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Social contexts of development in natural outdoor environments: children's motor activities, personal challenges and peer interactions at the river and the creek

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This study examined the influence of spending time outdoors on young children's physical and socioemotional development. We observed preschoolers' activities in two naturally provisioned outdoor environments over the course of one year. Eleven preschoolers were videotaped continuously for 16 days at a local river and 9 days at a creek adjacent to the school. In addition to the quantitative analyses of children's behaviors, a case study of three children's experiences over the course of the year was conducted. Both the river and the creek settings encouraged a multitude of physical and play behaviors with similar types of affordances, including flat surfaces for running, rocks for climbing and jumping off, and water for exploration and play, but the wilder environment (river) afforded more risk and personal challenges. Observations of children's motor activities, play and responses to challenging environmental features supported the importance of accumulated experience and social context for the development of confidence in the face of risk, individual exploration and positive social support and engagement with peers.

Keywords: nature; outdoor play; affordances; preschoolers

Introduction

In the last few decades there has been growing international concern that children are spending less time outdoors and becoming more sedentary (Fjørtoft, 2001; Louv, 2008). Changes in urban environments may be particularly restrictive for children's outdoor play, and in some countries play is becoming increasingly supervised due to safety concerns (Prince, Allin, Sandseter, & Årkemalm-Hagsér, 2013; Sandseter, 2012). Regulated and institutionalized play experiences may be replacing more informal play outdoors (Kernan, 2010; Stanley, 2011). In these 'sanitized' spaces, children have fewer opportunities for freedom of movement, choice and exploration. These trends are cause for concern, given the importance of spending unrestricted time outdoors in varied and challenging environments for children's healthy development (Louv, 2008; Sandseter, 2012).

Natural outdoor environments are often associated with free movement and space for children to play, which are essential elements of children's learning and development (Maynard & Waters, 2007). As compared with traditional playgrounds, natural environments may provide children with more opportunities for challenging play and gross-motor activities (Fjørtoft, 2001; Sandseter, 2009). Natural landscapes with varied topography such as steep slopes, woodland vegetation, rocks and meadows afford a diversity of play opportunities for children and increase opportunities for independent

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exploration, mastery of risk and social collaborations (Chawla, 2007; Fjørtoft, 2001; Sandseter, 2007; Stanley, 2011).

The present study was designed to add to a small but growing body of literature examining the influence of spending time outdoors on young children's physical and socioemotional development. We observed preschoolers' activities in two naturally provisioned outdoor environments over the course of one year: a creek adjacent to the preschool and a trail along a river in a local state park. We adopted an ecological approach to the data collection in order to assess enduring and complex interactions in the children's immediate environment over time, to take into account multiple environments in which the children's interactions take place and to include various developmental outcomes (Bronfenbrenner, 1994). A multilevel ecological approach enables researchers to analyze not only individual outcomes but also influential aspects of the social and natural surroundings with a more holistic approach (Cintrón-Moscoso, 2010).

Affordances in natural environments

According to theoretical tenets of ecological psychology, children are active agents who learn by exploring their environments as part of a relational system (Chawla, 2007; Gibson, 1979). Their perceptual experience extends beyond an awareness of objects' structures to an awareness of their functional significance. Importantly, the functional features of an environment are determined by attributes of the environment itself (e.g. large rocks afford opportunities for climbing, hiding, etc.) and by the attributes and behaviors of the individual (a child may choose to run or skip along a path, whereas an older adult may prefer to walk more slowly). Thus, the affordances of a given environment are what it 'invites' an individual to do, and are uniquely dependent upon a person's size, strengths, skills, fears and so forth (Gibson, 1979; Heft, 1988; Sandseter, 2009). Studying children's behavior in relation to natural environmental affordances enables a characterization of different features in terms of their functional possibilities as well as their psychological meaning (Heft, 1988). For example, a large rock affords climbing and hiding opportunities, but not all people who encounter it will choose to climb or hide. In addition, children who climb the rock and pretend to be a pirate or a bear are exercising different psychological resources as compared with adults who may climb the rock and use the space for meditation or conversation.

Prior research has examined the relations between environmental affordances, motor activities and play behaviors. Fjørtoft (2001) compared children's play and motor activities in two environments in Norway. Children in the 'experimental group' attended a kindergarten that regularly visited a nearby forest, whereas children in the comparison groups attended one of two neighborhood kindergartens that typically utilized a traditional outdoor playground for outdoor time. According to Fjørtoft, there was gradual improvement in the motor fitness of the children in the experimental group, such as increased abilities to master the rough and unstructured landscape over time and significantly higher scores on a test of balance and coordination at the post test. In addition, Fjørtoft (2001) observed a relationship between the topography and the types of play activities in the natural play environment. For example, the shrubs afforded opportunities for games such as hide-and-seek and fantasy or pretend play. Children named their favorite places in the woods, such as 'Space Ship,' showing a connection between the spaces and their play. In another study comparing two Norwegian preschools, one with a traditional playground and one with a nature playground, Sandseter (2009) examined risky play, defined as

