Interactional Arrangements for Learning about Science in Early Childhood: A Case Study Across Preschool and Home Contexts

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Abstract: In this case study, we compare activities experienced by one 5-year old child in her home and her preschool in terms of how they afford scientific exploration and inquiry. We focus specifically on two types of interactional configuration: the first is an adult-guided mode of interaction in which a parent closely monitors the child's attention and action and accordingly orchestrates the emergence of opportunities for scientific observation, exploration and knowledge construction; the other is a type of peer play that occurs frequently at preschool, in which children collaboratively explore the physical properties of the world around them. Through close microanalysis we compare these activities as *learning arrangements* (Stevens, Satwicz & McCarthy, 2008), considering how they allow for or constrain children's entry into scientific activities, as well as the particular opportunities for learning they may afford.

Introduction

In this paper, we compare aspects of the home and preschool contexts in terms of how they afford particular types of scientific exploration and inquiry in early childhood. Rather than surveying the entire range of activities in which children may engage in each of these environments, we focus on two types of interactional configuration which map onto these contexts—by this we mean not just that we have found them occurring in one of these settings, but rather that there are particular aspects of the environments that make them more likely to occur in one than the other. The first is an adult-guided mode of interaction in which the adult closely monitors the child's attention and action and accordingly orchestrates the emergence of opportunities for scientific observation, exploration and knowledge construction. Like others (e.g., Goodwin, 2007; Crowley & Jacobs, 2002), we have observed this occurring in family interactions. The other configuration is a type of peer interaction that occurs frequently within "free-play" periods at preschool. Often in the service of other goals, which may be fluid and loosely defined, children collaboratively explore the physical properties of the world around them—making observations, developing hypotheses, and even conducting informal experiments in short-lived social groupings of varying sizes. In both contexts, the type of science learning we focus on in this paper might be termed emergent or serendipitous (e.g., Stevens, 2000; Bell, et al., 2009) in that it occurs in the process of everyday living and playing with others, rather than within events that are explicitly designed for science learning.

In the pages that follow we analyze several interactions engaged in by one 5-year-old girl in our study. These include home interactions in which the child and her parents discuss the plants growing in their garden and the child's techniques for watering them, as well as preschool-based peer interactions such as one in which the child and her peers use a tape-measure to calculate the length of various objects in their classroom and then discover how to use it as a projectile. Through close microanalysis we compare these activities as *learning arrangements* (Stevens, Satwicz & McCarthy, 2008), considering how they allow for or constrain children's entry into scientific activities, as well as the particular opportunities for learning they may afford.

Background

This study responds to previous calls for research investigating learning across school and out-of-school experiences (Stevens et al, 2005). While much educational research has focused on children's school experience at the expense of what happens in the home, research on informal science learning in early childhood has focused primarily on the family. Such research has shown that children have opportunities to learn scientific concepts in everyday life, and that adults in their lives have practices for supporting them in this process (e.g., Tizard & Hughes, 1984; Callanan & Oakes, 1992). Other researchers have pointed to the value of learning from peers in early childhood (Rogoff, 1990; Williams, 2001). Our observations suggest that informal play activities create a rich interactional environment for such peer learning. Interestingly, a primary site for such informal peer interactions seems to be the quasi-formal context of the preschool.

While educational research on school-age children may tend to focus on the classroom more than the home, research on learning and development in early childhood has tended to focus on the home, and particularly the dyadic interactions between parents and children that occur there. This tendency may be partly due to dominant cultural notions about child-rearing in the American middle class, but has been compounded through the research methods usually employed to study interaction and development in early childhood (Ochs

& Schieffelin, 1984). Our ethnographic approach, on the other hand, allows us to examine both home and preschool settings in their own right to identify and examine the ways in which learning is occurring, which can then be compared with the other contexts of children's lives.

Study Description

This paper reports on one piece of a larger study examining young children's learning (2-5 years old) as it occurs in the multiple environments of their everyday lives, environments which may differ markedly in the opportunities for participation and resources for learning they offer. By observing and recording young children's interactions in multiple contexts (such as preschool, home, and playgroups) and among different configurations of co-interactants (including peers, older and younger children, teachers and caregivers), we seek to capture the complexity and variety of the social environments in and through which young children learn.

