivers and children had more conversational turns at the control site playground than at the future site of Urban Thinkscape (z = − 7.162, *p* = .001). This difference represents a large effect size (i.e., Cohen, 1988, *d* = − 1.49). At post-test, caregivers and children demonstrated more conversational turns at Urban Thinkscape than at the control site (z = − 4.950, *p* = .001). This difference also represents a large effect size (i.e., Cohen, 1988, *d* = − .933). As shown in Figure 3, 51% of caregiver-child groups did not talk at all at the Urban Thinkscape site at pre-test, and yet at post-test, 32% had

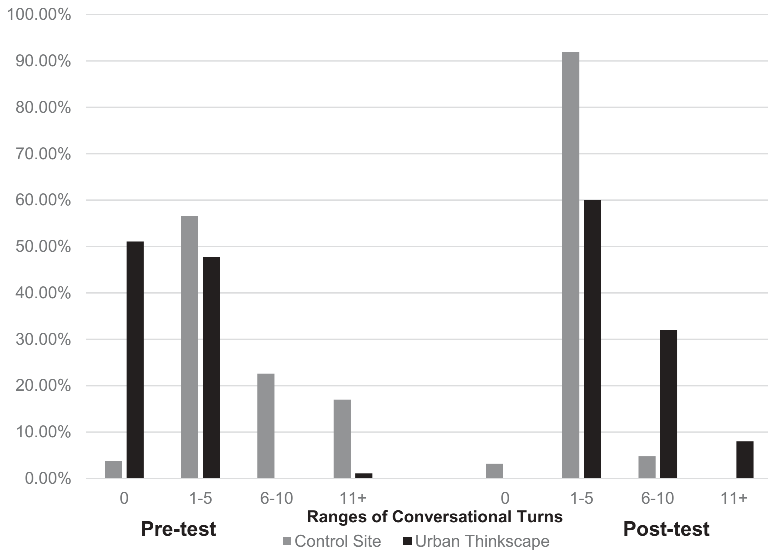


**Figure 3.** Percentage of caregiver-child groups in each conversational turn range by location and time point (pre-test and post-test).

6–10 conversational turns. At the control site, the shift was toward having fewer conversational turns, 57% having 1–5 turns at pre-test to 92% falling into that category at post-test. Again, this shift may have been due to seasonal weather conditions, and as such, we compared pre-test conversational turns at the control site playground with post-test values at Urban Thinkscape. This comparison showed no statistically significant differences in conversational turns between the two sites ($z = -.192$, $p = .848$), demonstrating that caregiver-child groups at Urban Thinkscape in the winter were talking as much as groups at the playground in the summertime.

**Hypothesis 2: Caregivers and children at Urban Thinkscape will have more conversations that reflect the specific topics highlighted installations, namely spatial, mathematics, and literacy content, both from pre- to post-assessment, and compared to a control site playground.**

To probe for the specific types of interactions shown to support child development, we examined Group Total Language Scores by location and time point. This variable includes caregiver and child use of numerical and spatial language as well as language related to colors and letters or sounds. It also includes caregiver and child question-asking and answering behaviors. There were significant differences between sites at both pre- and post-test time points. Using the Mann-Whitney *U*-test with the Group Total Language Score as the dependent variable at pre-test, caregivers and children used more of the targeted language at the control site than at the future site of Urban Thinkscape ($z = -8.301$, $p = .001$, $d = -1.93$). At post-test, caregivers and children demonstrated more of the targeted language types at Urban Thinkscape than at the control site playground ($z = -4.515$, $p = .001$, $d = -.837$).

Similar to the interaction results, these findings suggest that language use decreased from pre- to post-test at the control site while increasing at Urban Thinkscape. To address this issue, we compared the pre-test Group Total Language Scores at the control site playground with the post-test scores at Urban Thinkscape. There were no significant differences in total language use ($z = -1.104$, $p = .269$) between locations, demonstrating that overall language use at Urban Thinkscape increased enough from pre-test to be about equal with that at the control location.