'thrilling and exciting forms of play that involve a risk of physical injury' (p. 439). Based on Heft (1988)'s taxonomy, Sandseter (2009) generated a list of environmental affordances such as climbable features, jump-down-off-able features, balance-on-able features, swing-on-able features, smooth surfaces and dangerous elements. She found that both playgrounds afforded extensive opportunities for risky play, with some interesting differences. There were no dangerous elements present in the traditional preschool's playground, whereas the nature playground included dangerous features such as cliffs, a pond and a fire pit. In addition to a higher degree of risk, there were fewer restrictions in the nature playground. Sandseter (2009) argued that children seek risky play in any environment, but the natural provisions of the nature playground afforded children more opportunities for exhilarating and intense play experiences.

These and other studies have demonstrated that natural environmental affordances are linked with varied and demanding physical and social experiences. However, little is known about young children's socioemotional responses to the physical challenges of the environment and ways in which their responses may change with accumulated experience in the natural environments. For example, children's initial responses to a muddy, slippery slope may include excitement and fear. After repeated experience traversing muddy, slippery terrain, children may demonstrate increased confidence and begin to incorporate the physical challenges into their play. The physical and social aspects of a child's experience are deeply, intrinsically related (Chawla, 2007). In order to understand children's experiences outdoors, various elements of the social context should be considered, including the affordances, the child's individual responses and the interactions with peers and teachers (Stanley, 2011).

The purpose of the present study was to examine the ways in which two natural environments influenced preschoolers' physical and socioemotional development, including ways in which they interacted with various environmental affordances and their peers over the course of one year in preschool. In particular, we examined motor activity (e.g. running, jumping and climbing), children's personal challenges in relation to environmental features (e.g. difficulty navigating steep rocks or rushing water) and their social interactions with their peers (e.g. playing, collaborating, or experiencing frustration). The specific research questions included the following: what types of physical behaviors are elicited by various environmental affordances in an outdoor environment that is semi-structured as compared with an unstructured wild space (e.g. includes built elements versus entirely natural); how do different children respond to personal challenges (e.g. struggling to cross a creek or climb a steep rock) with accumulated experience in the natural environments; and what types of positive and negative peer interactions occur as children interact in natural environments over the course of one year? These questions were answered for a group of children in aggregate, quantitative data and for a smaller case study of three preschoolers in order to provide a rich description of their experiences over the course of one year in a qualitative analysis.

Methods

Context and participants

The present study was a case study of a small, non-profit preschool located in a mid-sized city in the southeast United States. The preschool has mixed-age grouping with a total of

12 children staying in the school for two or three years. The school is part-time with students attending four days a week from 8:30 a.m. until 1:30 p.m.

The school is Reggio-inspired, focusing on a curriculum of authentic work inspired by the children's passions where the classroom and outdoor environment act as the 'third teacher' (Edwards, Gandini, & Forman, 1998). The Reggio Emilia approach is a pedagogy that was developed in Reggio Emilia, Italy and emphasizes inquiry, play, scaffolding and a social-constructivist approach to teaching and learning (Edwards et al., 1998; Inan, Trundle, & Kantor, 2010). The preschools are child-responsive and adapt to children's changing interests. The environment is called the 'third teacher' because, along with the two teachers, it provides opportunities for children to engage in stimulating and meaningful work in a space that is organized, beautiful and well provisioned with extensive materials and tools (Edwards et al., 1998).

The school has an extensive outdoor environment with a playground, garden and creek located on site. Five children also go to a local river with a teacher once a week to explore and play. Two outdoor contexts were selected for the purposes of the present study: the creek and the river.

Creek

The creek is a moderately provisioned, semi-structured space that is an extension of the school's property located behind the playground. Although the school and playground can be seen from the creek, it is separated by a fence and children must walk down a path to get to it. The creek covers a small area and includes a rope swing, two bridges, a climbing structure, a boardwalk and a bamboo thicket (see Figures 1 and 2).

The creek is not always open to children (unlike the playground and adjacent garden). If it is a 'creek day', a teacher will be there the entire time and each child must come down at some point. However, children can come and go and stay as long as they wish, which means the group of children at the creek changes frequently and older, more experienced children mix readily with younger children for whom the creek is their first interaction with a wild space.



Figure 1. The school's creek showing one bridge and the bamboo thicket.



Figure 2. The school's creek showing the boardwalk.

River

The river, a wild, natural, unstructured area, is part of a state park located 15 minutes away from the school. There is fast-moving water, a rough path and many large rocks to climb (see [Figures 3 and 4](#)). Five children and one teacher are together for two to three hours at the river each week, hiking portions of a one-mile loop trail. While the creek is a semi-structured environment because of the built features (e.g. bridges, rope swing, boardwalk), the river is an unstructured environment. A comparison of these two spaces enabled an examination of the unique impact of various environmental affordances on children's behaviors.