The first phase of this study involved weekly video-recording in a childcare classroom for approximately five months. In addition, two of the children in the classroom were also observed and recorded in their home environments. All in all, approximately 98 hours of video were collected, digitized and logged. In a second phase of this study, we are video-recording in four rooms at two preschools for a total of nine months. In addition, out-of-school activities of eight children are being recorded.

In this paper we report on the first phase of the study, in which we observed and recorded activities in "Rocket Room," a kindergarten-readiness classroom (4-5 years old) in a nonprofit NAEYC-accredited childcare center. The center was located in a middle class neighborhood of a mid-sized Western city. There were 20 children in the Rocket Room, supervised by a lead teacher and an assistant teacher. Our observations took place in the mornings, during which time the children participated in free-play, breakfast, art activities, and circle time. We describe learning interactions experienced by Darcy, one of the focal children in the study, both in the preschool and her home environment. Darcy was 5 years old at the time of the study and had an 18-month old sister. Both Darcy and her sister attended the childcare center full time. Darcy's parents both worked in high-tech occupations.

We employ the method of video-based microanalysis of interaction (Stevens & Hall, 1998; see also Jordan & Henderson, 1995; Streeck & Mehus, 2005)**.** Our moment-by-moment analysis allows us to demonstrate possibilities for learning and requirements for interaction in the activities in which children participate. This form of qualitative inquiry allows us to cautiously generalize our findings not to populations but rather to practices and activities based on principles derived from analyzing structures of social action.

Analysis

Parent-Guided Learning Interactions at Home

When video-recording children in home environments, we frequently captured interactions that were intensely mediated by parents. In the section that follows, we describe some such interactions that arguably could have relevance for the development of scientific skills and interest, and analyze the particular opportunities for learning they afford.

Key Characteristics of the Learning Arrangement

What do we mean by "parent-guided learning interactions"? These are events that may be planned in advance, but even if not they are organized for children's learning as they proceed. Within these activities, children's talk and actions are closely monitored by adults and frequently commented upon, usually praised. Children's actions and other aspects of the environment are frequently used as a starting point for elaboration and exploration, within which there are clear (and often explicit) attempts to guide children's perception toward particular aspects of the scene and to provide labels for what children are experiencing (Stevens & Hall, 1998). The segment below exemplifies several of these features. This occurs in the back yard of Darcy's home. Darcy is splashing in an inflatable swimming pool while her mother and father watch. Her mother gets up to take a look at their garden, and calls Darcy's attention to what she sees.

Table 1: Data Excerpt

1	Mom:	Here you know what (.) Darce? It looks like the (.) the: uh sweet peas (over here)
2		need water. (That soil still) looks dry: doesn't it.
3		*((Darcy starts watering where her mom pointed))*
4	Mom:	Do you need some help with that? *((gets up))*
5		It's probably on the far side so it's kinda (.) kinda rough huh.
6	Mom:	You want me [to
7	Darcy:	[I can smell the sweet peas.
8	Mom:	You can smell the sweet peas? What do they smell like.
9		Do they smell (.) sweet?
10	Darcy:	*((grunts))*
11	Mom:	Woah. (.)
		((Darcy is rocking watering can back and forth))

12		That's kinda clever.
		((Darcy steps up onto side of bed))
13	Mom:	You're like (.) rocket-shipping.
		((Darcy reaches out with watering can over bed, wobbles))
14		Oh there you go.
15		Here I'll hang on to you: *((Mom holds Darcy around torso. Darcy holds watering can))*
16	Mom:	Hang on to you: (.)
17		That's kinda heavy huh. *((takes watering can))*
18		°Here you go. °
19		(can I) do these?
20	Darcy:	Mm hm. *((turns away from garden, towards pool))*
21		*((Darcy gets into pool, Mom continues watering))*
		… [01:10 exchange between parents and researcher not transcribed]
22	Mom:	Darcy! (.) Did you no:tice?
23	Dad:	Oh there's some sprouts coming up?
24	Mom:	Check it ou::t!
25		Holy cow that's fa:st. We just put this in last week.
26		Look!
27		What are tho::se?
28	Darcy:	Sprouts.
29	Mom:	What kinda sprouts.
30	Darcy:	Sunflower sprouts
31	Mom:	=sunflower sprouts. [Holy cow::!
32	Dad:	[°Sunflower sprou::ts.°
33	Darcy:	I've done (.) some (.) very good watering
34	Mom:	=You've done some very good watering.
35		That is instant gratification. (.) [Right there.
36	Dad:	[Oh. Educational moment.
37	Researcher:	Yeah.