To look more closely at the specific types of language used, we examined the percentage of caregiver-child groups that used each type of language at each location at pre- and post-test (Figure 4). At pre-test, 2.2% of caregiver-child groups used spatial language at the future site of Urban Thinkscape and no other language types were present. A maximum of 30% of groups at the control site used the various language types. At post-test, a maximum of 36% of caregiver-child groups used the various language types at the Urban Thinkscape site, while we saw major decreases in use at the control site, with the maximum groups using these language types being 9.7%. Yet, the comparison between pre-test control site and post-test Urban Thinkscape demonstrated that 6% more caregiver-child groups used the targeted language types at Urban Thinkscape, which is encouraging.

We were also interested in determining how often the caregiver followed the focus of the child during the interaction (Figure 5). Following the child's focus involved pointing or addressing the same person, target, or symbol as the child (Ridge et al., 2015). For example, if the child says, "Look at the slide! I want to go over there," and the caregiver replies, "Oh yes, I know you love the slide. Let's leave this and go over there," that would count as an instance of following the focus of the child. At pre-test, caregivers at the control site playground followed the children's focus more frequently than caregivers at the future site of Urban Thinkscape ($z = -6.20$, $p = .001$, $d = -1.21$), while at post-test, caregivers at Urban Thinkscape followed children's focus the most often ($z = -8.62$, $p = .001$, $d = -.70$). For children following the caregiver's focus, at pre-test, children at the control site playground followed the caregiver's focus more often than children at the future site of Urban Thinkscape ($z = -5.871$, $p = .001$, $d = -1.13$). At post-test, children at Urban Thinkscape followed their caregiver's focus more often ($z = -3.703$, $p = .001$, $d = -.67$). In fact, caregivers at Urban Thinkscape at post-test were following children's focus at a similar rate as those at the control site at pre-test ($z = -1.936$, $p = .060$).

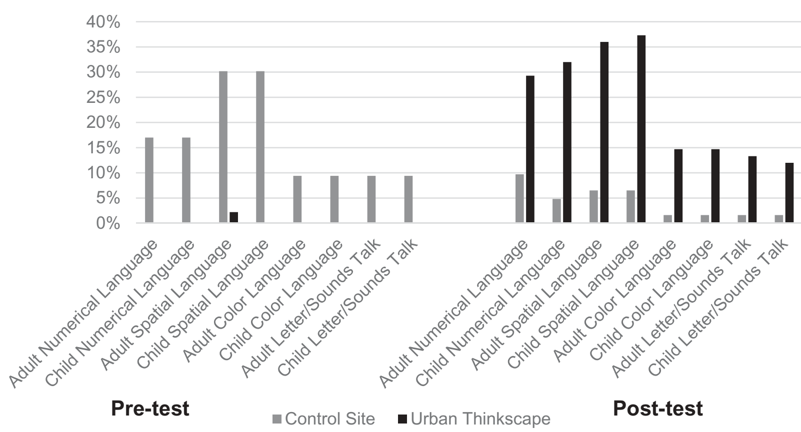


Figure 4. Percentage of caregiver-child groups that used specific language types by location and time point.

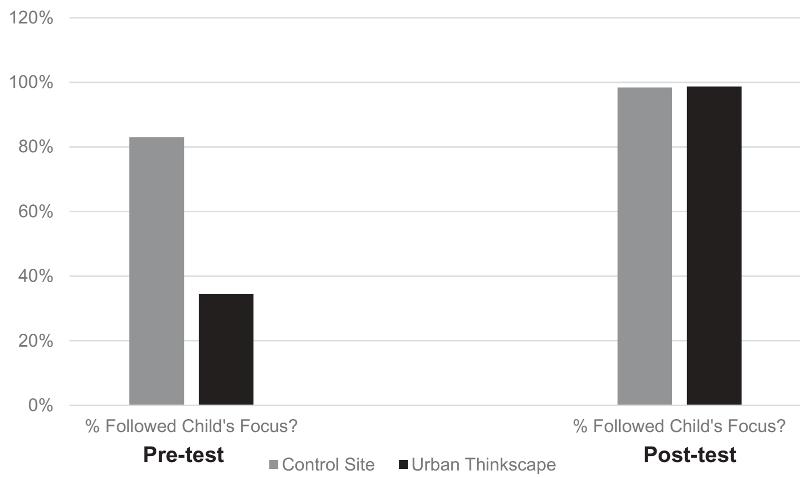


**Figure 5.** Percentage of caregivers who followed child's focus by location and time point.

## Discussion

Urban Thinkscape was designed as a rich placemaking initiative for the purpose of increasing caregiver-child interaction and discourse. The project was designed alongside the local community and featured a truly interdisciplinary collaboration between psychologists, architects, urban planners, city officials, community leaders, local nonprofit organizations, and community members.