Participants

The participants were 11 mixed-aged preschoolers (five males, six females) ranging in age from 33 to 59 months at the beginning of the study. Six of the children were Caucasian, two were African-American, two were Asian and one was Latino. Based on a



Figure 3. The local river showing a typical area off the trail, including rocks and a fallen tree.



Figure 4. The local river showing the trail with steps, a bridge and water (in the top part of the image).

demographic survey administered to parents, average family income was greater than the US average, indicating the families are relatively affluent. Both of the school's teachers, Lisa and Sharon, participated as well. They are female Caucasian, and at the time of the study were 51 and 43 years old. Lisa had been at the school since it opened in 1990 (22 years) and Sharon had been there for six years. All teacher and student names are pseudonyms. Research was approved by the university institutional review board in collaboration with the school teachers, and permission for all observations was provided by the children's parents.

The researchers

The primary researcher who conducted all data collection (Cara) was a participant observer who participated only if a child or teacher spoke directly to her or if there was information that needed to be communicated immediately (e.g. a dangerous situation). Rather than looking from the outside in, as a participant observer, the researcher was able to fit smoothly into the school and remain unnoticed much of the time because the children were already familiar with her. The researcher is related to one of the teachers, had visited the school frequently and had previously worked with some of the children at the school's summer camp. The children felt comfortable engaging with the researcher but

mostly ignored her. The second researcher was only involved in data analysis and did not collect any data.

Data collection

The researcher conducted observations of children's nature experiences at the river and creek beginning in August 2012 and ending in May 2013. The children were videotaped continuously with a total of 16 days at the river and 9 days at the creek for 50 hours of video. At the river, because the children go in groups of five, it was possible to record almost all of the interactions for each visit. Because the teachers complete extensive documentation on a daily basis (Edwards et al., 1998), the children were already used to having their pictures taken and their language recorded.

Data analysis

The primary data analysis focused on environmental affordances in conjunction with motor activities, personal challenges and social behaviors. The first hour (or entire video if less than one hour) was coded for the 16 river days and 9 creek days. Coding was completed using Observer XT 11.5, a software package that is used to code the frequencies of various behaviors layered with the time spent in each environmental affordance. An extensive coding manual was developed with the creek and the river as the independent variables. To establish inter-rater reliability, two raters independently coded 20% of the data, and the calculated percent agreement was 80%.

Affordances were coded by duration based on the focal children being videotaped (e.g. if most children were in the water, water was coded as the affordance). All behaviors of children and teachers were coded as frequencies. Behaviors were not double-coded unless the person stopped the target behavior, began doing something else and then returned to the initial behavior.

Physical behaviors were coded once per continuous event (e.g. Michael jumps off a log and then Anthony jumps) unless the children moved to a different part of the river (e.g. getting wet), more children joined in or a different type of physical behavior occurred (e.g. jumping off the river bank and then jumping off the bridge). Emotional state was coded for each physical behavior, noting if a child was clearly experiencing a negative emotion.

Pretend play was defined as imaginative role-play with symbolic transformation and pretend content. Games, or social physical play, occurred when a physical experience became organized and social, taking on the routine of a game (e.g. turn-taking, structure, spoken or unspoken rules). Play episodes were coded as one event with a behavioral modifier for the theme (e.g. cooking, fishing).

Positive and negative social behaviors (e.g. helping, conflict) were only coded for child-to-child interaction (not child-to-teacher interaction). In addition, if a child exhibited two different types of positive (or negative) social behaviors close together in time, both were coded.

Personal challenge was coded when a child struggled with something initially but continued to try or was challenged by the teacher to continue engaging with the difficulty (e.g. working to cross a river). For each personal challenge, the following was coded: who (which child), initial emotional response to the challenge, help (from a teacher, a child or both), resolution (completion or not) and emotional state at the end.

In conjunction with the primary data analysis, a case-study analysis was conducted to describe three children's repeated experiences at the river and the creek over the course of the

year. Three children were selected for this detailed analysis in order to provide examples of the preschoolers' different levels of comfort and experience with outdoor environments, depicting change over time. In particular, the case study examined how experience in natural settings influenced three preschoolers' socioemotional and physical development by analyzing their personal challenges and positive and negative social behaviors:

Child 1: Michael (male, age four) was an older child who was very comfortable being outside. He had been at the school for a year already, going to the river and creek many times. During the course of the study, he went to the river the most (12 times).

Child 2: Daniel (male, age four) was an older child who felt less comfortable outside, experiencing many challenges. He had been at the school for a year already, going to the river and creek many times. During the course of the study, he went to the river the second most (10 times).

Child 3: Sophie (female, age three) was new to the school at the beginning of the study with no experience at the creek or river. During the course of the study, she went to the river the least (five times).