This segment exemplifies several of the features that characterize adult-child learning interactions in the homes that we studied. First, these *events are managed for children's learning*. In some cases, they are pre-planned, involving the preparation of materials and the use of predesignated roles and actions. Even when they are not, the activities are organized by adults in the moment, with slots for children's participation being provided by the parents. While the particular event above was not planned at the level of a classroom lesson, it was purposefully brought into being for educational purposes by the parents. Darcy's mother told us that they decided to plant a garden (their first) specifically for Darcy's benefit (as a means to "inspire little Darcy about growing things," as well as potentially get her more interested in eating vegetables). Within the moment, Darcy's mother enlists her participation in a familiar interactional routine. For examples, in lines 27-31, Darcy's mother engages her in a school-like initiation-response sequence in which the mother is asking Darcy "known-answer" questions (cf. Mehan, 1979; Cazden, 1988).

Within these events, *children's actions and talk are closely monitored*, explicitly commented on, often praised, and elaborated upon. For instance, in line 12 Darcy's mother verbally calls attention to Darcy's action and labels it as "kinda clever," further describing it in line 13 as being "like rocket-shipping". *Physical phenomena in the environment are also noted and commented upon*, even used as opportunities for "occasioned knowledge exploration" (Goodwin, 2007). We see this in lines 1-3 above, when Darcy's mother first calls her attention to the garden's need for water, as well as in lines 22-34, when she discovers new growth and subsequently guides Darcy in specifying what they are seeing. Parents orient to these as potentially educational moments (though not usually as explicitly as does Darcy's father in line 36 above).

Opportunities for Learning in Parent-Guided Interactions

There are several types of learning opportunities that children encounter in these types of interaction. Many of them are provided by parents through talk. For instance, a prominent source of potential learning in the interaction above comes from the mothers' directing of her daughter's attention and guiding or disciplining of her perception (e.g., Stevens & Hall, 1998). We see this in lines 1-2, in which Darcy's mother not only calls her attention to a specific aspect of the environment, but guides her in how to *see* it—i.e., to recognize the dirt as soil that "looks dry."

We can also see this in the way Darcy's mother calls attention to Darcy's actions. For example, in this exchange Darcy's mother verbally takes notice of an action being performed by the child and frames this action as being both purposeful and ingenious. In Line 12 an explicit positive assessment is made, linked to the child's action with the deictic pronoun "that's." This assessment is followed by elaboration of *why* the child's action seems like a good idea, in the form of a description of what the child is achieving through her action (line 13). At that moment Darcy is standing on the edge of the garden bed and rocking the watering can back and forth, which causes the water to slosh out, reaching further into the bed than it would if she were simply pouring it out. Darcy's mother's "rocket-ship" analogy conveys the notion that through her action, Darcy is causing something

to be propelled through the air, "cleverly" solving the problem of how to water the far side of the garden. This represents a compelling example of the ways in which adults can frame aspects of the world for children, in this case quite possibly shaping a child's retrospective understanding of her own action.

Darcy's mother also engages Darcy's participation in these labeling activities. For instance, in line 27 Darcy's mother elicits a label from Darcy by asking "What are those?", and then requests specification in line 29 with "what kinda sprouts?". As Darcy participates in these activities, she potentially learns ways of seeing, categorizing and labeling the world around her—as well as ways of thinking about and valuing her own actions.