Results demonstrated that Urban Thinkscape made an impact on caregiver-child interaction in the community. The majority of the interaction and discourse dependent variables of interest demonstrated large effect sizes, which suggests sizable and meaningful differences were present between the groups. Caregiver-child groups interacted more and had more conversations at the completed Urban Thinkscape site than they did before installation (and they also almost equaled or outperformed caregiver-child groups at our control site playground) – demonstrating that regardless of the time of year, families need to take the bus to work, school, and other everyday activities.

By increasing interaction at Urban Thinkscape to similar levels present at the control site playground at pre-test, we demonstrate that infusing some of the science of learning into architectural design has the potential to inspire caregivers and children to transform their interactions at the bus stop and adjacent space from silently waiting to engaging each other in conversation. Caregivers and children also interacted more with the physical space at Urban Thinkscape after installation than before. This suggests that groups found the cluster of installations to be engaging – with Jumping Feet being frequently noted as the installation most used by individual groups. Additionally, the increase in numerical, spatial, and letters/sounds talk suggests that groups were addressing the topics that we were targeting through the installations. These findings suggest that the introduction of the four Urban Thinkscape designs – Stories, Hidden Figures, Jumping Feet, and Puzzle Bench – spurred also spurred caregivers to use the types of language that we targeted through the installations, at greater rates than the families at the control site playground.

### *Why urban thinkscape?*

Urban Thinkscape is not the only project exploring ideas of transforming public spaces into opportunities for caregiver-child conversation and interaction through play – it is part of a larger initiative called Playful Learning Landscapes (Bustamante, Hassinger-Das, Hirsh-Pasek, & Golinkoff, 2019; Hassinger-Das, Bustamante, Hirsh-Pasek, & Golinkoff, 2018). Playful Learning Landscapes includes projects targeting different types of spaces, from the bus stop in Urban Thinkscape, to supermarkets (Ridge et al., 2015) and parks (Grob et al., 2017). The first Learning Landscapes project – the Ultimate Block Party (UBP; Grob et al., 2017) – was an event that engaged 50,000 people in 28 playful learning activities in Central Park in 2010. Like Urban Thinkscape, UBP sought to transform parental attitudes about the relation between play and learning in a community setting. The results from UBP showed that playful learning can be successfully introduced in public spaces targeting outcomes in STEM learning and in literacy to name a few, but it takes exposure to 3–4 activities to change caregivers' attitudes about the relation between play and learning (Grob et al., 2017). Urban Thinkscape takes the lessons from UBP and extends them into the community itself by going where people naturally wait rather than to a destination.

Though the Ultimate Block Party was a destination, Ridge et al., (2015) sought to bring similar interventions to natural daily routines – trips to the supermarket. Authors and colleagues studied whether unobtrusive signs placed in supermarkets would increase conversations among families across socioeconomic groups. Open-ended questions relating to supermarket topics were placed in both low-SES and high-SES stores like "What's your favorite vegetable?" An introductory sign was placed toward the front of the store informing parents that talking with children helps their language grow – priming parents for further engagement. Two additional signs were placed in the refrigerated section: one for milk and one for frozen vegetables. These signs guided parents to start conversations about the origin of the items, why these items are healthy, and what items do the children prefer. A sign-up condition was noted when the signs were present to shoppers, while no signs were present in the sign-down condition. Live observers coded for conversation in caregiver-child groups. Results showed that when signs were posted, low-income families demonstrated a 33% increase in interaction versus the levels of interaction present when the signs were not present. This increase in conversation during the sign-up condition was not present with higher-income families (Ridge et al., 2015), who were already engaging in frequent conversations.