To develop the case study, the researchers followed a deductive process where protocol codes were taken from the quantitative analysis (Miles, Huberman, & Saldaña, 2014). Using a prescribed coding system, every instance where Michael, Daniel and Sophie exhibited personal challenges, positive social behavior or negative social behavior was coded. Each video recording of the children's behaviors was watched again and detailed subcodes were generated for each primary protocol code to enrich the coding and allow for a nuanced qualitative case-study analysis (Miles et al., 2014). Coding of the location, day, time, context, emotions, involvement with teachers and other children, and ways in which the experience is different for the particular child from other children was recorded. When determining results, the researchers generalized across specific observations and across the subcategories to describe the children in general. Next, using a constant comparative method, the children were compared and contrasted, resulting in narratives about each case-study child (Flick, 2006). A constant comparative method emphasizes comparing and interpreting all data throughout the analytic process through four stages: '(1) comparing incidents applicable to each category, (2) integrating categories and their properties, (3) delimiting the theory, and (4) writing the theory' (Flick, 2006, p. 37). Analysis follows a circular process with constant comparison of codes with codes and classifications that have already been made. Material that has been coded continues to be integrated into the later comparison process.

Results

To investigate how children develop in the context of their interactions with different environmental affordances, the researchers examined the influence of the various features of the environment on children's motor activity, personal challenges, positive and negative social interactions with their peers, and pretend play.

Motor activity

At both the creek and the river, children spent the most time on flat and water affordances, followed by climbable affordances (see Table 1). Both outdoor environments encouraged physical behavior with an average of 84.6 codes each day at the creek and 58.4 at the river (see Table 2). The creek had high numbers of the following physical behaviors: falling

Table 1. Time spent in affordances at the river and the creek.

Affordance type	Creek		River	
	Total duration (minutes)	Daily average (minutes)	Total duration (minutes)	Daily average (minutes)
Flat surface	10,870.1	20.12981	19,374.3	20.18156
Water and surrounding area	11,056.2	20.47444	18,788.9	19.57177
Climbable	7171.7	13.28093	12,687.3	13.21594
Rough/bumpy/slippery	427.34	0.79137	4165.04	4.338583
Sloped surface	N/A	N/A	2529.91	2.635323

Table 2. Overall behavioral frequencies for all children.

Behavior	Creek			River		
	Total	Mean	SD	Total	Mean	SD
Physical behavior						
Swinging	46	5.11	2.32	1	0.06	N/A
Running	84	9.33	4.66	168	10.5	3.37
Hiding	2	0.22	N/A	21	1.31	0.85
Balancing	17	1.89	1.34	11	0.69	0.75
Digging/scooping	19	2.11	1.60	31	1.94	1.83
Climbing	108	12	6.84	290	18.13	7.59
Jumping	30	3.33	3.54	20	1.25	1.31
Jumping off	73	8.11	3.55	100	6.25	4.47
Getting wet	24	2.67	4.15	56	3.5	3.92
Falling down/slipping	93	10.33	4.11	171	10.69	5.64
Throwing	33	3.67	2.24	23	1.44	2.11
Splashing	26	2.89	4.55	8	0.5	0.55
Sliding (intentionally)	10	1.11	0.82	27	1.69	1.22
Moving heavy objects	10	1.11	1.29	7	0.44	N/A
Building	6	0.67	0.00	0	0	N/A
Total	581	64.56	4.72	934	58.38	6.24
Play						
Pretend play	114	12.67	1.81	146	9.13	1.11
Games	62	6.89	3.37	35	2.19	1.65
Total	176	19.56	2.66	181	11.31	1.22
Social behavior						
Positive behaviors	127	14.11	5.13	159	9.94	7.03
Negative behaviors	40	4.44	1.98	16	1	1.09
Total	N/A	N/A	N/A	N/A	N/A	N/A

Note: 'Total' denotes the total number of observed instances across all days. Means were calculated as the total divided by the number of days at each site (9 for the creek; 16 for the river). SD, standard deviation.

down, jumping off, running, climbing and swinging. The flat surfaces enabled running while water play and movement around the creek bank encouraged jumping off. The rope swing meant many games centered on swinging, while the boardwalk and climbing

structure enabled climbing. Finally, the mixture of ages at the creek and the rapid movement between affordances yielded a high number of falls.

At the river, climbing, running, falling down and jumping off were the most common behaviors. As compared with the creek, there were more climbing instances each day (18.13 versus 12, see Table 2). Between pre-arranged stopping points known as rendezvous, children ran on the flat path. Each rendezvous had opportunities for climbing on rocks and much of the pretend play centered on climbing, jumping off and exploring. The emphasis on exploration in a wilder environment yielded high numbers of falling.

While the two environments had similar affordances and encouraged many of the same behaviors, the degree of risk was greater at the river, especially around climbing and jumping. At the creek, a jump could be no greater than two feet (e.g. off the creek bank) and the highest climb was about four feet. In contrast, children jumped five feet off large rocks at the river. Children would climb approximately eight feet into the air on rocks. At one rendezvous, they climbed up the side of a steep hill.