Finally, it should be noted that Darcy takes advantage of this interactional arrangement to initiate and further her own learning experiences. Twice she issues declarative statements that draw responses from her mother. For instance, in line 7, Darcy asserts that she can smell the sweet peas. Her mother responds with the question "what do they smell like?" then proposes a candidate answer: "Do they smell sweet?" In line 33, in response to her mother's enthusiastic pointing out of the new sprouts, Darcy comments that she (Darcy) has "done some very good watering." The timing of Darcy's assertion suggests that she is making a connection between the sprouting of the sunflower seeds and her previous watering actions—an idea that may have been planted (so to speak) in previous interactions with adults. By making this claim in the context of an interaction with her mother, Darcy makes it available for confirmation, which her mother provides unambiguously in the next line.

Discussion: Adult-Child Interaction in the Home as Learning Arrangement

The participation framework of adult-child talk in the home makes for excellent learning opportunities for children: parents guide children's attention, deliver comments and questions that are tightly coupled with children's activities, and design and orchestrate interactions with children's learning in mind. Children's initiations of learning opportunities are taken up readily and enthusiastically. The interactional demands on children are low: adults do much work to invite children's participation and ensure that these activities work as learning arrangements. These do not represent the totality of children's interactions at home; there are times when the children do not have their parents' full attention. Even when they do, parents are not always able to take advantage of every learning opportunity. It should also be noted that other types of interaction that occur in this home (and other homes) may offer different types of learning opportunities (such as guided participation in adult activity, intent observation of adult or peer activity, peer learning in sibling play, to name only a few). We focus on this type both because we observed it frequently, and because particular features of the interaction format make it rich with learning opportunities, as described above.

We propose that structural and cultural aspects of the home setting make these types of interaction more likely to occur there than in preschool, most simply the numbers of adults and children. In preschool, the ratio of children to adults means that teachers must frequently shift attention in order to monitor and care for everyone. While adults in the home may also have other demands on their attention, they are much more likely to be able to carry out extended interactions in which they maintain focus on the talk and action of an individual child. This does not mean that similar interactions cannot occur in preschool settings, and in fact they do. It does suggest, however, that the unique features of the preschool environment may give rise to *other* interaction patterns, which can in turn be analyzed for the ways in which they allow science learning to occur.

Learning through Peer Interaction in the Preschool Classroom

In this section, by way of comparison, we analyze the learning opportunities inherent in an interactional arrangement that we found in our preschool observations and did not find to occur in home—these are small group activities, organized and guided by children. Though we do not preclude the possibility that this type of activity might occur in other contexts, there are certain features of this environment that make it possible. For instance, during free-play periods at school, teachers rarely spend long periods of time with a single child or group of children. This means that while they do set up activities for children and step in to mediate children's interactions, teachers infrequently engage in the intense moment-to-moment guidance typical of the homes we observed. Rather than having interaction initiated and maintained for them, children engage one another.

Key Characteristics of the Learning Arrangement

The type of activity analyzed in this section is characterized by (1) including 3 or more children (more children may come in and out of the activity), (2) being initiated, guided and maintained by the children, rather than by adults, (3) enduring over a relatively long stretch of time (for example, the measuring activity analyzed in this paper endured for nearly 45 minutes in total), (4) being organized towards some purpose (although individual goals may not be shared by all participants and may shift during the activity). For the purposes of this paper, we analyze one extended activity in which all four characteristics are present, as representative of this type of interaction format. Though the activity we describe is not explicitly undertaken as a "science" or "math" activity, there are opportunities for scientific and mathematical exploration and discovery available within it.