### *Engagement and interaction in public spaces*

As its particular contribution to the Playful Learning Landscapes initiative, Urban Thinkscape demonstrated that this playful space was a way to bring people together to talk, interact, and use an everyday public space in new ways (Sumerling, 2017). In particular, playful learning provides a unique way to foster learning and engagement with the built environment. The physical environment may influence curiosity, through the creation of a *mise en place* – a disposition and readiness to engage in and explore a learning activity (Weisberg, Hirsh-Pasek, Golinkoff, & McCandliss, 2014) – while also encouraging caregiver-child discourse and engagement in activities involving language, mathematics, and spatial topics. When families visit a place like Urban Thinkscape, it may be that the connection between play and learning is strengthened, which might lead to a more positive approach to learning activities, especially if they visit multiple times and if it is situated in the context of more densely clustered activities.

It is worth noting that the gains in interaction and language use at Urban Thinkscape were large and statistically significant – for example, in the case of Group Total Interaction at Urban Thinkscape, scores increased 24% from pre- to post-test, and Group Total Language scores were 27% greater at post-test. Additionally, at post-test, the mean Group Total Language score at Urban Thinkscape was 5.3 out of a possible 17 – up significantly from the pre-test mean of 0.77. Importantly, these gains are similar to those present in the supermarket study (Ridge et al., 2015). These findings support our targets of increased caregiver-child communication at the Urban Thinkscape site.

This initial growth is encouraging, and our current work is examining how the addition of new signage with simple prompts and information about the content highlighted in each design might affect children's learning outcomes. Song et al. (2017) found that signage featuring information about the type of academic content contained in a children's museum exhibit was associated with an increase in parents recognizing the educational value of the exhibit. Additionally, signage including information about the academic content related to the activity may put caregivers into an educational mindset, helping them see the area as a learning opportunity for their child. For example, the updated sign for Stories reads, "Ask your child: Can you connect the pictures to tell your own story?" and also, "Fact: Telling stories builds strong language skills." The goal of the new signage is to see if a simple alteration can provide an additional boost in caregiver-child interaction and conversation.

Finally, it is critical to highlight the nature of working on community-based participatory research projects. Throughout the process of creating Urban Thinkscape, we were committed to involving community members from the very beginning of a project. It was absolutely necessary to have community support over the course of the project to make sure that the installations were reflective of the neighborhood and its residents; but it was also critical to have community support after the end of the project to ensure that neighbors felt ownership over the project and community groups took part in caretaking the site. Our main community partner, Ms. Bettye Ferguson from the Belmont Alliance Civic Association, has also taken part in disseminating the findings of the project by presenting both with the research team and solo at national conferences and community gatherings.

## Limitations

Although results from Urban Thinkscape are encouraging, there are limitations that should be noted. Firstly, one major limitation was the lack of time at site data for less than half (45%) of the sample. This was due to all of the Data Ambassadors failing to note the starting and ending time of some of the observations. The lead author worked with all data collectors to improve this rating over the course of the study, but the data that are missing would help us to know more about how the caregiver-child groups spent their time at the sites. Second, it is unclear exactly which Urban Thinkscape activities made the difference in increasing caregiver-child interaction since our unit of analysis was the cluster as a whole. Thirdly, due to the nature of naturalistic observation, we were unable to determine exact demographic information about caregivers and children or if families visited the sites multiple times. This information would be helpful in determining the effects of Urban Thinkscape on caregiver-child interaction and conversation.

It will be informative for future research to include a delayed post-test to shed light on what degree the novelty of the installations drives the increased caregiver and child outcomes. However, our other work with designers and community members to install Play-and-Learn Spaces in libraries has demonstrated similar results with even longer periods of data collection (Hassinger-Das et al., under review), suggesting that while novelty may play a role, it is not the sole driver of the success of these type of installations.