To look more closely at the impact of affordances on children's development, the percentages of behaviors per affordance were analyzed (percentages were adjusted for time spent in each affordance, see Table 3). At the river, flat affordances yielded 15.92% of all physical behavior codes with 278 instances. The majority of running and hiding took place on flat surfaces. Other behaviors with significant percentages on a flat surface included balancing, climbing, jumping, jumping off, throwing and falling (with both positive and negative responses, see Table 3). Climbable affordances had 16.26% of physical behaviors with 186 instances (see Table 3). Primary behaviors were climbing, sliding intentionally and jumping off. Climbable affordances also enabled jumping, falling

Table 3. Percentages of physical behaviors occurring in each affordance type.

Physical behavior	Flat adjusted %		Climbable adjusted %		Water adjusted %	
	River	Creek	River	Creek	River	Creek
Swinging	0.00	0.00	100.0	100.0	0.00	0.00
Running	67.21	65.71	3.06	10.49	11.90	23.80
Hiding	67.43	65.19	5.42	0.00	0.00	0.00
Balancing	5.46	41.59	0.00	0.00	5.63	58.41
Digging/scooping	0.00	16.02	0.00	0.00	53.09	83.98
Climbing	7.49	16.92	24.32	62.44	13.20	20.25
Climbing (negative emotion)	0.00	N/A	16.64	N/A	0.00	N/A
Jumping	16.36	14.32	8.32	43.43	11.24	42.25
Jumping off	12.93	37.38	25.39	28.33	21.59	34.30
Getting wet	3.44	0.00	0.00	0.00	88.58	100.0
Getting wet (negative emotion)	0.00	0.00	0.00	0.00	100.0	100.0
Falling/slipping (positive/neutral emotion)	9.50	31.32	10.78	31.15	18.76	37.53
Falling/slipping (negative emotion)	26.69	0.00	13.59	100.0	18.35	0.00
Throwing	12.57	13.21	9.60	40.04	48.61	46.75
Splashing	0.00	0.00	0.00	5.81	100.0	94.19
Sliding (intentionally)	1.36	9.56	37.42	43.46	2.81	46.98
Sliding (negative emotion)	0.00	0.00	0.00	100.0	0.00	0.00
Moving heavy objects	0.00	70.36	0.00	0.00	100.0	29.64
Building	N/A	100.0	N/A	0.00	N/A	0.00
Total	15.92	26.66	16.26	38.82	19.36	34.36

Note: The adjusted percentage was calculated based on the percentage of time spent in each affordance type per day.

and swinging. Water and the surrounding area had 19.36% of physical behaviors with 328 instances (see Table 3). The majority of getting wet, digging/scooping, throwing, splashing and moving heavy objects occurred in the water affordance. Other key behaviors included running, balancing, climbing, jumping, jumping off and falling.

At the creek, flat affordances had 26.66% of physical behaviors with 177 instances (see Table 3). The majority of running, hiding, balancing, jumping off, building and moving heavy objects occurred on flat affordances with high levels of climbing, jumping, throwing and falling as well. Climbing affordances had 170 codes, making up 38.82% of total physical behaviors (see Table 3). The majority of swinging and climbing occurred on climbable surfaces. Other notable behaviors included jumping, jumping off, falling and throwing. Water and the surrounding area had 34.36% of physical behaviors with 232 instances (see Table 3). Water had the majority of balancing, digging, getting wet, throwing, splashing, sliding and falling. It also included many instances of running, climbing, jumping and jumping off. Finally, there were only two physical behavior codes on rough surfaces.

In terms of emotional responses to physical challenges, overall the children showed very high levels of either positive or neutral responses (see Table 4). Out of 835 total physical behaviors at the river, only 11 were associated with negative emotional responses (one from climbing, three from getting wet, seven from falling down; see Table 4). From the creek, 3 out of 581 behaviors yielded a negative emotional response (one each for getting wet, falling down and sliding; see Table 4). Considering that the children are in a challenging, wild environment engaging in physical behavior at varying levels of risk, the low number of negative emotional responses is remarkable.

Personal challenges

Personal challenges, or children’s responses to particularly difficult affordances such as rushing water or a steep rock, are largely a function of the environment itself, the teachers’

Table 4. Children’s emotional reactions to behaviors.

Behavior	River			Creek		
	Neutral/ positive total	Negative total	Percentage positive	Neutral/ positive total	Negative total	Percentage positive
Swinging	1	0	100	46	0	100
Running	168	0	100	84	0	100
Hiding	21	0	100	2	0	100
Digging/scooping	31	0	100	19	0	100
Climbing	289	1	99.65	108	0	100
Jumping	1	0	100	30	0	100
Jumping off	20	0	100	73	0	100
Getting wet	53	3	94.64	23	1	95.83
Falling down	164	7	95.91	92	1	98.92
Throwing	23	0	100	33	0	100
Splashing	8	0	100	26	0	100
Sliding	27	0	100	9	1	90
Moving heavy objects	7	0	100	10	0	100
Building	0	0	N/A	6	0	100
Balancing	11	0	100	17	0	100

practices in allowing children freedom of exploration and the response of peers. Given the highly social context of personal challenges, the peer collaborative aspect was particularly important, whether that was direct (e.g. taking on a challenge with a friend) or indirect (e.g. trying something because you saw a peer doing it).