Measuring Tape

The activity we analyze in this section occurs over an extended period of time during which a core group of three children, joined occasionally by other children in the room, play with a tape measure that one of the children has brought from home. It is free-play time in the preschool classroom. One of the children, Anna, gets up from a table and shows a drawing to one of the teachers (Nancy). She then brings it over to her cubbie, puts it in, and pulls out a tape measure. "I brought this from home:::!" she says enthusiastically to an entering parent. Anna then brings the tape measure over to Nancy who compliments her on the idea to bring a tape measure from home and asks her what she wants to measure. Anna begins to measure a bookshelf. Though Nancy soon becomes occupied with other children, Anna is able to regain her attention long enough to get some help with the measuring task she has begun. Specifically, Nancy provides instruction in reading numbers from the tape ("A three and a seven is thirty-seven.") and with the unit of measurement ("An inch is about that long," gesturing with thumb and forefinger). She also provides a different type of guidance: in the form of a question, she suggests to Anna ways of linking her current measuring activity with adult professional practices ("Are you a carpenter? A mathematician? A scientist?"). After this point, the children's measuring activity proceeds with no significant input from any of the adults in the room.

Perhaps taking her cue from Nancy's question, Anna then initiates a game with some other children, in which Anna plays the role of carpenter. That game is short-lived, and when it ends Anna and one of the children (Mira) begin stretching out the measuring tape and letting it go so it retracts into the case. They are then joined by one of the girls who will make up the core group: Susan. Susan suggests that they measure people, and though Anna initially resists this idea, when we find them again (after a one minute gap in which they are out of camera range) Susan is measuring Anna's height, while Mira watches. Susan struggles with the challenge of holding the tape at the floor with one hand and extending the to Anna's head with the other, and then being able to see the numbers at the top.

It is at this point that Darcy (one of our focal children and the third girl forming the core group) joins them. She approaches the two girls, takes the end of the measuring tape, stretches it to the top of Anna's head, and holds it there. This allows the girls to move to the next step of the measuring task, which is to read the number. Anna and Susan then measure Darcy, and the three then move on to measuring a large cardboard tree. The three girls continue to work together as a team, measuring objects all over the preschool classroom.

For most of this period, they measure pre-existing objects, such as tables, the refrigerator, chairs, bookshelves, the elevated stage, room dividers, and a large block. During this time, they negotiate a set of roles and a turn-taking system. The set of roles evolves and shifts over the course of the activity, however, some core "jobs" emerge, such as holding (and hooking) the tab end of the tape measure; extending the tape measure case; looking at, reading, and shouting out the measurements (numbers); and being the one to yell "Let go!"; and releasing the tape measure case (so that it springs back to the hooked tab end as the tape retracts into the case).

In the last minutes of the activity, the girls begin to put blocks together to construct a low wall to measure. Though it may not be appropriate to attribute an overall purpose to the activity – as purposes surely shift locally and vary between individuals – a concern expressed explicitly and manifested in the girls' actions is to add a block between each measuring without reaching the point where the tape measure will no longer extend to the end of the block line. When the block line gets all the way to a low stage on one side of the room, they discover that when they let the tape case go it will slide along the top of the block line and then jump up onto the stage. This effect is greeted with celebratory whoops and jumps and repeated several times.

There is then an interruption of the dominant activity while the girls join some of their classmates in a different activity with one of the teachers. When the girls leave the line of blocks, other children immediately approach it and begin to appropriate the blocks for their own purposes. The girls enlist the help of a teacher (Nancy) in re-establishing the exclusive use of the block line for measuring activities. One of the children, Nathaniel, sticks around and gains access to the group by assigning himself a role ("I'm the guy who watches") in the activity. It is at this point that our focal child, Darcy, exits the group to engage in another activity.

Learning Opportunities

Over the course of the period the three girls play with the measuring tape, there are multiple opportunities for them to learn from (and teach) each other. We focus here on the experience of our focal child, Darcy, and find types of learning afforded by the activity can be analytically separated into two rough categories. The first is more directly related to the activity of measuring as ordinarily carried out and relates to a set of concepts that include number identification, dimension (height vs. length), and quantitative comparison (testing whether one thing is longer or shorter than another thing). The other category is not directly tied to the activity of measuring, but rather to the physical affordances and constraints of the tape measure as an object. This set includes learning about the limitations of the material – both in terms of its length (the tape can only be stretched a certain distance) and in terms of its strength (the tape will collapse if it is stretched too far without any external support). Particularly interesting for Darcy and the other girls is a particular affordance of the tape measure tool: that the tape automatically retracts into the case when released, and that this mechanism will also cause the

case end to spring toward the tape end when that end is held (or hooked on something). While the learning in the first category can be related by a knowledgeable observer to mathematics (including geometry), the second can be related primarily to physics and engineering.