Also, it may be that some of the observations at both sites and at both time points may have been the same caregiver-child groups, which limits the generalizability of these findings. Families may use Urban Thinkscape somewhat similarly to a playground, although they are likely using it because they are waiting for the bus or stopping there on their way to somewhere else. On the other hand, the control site playground is a destination that caregivers and children plan to visit. Thus, it is likely that the samples are different because the two places have difference purposes. In addition, while they are within the same much larger neighborhood, the two sites are approximately a 20-minute walk apart, suggesting that they are drawing on different visitors from the same neighborhood.

Additionally, though the Data Ambassadors were blind to the study hypotheses, they could not be blind to whether they were at a bus stop or a playground. It is, however, likely that they expected more interactions at a playground than a bus stop, which would be contrary to the main hypotheses of the study. Another limitation was the time of year for post-test data collection. The installation of Urban Thinkscape was delayed by four months due to construction issues, which led to data collection taking place in the Fall and Winter instead of Summer. It is encouraging that we still saw significant gains in interaction and language use at the Urban Thinkscape site, regardless of the weather conditions and it is noteworthy that the observations were still plentiful at post-test in both environments and that the weather in both environments was the same. Additionally, we also provided comparisons between pre-test control site data and post-test Urban Thinkscape, in order to demonstrate a more stringent test of the installations.

One other limitation worth noting is that although the overarching goal of Urban Thinkscape (and other Playful Learning Landscapes projects) is to improve learning outcomes for children. Here, we can only suggest that there is a connection between increased caregiver-child interaction and use of specific language types–including spatial and mathematics–that might relate to children's development of academic and 21st century skills. While this link is suggested by previous work (Adamson et al., 2014; Hirsh-Pasek et al., 2015; Gunderson & Levine, 2011; Levine et al., 2010; Pruden et al., 2011), future research will examine possible ways to collect child-level data that focus more directly on learning outcomes.

## Conclusion

This project ushers in a form of architectural design that explicitly embodies lessons from psychological science about how children learn. It was designed to invite exploration and interaction between caregivers and children that have been shown to spur children's curiosity and informal learning. Urban Thinkscape involved attempted to increase caregiver-child discourse and engagement around public space; it involved a large number of community members who had not been in prior communication, such as parents and other caregivers, psychology researchers, architects, and community organizers. It is this element of community collaboration that created the foundation for a sustainable intervention.

Urban Thinkscape relates closely to other work designed to focus heavily on translational external validity, meaning how well we can apply the findings to other situations. This type of research was highlighted in a special issue of *Child Development* (Volume 88, Issue 5) entitled "Bringing Developmental Science into the World," whose purpose was to share research that demonstrates the call that Urie Bronfenbrenner and Ernest Boyer gave for leaving the laboratory to conduct rigorous developmental research in the real world in the places where children go. We have continued the conversation that this issue started between researchers, designers, and community members to encourage the natural integration of playful learning into a variety of community spaces to enrich the "other 80%" of time that children spend outside of school while also enhancing community participation and beautifying the community. Urban Thinkscape has great potential for spurring discourse and interaction in urban environments and this iteration of the project represents just a beginning.

Beyond the first Urban Thinkscape installations, our eventual goal is to introduce similar projects in other neighborhoods in Philadelphia – in fact, this work has already begun through the debut of Parkopolis, a life-sized board game (Hassinger-Das et al., 2018), and Play Wall, which asked community members to contribute their memories about how they played when they were young and then hosting an intergenerational community event featuring those very same games (Hassinger-Das et al., 2018). We are particularly interested in fostering this type of family-to-family interaction within future projects. We will also seek to expand Urban Thinkscape and our other Learning Landscapes projects into other cities around the world – a process that has already begun in places like Johannesburg, South Africa. Urban Thinkscape uses the city itself as the agent of change in an effort to encourage increased caregiver-child engagement and interaction, which may in turn lead to gains in learning outcomes.

## Acknowledgments

The authors thank Ms. Bettye Ferguson, CEO of the Belmont Alliance Civic Association, for her invaluable support of Urban Thinkscape. They also extend their thanks to the project's Data Ambassadors, Ms. Sherry-Jane Alindogan, Ms. Maria Lyles, Ms. Alicia Walton, and Ms. Sharon Williams. Finally, the authors thank the Community Bible Deliverance Kingdom Ministries for donating the use of the land on which Urban Thinkscape is located.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Funding

This work was supported by the William Penn Foundation [grant number 103-15].