The river elicited more challenges than the creek (21 and 6 respectively), and therefore was an ideal environmental for helping children connect with nature as they overcame obstacles, expanded their sense of self and felt more competent. At the river, the majority of personal challenges occurred on climbable or water affordances. The creek was associated with personal challenges on water, flat and climbable affordances. The case studies of each child illustrate the individual responses to environmental challenges and the social context in which they occurred.

Child 1: Michael

The first case-study child, Michael, was older and highly comfortable in the outdoor environment. He had six total personal challenges, but only in the first half of the year (five at the river). His challenges had more risk and difficulty as compared with the other children. For example, Michael would climb a tree but make it more challenging by going higher than his peers. He tended to move quickly into challenges with a sense of excitement and opportunity, which was very different from other children who experienced a high degree of nervousness and fear in challenging situations. Because of his willingness to challenge himself, Michael also saw himself as competent. Part of his excitement stemmed from making personal challenges social (e.g. wading through deep water with a peer so they could hold onto one another or teaching a friend how he climbed a tree and then helping him try too).

The most notable aspect of Michael's challenges was how he frequently continued pretending during them or took on the challenge to enable a certain aspect of pretend play. Michael ventured 50 feet into the river (almost to the other bank) through deep, quickly moving water and played a game with peers the whole time. He integrated problem-solving: finding a way to carry a heavy stick with him as he climbed up a steep rock. Although he struggled and kept slipping, his perseverance led to eventual success, and he resumed his pretend play game immediately upon reaching the top of the rock (the stick served as the fireman's hose).

Michael had limited teacher involvement, encouragement and awareness around challenges. He did not need much (if any) teacher support. The most notable instance of teacher involvement came when Lisa dropped a water bottle off a rock and asked Michael to retrieve it. It was a hard climbing rock, and her request demonstrated her confidence in his abilities.

Child 2: Daniel

Daniel was the child with the highest frequency of personal challenges (14 at the river, 4 at the creek). He struggled greatly at the beginning of the school year, particularly in comparison with his same-age peers. He had three times as many personal challenges as Michael, and this was the defining feature of his experience at the river: his difficulties, his development of coping strategies and his progress over the course of the year.

Most of Daniel's challenges were low or average risk, and other children his age did not have trouble with the same experiences. For example, on the first day at the river, Daniel spent a considerable amount of time trying to find the courage to cross from the bank to a rock in the water over a one-foot gap. His peers jumped from the bank to the rock, but

Daniel got on his hands and knees and tried to reach out to the rock. Eventually, after the teacher suggested it, Daniel asked for a friend to come back and hold out a hand for him.

Daniel tended to feel nervous during a physical challenge (e.g. saying ‘I cannot quite reach’ in a shaky voice) but outwardly celebrated when he figured out a strategy or succeeded. He disliked getting wet and carefully avoided situations that had this potential. He remained acutely aware of safety in the more intense physical environment of the river (and the creek to a lesser extent) in comparison with the school’s playground or garden. Because Daniel was so consumed by his challenges, his engagement could be limited (e.g. less pretend play than when he was on the playground). This limited engagement also meant his challenges tended to be individual, which contrasted with Michael’s desire to collaborate on challenges.

The teachers worked with Daniel over time to increase his strategic use of positive and encouraging self-talk. As his verbalization and physical strategies developed, Daniel was better able to navigate challenges by himself and then to help others with their own obstacles (e.g. sharing a strategy). His primary tool was verbalization, where he talked to himself throughout his entire challenge (e.g. describing the environment, stating his feelings, brainstorming ideas, giving himself encouraging self-talk).

Daniel’s secondary strategy, one that the two teachers encouraged and helped him develop, was to keep his body low and use four touch points (both hands and both feet) at all times to feel more secure. Because Daniel was often on all fours, he moved more slowly than other children, but he also far exceeded their kinesthetic awareness. After completing a challenge, Daniel was able to detail the steps he took to get from point A to point B. This awareness also meant that while Daniel was in the middle of a challenge, it was all-consuming for him and he was unable to engage in pretend play.

A key factor in the degree to which Daniel engaged with personal challenges was his peers. Social comparison of his peers’ abilities was particularly acute for Daniel given that they were his age (or a year younger). Daniel pushed himself further once he saw what others were doing. For example, although he disliked getting wet, once he saw others splashing through the deep water at the river, he contemplated joining, wavered for a few minutes and finally went along with it. He would not have played in chest deep water without his peers creating an environment that made this the norm.