Over the course of the activity we do not necessarily see a clear progression towards mastery of particular concepts or skills. However, we do see the children engaging in negotiation and discussion about how to do things, trying out terminology with one another, making discoveries, issuing predictions about the behavior of physical objects (informal hypotheses), and watching to see if their predictions are borne out.

Learning about measuring: One of the basic sub-tasks involved in measuring is *identifying and reading the numeral*s printed on the tape. Anna receives direct instruction in this from the teacher (as described above). After Darcy joins the group, the girls continue to negotiate how do to this. In the excerpt below, the girls are measuring their sixth object together, and still working out how to read numbers from the tape. Also under discussion and available for learning are issues of *dimension*; i.e., that there are different terms to describe measurements made in different directions (lines 13 and 15), and that this is a distinction worth noting.

Table 2: Data Excerpt

1	Susan:	*((jumps off stage and bounces over to Anna))* How about the ta::ble.
2	Anna:	(oew:::)
3		*((girls run off-screen))*
4	Anna:	I know.
5		How about we measure this table.
6	Susan:	Okay.
7	Anna:	Okay. so.
8		Um Susan [we're measuring to thi::s
9	(Darcy:)	[(we're measuring the table)
10	Susan:	Okay.
11	Anna:	You know::?
12		Okay um
13	Susan:	You mean you're measuring how long it is.
14	Anna:	Yes.
15	Susan:	Not how tall it is.
16	Anna:	Yeah.
17	Susan:	Hey. When it (springs) back it might (.) pinch your fingers.
18	Darcy:	Yeah. I know that.
19	Anna:	=How many [is it?
20	(Susan:)	[(so if it falls (.) back it might)
21	Darcy:	It's seventy-five feet.
22	Susan:	Lemme see! Actually (.) it's (.) fifty-seven feet.
23	Anna:	OKAY:: [( )
24	Susan:	[Actually actually it's (.) seventy-five feet.
25	Anna:	Okay. STA:ND BACK EVERYONE:
26		*((sound of tape measure case scooting over table and dropping to floor))*
27	Girl:	YES!
28	Anna:	How about the fridge?
29	Susan:	Yeah we'll mea:sure the fri::dge!

Learning about the constraints and affordances of the object: Over the course of their play activity, the girls encounter and explore various properties of the tape measure itself. For instance, they (particularly Anna) display awareness that the tape is limited in length, and concern themselves with limiting the length of their block wall accordingly. Earlier on, they discover that the strength, or the ability of the tape measure to support its own weight when extended, is also limited – e.g., when measuring a tall cardboard tree, the measuring tape bends over on itself and Anna yells, "It's too high!"). However, it is a curious affordance of the tool that captures their interest the most. That is the self-propelling action of the tape measure – that the tape end automatically retracts into the case, but also the case end can spring back to the tabbed end if the tabbed end is held in place (see lines 17-18 and 25-27 above).

That this is a learning experience for Darcy is evidenced at a later moment. The girls are measuring a bookcase by placing the tape measure case on the floor and extending the tape towards the top of the bookcase. When Anna lets go of the case, which is resting on the floor, Darcy abruptly pulls her hand back and jumps away from the tabbed end. Evidently, she expects the case to spring up towards the tabbed end (though it does not because it is too heavy). Darcy's reaction represents learning in progress. Her earlier experiences with the tape measure have led her to form the expectation that the case will always spring towards the tabbed end when released. It is fairly certain that she would not have expected a metal case to rise into the air if she had not had this experience with the tape measure. That the tape measure does not do what she expects provides an opportunity for Darcy to revise her conceptualization of the properties of this object, potentially gaining a more complex (though unarticulated) understanding of the interaction between gravity and the pull of the spring retracting the tape measure into the case.

Much later, after the girls have created a wall of blocks for measuring, the girls discover that when the tape measure is released so that it runs along the block wall, it will act as a projectile and pop up onto the stage (beyond the spot at which the end was hooked). The first time this happens, the girls react with excitement and try it again. The second try is less successful and meets with less enthusiasm. The third try is presented below.