## ORCID

Brenna Hassinger-Das http://orcid.org/0000-0002-1183-0646
Kathy Hirsh-Pasek http://orcid.org/0000-0003-2947-4544

## References

Adamson, L. B., Bakeman, R., Deckner, D. F., & Nelson, P. B. (2014). From interactions to conversations: The development of joint engagement during early childhood. *Child Development*, *85*, 941–955. doi:10.1111/cdev.12189

Bjorklund, D. F., & Gardiner, A. K. (2010). Object play and tool use: Developmental and evolutionary perspectives. In A. Pellegrini (Ed.), *Oxford handbook of the development of play* (pp. 153–171). New York, NY: Oxford University Press.

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten.*Child Development*, *78*(2), 647–663.:

Brekke, H. (2016). How does the built environment affect behaviour and cognition? In A. Fritz (Ed.), *Conscious cities: An anthology no. 1*. London, UK: The Cube and the Museum of Architecture.

Bustamante, A. S., Hassinger-Das, B., Hirsh-Pasek, K., & Golinkoff, R. M. (2019). Putting the science of learning to work: Designing learning landscapes for cities and families. *Child Development Perspectives*, *13*(1), 34-40. doi:10.1111/cdep.12309

Cannon, J., Levine, S., & Huttenlocher, J. (2007). A system for analyzing children and caregivers' language about space in structured and unstructured contexts. Spatial Intelligence and Learning Center (SILC) technical report.

City-Data. (2016). *Philadelphia, PA Detailed Profile*. Retrieved from http://www.city-data.com/

Claessens, A., & Engel, M. (2013). How important is where you start? Early mathematics knowledge and later school success. *Teachers College Record*, *115*, 1–29.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Collins, S. E., Clifasefi, S. L., Stanton, J., Straits, K. J. E., Gil-Kashiwabara, E., & Wallerstein, N.; ; . (2018). Community-based participatory research (CBPR): Towards equitable involvement of community in psychology research. *American Psychologist*, *73*(7), 884–898. doi:10.1037/amp0000167.

Duncan, G. J., Kalil, A., & Ziol-Guest, K. M. (2017). Increasing inequality in parent incomes and children's schooling. *Demography*, *54*(5), 1603–1626. doi:10.1007/s13524-017-0600-4

Fisher, K., Hirsh-Pasek, K., Golinkoff, R. M., Singer, D., & Berk, L. E. (2011). Playing around in school: Implications for learning and educational policy. In A. Pellegrini (Ed.), *The Oxford handbook of play* (pp. 341–363). New York, NY: Oxford University Press.

Golinkoff, R. M., & Hirsh-Pasek, K. (2016). *Becoming brilliant*. Washington, DC: American Psychological Association.

Grob, R., Schlesinger, M., Pace, A., Golinkoff, R. M, & Hirsh-Pasek, K. (2017). Playing with ideas: Evaluating the impact of the ultimate block party, a collective experiential intervention to enrich perceptions of play. *Child Development*, *88*(5), 1419-1434.

Gunderson, E. A., & Levine, S. C. (2011). Some types of parent number talk count more than others: Relations between parents' input and children's cardinal-number knowledge. *Developmental Science*, *14*(5), 1021–1032. doi:10.1111/j.1467-7687.2011.01050.x

Han, M., Moore, N., Vukelich, C., & Buell, M. (2010). Does play make a difference? Effects of play intervention on at-risk preschoolers' vocabulary learning. *American Journal of Play*, *3*, 82–105.

Hassinger-Das, B., Bustamante, A., Hirsh-Pasek, K., & Golinkoff, R. M. (2018). Learning landscapes: Playing the way to learning in public spaces. *Education Sciences: (Special Issue) Early Childhood Education*, *8*(2), 74. doi:10.3390/educsci8020074

Hassinger-Das, B., Hansen, N., Zosh, J. M., Talarowski, M., Zmich, K., Golinkoff, R. M., & Hirsh-Pasek, K. (under review). Play-and-Learn spaces in the library: Leveraging library spaces to promote play and learning. Manuscript submitted for publication.