Over the course of the year, Daniel made significant progress in his competency with personal challenges, moving from struggling more than his peers to having challenges similar to them (although still with his signature style of vocalization and slower physical movement). His change over time was exemplified by the gap between the bank and a rock in the river that he worked through the first day. On the fourth day, he did it again, still slowly, but without child or teacher help. On his second-to-last day (day 15) he faced the same challenge, doing it all by himself and vocalizing his process throughout (e.g. ‘I put this foot there, then turn around’). While he still remained nervous, he was much less nervous than before.

Child 3: Sophie

Sophie’s personal challenges showed what was expected of a young child who was having her first experiences in these environments (two at the river, one at the creek). During her first time at the river, she only made it halfway up a rock that other children scale easily, and she got stuck coming back down. She was more nervous about climbing and

sometimes pushed herself too far, beyond what she was able to do, because she was following her peers. Later, Sophie moved across a series of flat rocks in the river. Michael ran across those same rocks ahead of her, while Sophie crawled on her hands and knees. She tried multiple times before she was able to cross a narrow log at the creek. In sharp contrast to Daniel, Sophie was quiet during her challenges.

Sophie struggled in developmentally appropriate ways but continued to try and stick with challenges. Peers were important in Sophie's development because she sought inclusion and the ability to mirror activities of her peers. Her challenges all came in the first half of the school year, and she had moved into a leadership role with the younger children by the spring.

Social behaviors

Even in a wild environment, a supportive social context was established. While outdoors, children participated in active and complex pretend play and exhibited far more positive than negative social behavior. Children rarely had negative emotional responses to challenging experiences; their base state was happy, excited or neutral.

Children tended to respond positively to the challenges of both wild places, exhibiting a variety of behaviors including self-awareness and collaboration. High levels of collaboration were evident through positive social behaviors (127 at the creek, 159 at the river), particularly in comparison with negative social behavior (40 and 16 respectively). The preschoolers put far more energy into social collaboration, inclusion and helping than into competition and fighting despite—or perhaps because of—the challenges present in the wild environments.

As an example, Michael was very social and a leader who sought opportunities to include others and collaborate. He reminded his peers about rules (e.g. leaving shoes on at the creek), thought about safety (e.g. checking that no one was in his way before he jumped), taught others (e.g. how to climb a wooden structure) and helped (e.g. lending a hand to Daniel). At the river, Michael also showed physical affection, holding hands or kissing his friends on the cheek. He made sure his friends were safe and not climbing too close to moving water. Michael modeled behavior, showing others how to drink water at the river, and also invited everyone to play his games. His negative social behavior occurred when he used his physical abilities for an advantage (e.g. running competitively with Olivia, not making space for Daniel on a ladder, taking a ball away from Brian after he ran faster to it or excluding Sophie from a pretend game when she moved too slowly getting there).

As a second example, Daniel moved away from his self-focus during personal challenges through positive social behavior. He had a strong desire for social interaction and spoke frequently about his peers. He used his vocalization and physical strategies developed through personal challenges to help others (e.g. warning them to watch out for a hole he fell into). He also continued to advocate for himself in positive, socially appropriate ways that showed he was sensitive to his peers' feelings. He would ask for more personal space when climbing or warn someone before he jumped. In one instance, he discovered some seedpods that Olivia then decided she wanted. Daniel stated that Olivia could have them when he was done (the rule at the school), but she began crying and was very upset. For the next 20 minutes, Daniel sought solutions, finding new seedpods to offer to Olivia. He stood his ground and asked for what he needed, but also tried to share and participate.

Connected to positive social behavior, pretend play and games enabled collaboration and socioemotional development. Both contexts afforded high levels of pretend play (114 at the creek and 146 at the river with daily averages of 12.7 and 9.13 respectively). The children engaged in many play themes, some that carried over from school (family, animals) and others that fit more closely with the outdoor context (cooking, fishing, natural disasters). While the pretend play at the river changed more between trips, there was some consistency around the theme (cooking, fishing and the ‘germ game’ where the ‘bad guys’ have germs). The creek had the most consistent pretend play because the boardwalk (called the ‘rocket ship’ by the children) is used almost every time for outer space play. Games were less common (62 instances at the creek, 35 at the river) but were another way in which children interacted with the environment and one another, creating a structure (e.g. taking turns jumping into the creek) for social collaboration.

Discussion

Based on the theoretical premise that children actively learn by exploring their environments as part of a relational system (Chawla, 2007; Gibson, 1979), the purpose of the present study was to examine preschoolers’ physical and socioemotional development in the context of their interactions with various environmental affordances and their peers over the course of one year in preschool. The findings of the quantitative and qualitative analyses highlight the importance of varied and challenging environmental affordances for children’s movement and play.