Hassinger-Das, B., Toub, T. S., Zosh, J. M., Michnick, J., Hirsh-Pasek, K., & Golinkoff, R. M. (2017). More than just fun: A place for games in playful learning. *Infancia y Aprendizaje [Infancy and Learning], 40,* 191–281. https://doi.org/10.1080/02103702.2017

Hirsh-Pasek, K., Zosh, J. M., Golinkoff, R. M., Gray, J. H., Robb, M. B., & Kaufman, J. (2015). Putting education in "educational" apps: Les- sons from the science of learning. *Psychological Science and Public Interest, 16*, 3–34. https://doi.org/10.1177/1529100615569721

Hoff, E. (2013). Interpreting the early language trajectories of children from low-SES and language minority homes: Implications for closing achievement gaps. *Developmental Psychology*, *49*, 4–14. doi:10.1037/a0027238

Lagattuta, K. H., Sayfan, L., & Monsour, M. (2011). A new measure for assessing executive function across a wide age range: Children and caregivers find happy-sad more difficult than day-night. *Developmental Science*, *14*(3), 481–489. doi:10.1111/j.1467-7687.2010.00994.x

Levine, S. C., Suriyakham, L. W., Rowe, M. L., Huttenlocher, J., & Gunderson, E. A. (2010). What counts in the development of young children's number knowledge? *Developmental Psychology*, *46*, 1309–1319. doi:10.1037/a0019671

Lillard, A. S., Lerner, M. D., Hopkins, E. J., Dore, R. A., Smith, E. D., & Palmquist, C. M. (2013). The impact of pretend play on children's development: A review of the evidence. *Psychological Bulletin*, *139*, 1-34. doi:10.1037/a0029321

Meltzoff, A. N., Kuhl, P. K., Movellan, J., & Sejnowski, T. J. (2009). Foundations for a new science of learning. *Science*, *325*, 284–288. doi:10.1126/science.1175626

Nicolopoulou, A., McDowell, J., & Brockmeyer, C. (2006). Narrative play and emergent literacy: Storytelling and story-acting meet journal writing. In D. G. Singer, R. M. Golinkoff, & K. Hirsh-Pasek (Eds.), *Play = learning: How play motivates and enhances children's cognitive and social-emotional growth* (pp. 124–144). New York, NY: Oxford University Press.

Pace, A., Alper, R., Burchinal, M. R., Golinkoff, R. M., & Hirsh-Pasek, K. (2018). Measuring success: Within and cross-domain predictors of academic and social trajectories in elementary school. *Early Childhood Research Quarterly*. Advance online publication. doi: 10.1016/j.ecresq.2018.04.001.

Palti, I., & Bar, M. (2015, August 28). A manifesto for conscious cities: Should streets be sensitive to our mental needs? *The Guardian*. Retrieved from https://www.theguardian.com/cities/2015/aug/28/manifesto-conscious-cities-streets-sensitive-mental-needs

Pellegrini, A. (1984). The effect of dramatic play on children's generation of cohesive text. *Discourse Processes*, *7*, 57–67. doi:10.1080/01638538409544581

Perry, L. K., Prince, E. B., Valtierra, A. M., Rivero-Fernandez, C., Ullery, M. A., Katz, L. F., … Messinger, D. S. (2018). A year in words: The dynamics and consequences of language experiences in an intervention classroom. *PLoS One*, *13*(7), e0199893. doi:10.1371/journal.pone.0199893

PEW Charitable Trusts. (2018). *Philadelphia 2018: The state of the city*. Philadelphia, PA: Author.