One goal of the research was to compare the types of physical behaviors that were elicited by affordances in two natural environments, one semi-structured space connected to the outdoor playground and another wilder space in a local state park. According to Fjørtoft (2001) and others, there is a strong relationship between landscape structures and the functions of play. Supporting prior research, both the creek and river settings encouraged a multitude of physical and play behaviors with similar types of affordances including flat surfaces for running and hiding, rocks for climbing and jumping off, and water for exploration and play (Fjørtoft, 2001; Heft, 1988; Sandseter, 2009). While the two environments had similar affordances and encouraged many of the same behaviors, the degree of risk was greater at the river, especially around climbing and jumping. The results support Sandseter (2009), who found that higher levels of risk and few restrictions of children’s movements provided numerous opportunities for children’s intense and exhilarating exploration and play. Extending prior research, we also examined children’s socioemotional responses to particularly challenging or risky environmental affordances such as rushing water, slippery terrain and steep climbing rocks. The predominant emotional state observed in both outdoor contexts was either positive or neutral, and the number of negative responses was less than 2% of observed behaviors. At times the mixture of ages and the rapid movement between affordances yielded a high number of falls (Sandseter, 2009), but the children’s emotional responses to falling and other personal challenges were overwhelmingly positive. The very few negative emotional responses (fewer than 20 out of over 1400 physical behaviors observed in both contexts throughout the year) were in response to falling down, getting wet and climbing challenges. Early childhood educators should be encouraged to provide a diversity of outdoor contexts for play with varying degrees of risk in order to enhance children’s opportunities for development not only in motor and play-related activities, but also in terms of their personal growth in response to experiencing risk and overcoming challenges.

This study was also designed to investigate the ways in which different children respond to personal challenges with accumulated experience in the natural environments. Personal challenges were experienced by many of the preschoolers, and the case study provides insight into three children's experiences over the course of the year in two different environments. For Michael, an older child who was generally comfortable in both natural environments and had more experience than the younger children, personal challenges were a result of increased risk-taking (e.g. wading into rushing water) and provided a context for collaboration with his peers. The higher degree of risk at the river enabled Michael to engage in more complex physical and play behaviors. He embraced increasing levels of challenge over the course of the year, and was able to incorporate pretend play and social collaboration into his experiences without hesitation.

For Daniel, also an older child with experience but less confidence and self-assurance in outdoor environments, the focus was largely internal; overcoming personal challenges was an intense struggle accompanied by self-talk. Vygotsky's (1962, 1978) theory of verbal self-regulation states that a child's private speech reflects the child's potential for cognitive self-direction to 'plan, guide, and monitor [a] goal-directed activity' (Manning, White, & Daugherty, 1994, p. 193). Self-guiding speech is linked closely with cognitive development and serves as scaffolding. Self-talk is a means through which children organize, plan and control their behavior, fostering self-regulated learning of cognitive skills (Manning et al., 1994; Schunk, 1986). Daniel's self-talk thus enabled him to navigate the environmental affordances and eventually to focus not only on himself but also on his peers. Daniel noticed what his peers were doing and this social comparison seemed to result in his desire to succeed at tasks that he initially perceived to be quite difficult. In addition, the teachers worked with him throughout the year to develop other strategies and coping mechanisms for his fears of getting wet and falling.

Sophie was the youngest child in the case study and social comparison was for her also an essential feature of the social context in which she interacted with peers. She pushed herself to do what the older and more experienced children were doing and, although this initially caused her to struggle, after just a few visits to the wilder natural environment, it was clear that she had developed confidence and was becoming a leader among her peers.

Findings from the case study illustrate the importance of multiple, interacting social contexts of development, including children's experiences in natural environments as well as their ongoing interactions with peers and teachers over time (Chawla, 2007; Stanley, 2011). The children in this study developed increasing confidence with accumulated experience and moved from a focus on themselves and their own abilities to a broader awareness of their peers through social collaborations. The observed patterns for each child must be considered in relation to their age, levels of experience and degree of comfort with risks encountered in the natural world. Teachers in early childhood settings should be sensitive to individual differences and provide a combination of challenge and support, giving each child ample opportunity to encounter varying degrees of risk during outdoor play in natural environments. This is particularly important in sociocultural contexts in which there are diminishing opportunities for unrestricted play outdoors (Prince et al., 2013).

The small sample size and the environmental focus of the preschool limits the generalizability of the findings. The children were provided with multiple opportunities to spend time outdoors throughout each day in preschool, and the beliefs and practices of these teachers do not represent the majority of preschools in the United States by any means. Nonetheless, the findings may provide incentive for more teachers to take

preschool children outside to relatively wild, natural environments and allow them to explore, play and take risks on a regular basis over time when possible (Sandseter, 2012).

This research illuminates the importance of exploring multiple aspects of the social context in which preschool children experience natural environments in order to understand their initial responses as well as their developing skills over time (Chawla, 2007; Bronfenbrenner, 1994). In this study, the teachers encouraged freedom of movement and provided regular opportunities for children to interact with each other and with challenging environmental affordances in two naturally provisioned, relatively wild spaces. Observations of children's motor activities, play and responses to challenging features of the environment supported the importance of accumulated experience and social interactions for the development of confidence in the face of risk, individual exploration and positive social support and engagement with peers.

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