PEW Research Center. (2018). *Who relies on public transit in the U.S.* Retrieved from https://www.pewresearch.org/fact-tank/2016/04/07/who-relies-on-public-transit-in-the-u-s/

Pruden, S. M., Levine, S. C., & Huttenlocher, J. (2011). Children's spatial thinking: Does talk about the spatial world matter? *Developmental Science*, *14*, 1–14. doi:10.1111/j.1467-7687.2009.00949.x

Reardon, S. F., & Portilla, X. A. (2016). Recent trends in income, racial, and ethnic school readiness gaps at kindergarten entry. *AERA Open*, *2*(3), 2332858416657343. doi:10.1177/2332858416657343

Ridge, K. E., Weisberg, D. S., llgaz, H., Hirsh-Pasek, K., & Golinkoff, R. M. (2015). Supermarket speak: Increasing talk among low-socio- economic status families. *Mind, Brain, and Education*, *9*, 127–135. https://doi.org/10.1111/mbe.12081

Rogoff, B. (2003). *The cultural nature of human development*. New York, NY: Oxford University Press.

Romeo, R. R., Leonard, J. A., Robinson, S. T., West, M. R., Mackey, A. P., Rowe, M. L., & Gabrieli, J. D. E. (2018). Beyond the 30-million-word gap: Children's conversational exposure is associated with language-related brain function. *Psychological Science*, *29*(5), 700–710. doi:10.1177/0956797617742725

Sheridan, S. M., Knoche, L. L., Kupzyk, K. A., Edwards, C. P., & Marvin, C. A. (2011). A randomized trial examining the effects of parent engagement on early language and literacy:

The Getting Ready intervention. *Journal of School Psychology*, *49*(3), 361–383. doi:10.1016/j.jsp.2011.03.001

Song, L., Golinkoff, R. M., Stuehling, A., Resnick, I., Mahajan, N., Hirsh-Pasek, K., & Thompson, N. (2017). Parents and experts awareness of learning opportunities in children's museum exhibits. *Journal of Applied Developmental Psychology*, *49*, 39–45. doi:10.1016/j.appdev.2017.01.006

Song, L., Spier, E. T., & Tamis-LeMonda, C. S. (2014). Reciprocal influences between maternal language and children's language and cognitive development in low-income families. *Journal of Child Language*, *41*, 305–326. doi:10.1017/S0305000912000700

Sumerling, B. (2017). A place to play: An exploration of people's connection to local greenspace in East Leeds. *Conscious Cities* (Vol. 2). Retrieved from https://www.ccities.org/place-play-exploration-peoples-connection-local-greenspace-east-leeds/

Suskind, D. (2016). Thirty million words: Chicago children's museum- chicago public library exhibit evaluation. Unpublished coding manual. *University of Chicago Medicine and Biological Sciences*. Chicago, Illinois: University of chicago.

Tabors, P. O., Snow, C. E., & Dickinson, D. K. (2001). Homes and schools together: Supporting language and literacy development. In D. K. Dickinson & P. O. Tabors (Eds.), *Beginning literacy with language* (pp. 313–334). Baltimore, MD: Brookes Publishing.

Toub, T. S., Hassinger-Das, B., Nesbitt, K. T., Ilgaz, H., Weisberg, D. S., Hirsh-Pasek, K., … Dickinson, D. (2018). The language of play: Developing preschool vocabulary through play following shared book-reading. *Early Childhood Research Quarterly*, *45*, 1–17. doi:10.1016/j.ecresq.2018.01.010

Verdine, B. N., Golinkoff, R. M., Hirsh-Pasek, K., & Newcombe, N. S. (2017). Links between spatial and mathematical skills across the preschool years. *Monographs of the Society for Research in Child Development*, *82*(1), 1–150.

Verdine, B. N., Irwin, C. M., Golinkoff, R. M., & Hirsh-Pasek, K. (2014). Contributions of executive function and spatial skills to preschool mathematics achievement. *Journal of Experimental Child Psychology*, *126*, 37–51. doi:10.1016/j.jecp.2014.02.012

Weisberg, D. S., Hirsh-Pasek, K., Golinkoff, R. M., Kittredge, A. K., & Klahr, D. (2016). Guided play: Principles and practices. *Current Directions in Psychological Science*, *25*(3), 177–182. doi:10.1177/0963721416645512

Weisberg, D. S., Hirsh-Pasek, K., Golinkoff, R. M., & McCandliss, B. D. (2014). Mise en place: Setting the stage for thought and action. *Trends in Cognitive Science*, *18*, 276–278. doi:10.1016/j.tics.2014.02.012