Table 3: Data Excerpt

1	Anna:	OKAY. Now:::: *((nasal))* I wanna do (.) as many ( ) *((picks up blue block and puts at end of wall, looks back to Darcy*
2		*and Susan))*
3		*((Darcy stretches measuring tape along the length of the wall))*
4	Anna:	*((nods))* *((puts hands on hips))* I think (it'll) stop soon. Because it does stop.
5		*((Darcy gets to end of block wall--back end of tape measure is lined up with end of wall))*
6	Anna:	Okay. *((looks at end of tape measure, looks at Darcy))*
7	(Darcy:)	Okay?
8	Susan:	Okay.
9		*((Both girls look at Susan, holding tab end))*
10	Girl:	(All right. Let's go. Looks goo::d.)
11		*((Susan lets go of hooked end and moves away from block wall.))*
12	Anna:	Okay [( )
13		[*((Darcy lets go of tape measure))*
14		*((tape measure pops up onto stage))*
15	Anna:	Waaa[::oh *((runs toward tape measure))*
16	Susan:	[Wu Hoo::=
17	Darcy:	=Wuhoh *((jumps, walks to end of wall))*
18		*((Susan jumps, walks toward group at table.))*
19	Anna:	Okay 'm gonna I'm gonna
20		*((Susan moves chair))*
21	Anna:	*((calling out))* Okay. Put ano- another block the::re.

Four times in all the girls let go of tape measure and it pops onto the stage. The girls display excitement about this when it happens (in the form of whoops, jumps, and screams). They do not make verbal reference to it. This activity is in some ways like an experiment. For instance, as she lets go of the case on the last try, Anna says, "let's see:::," which suggests that she is orienting to this as trying something out. It is also experiment-like in that it consists of multiple repetitions of a procedure with slight modifications each time. These multiple repetitions, in which the girls take different roles, allow them to see the phenomenon from different perspectives and observe which aspects remain stable and which aspects change. However, there is no evidence that the modifications undertaken are designed to produce an effect, especially not of making the tape measure jump when released. To the extent that there is a particular purpose indicated, it is to add blocks of the right number and length such that the tape measure will still extend to the end of the block wall (lines 1, 4, 19-21). Otherwise, the majority of the talk surrounding this activity is about the turn-taking process itself (e.g., "It's my turn.") and the appropriate performance of roles (e.g., "No. You have to say 'let go'!").

Discussion: Peer-regulated Group Activity as Learning Arrangement

We can recognize several advantages of this form of interaction as a learning arrangement for young children. First, there appears to be strong social motivation for participating in these activities. Even when their participation is not solicited nor reliably rewarded by other children—as it tends to be by parents in the home environment—children actively seek out and work hard to gain entrance into these activities. We might say that the activities exhibit something like a gravitational pull on children. Furthermore, these activities afford different types of learning opportunities. Children negotiate with each other in guiding and regulating the activity themselves—as such they have increased opportunity to both exercise agency and to develop skills at collaborating with others. Children can position themselves as both learners and teachers in such interaction. The lack of stable and explicit goal orientation gives children a great deal of freedom to explore the aspects of a phenomenon that most interest them (Rogoff, 1990). These peer-organized learning arrangements also seem to offer enhanced opportunities for embodied participation and experiential learning, as children move about the rooms with little constraint, drawing into their activity a variety of different types of artifacts and structures.

There also are disadvantages when compared with adult-mediated interaction. These have to do with the interactional challenges of the activity and the lack of adult support in developing an activity in the direction of disciplinary knowledge. In child-regulated peer group activity the interactional demands fall squarely on the shoulders of the children themselves. Our analysis of this activity shows that gaining entrance is itself a difficult maneuver—while one our focal children succeeds, the other attempts to participate but is unsuccessful (even reprimanded for her attempt by the core trio of girls). Similarly, it is the children who must maintain the activity and direct it in fruitful and enjoyable directions. Young children may not always be able to do this effectively, which may be why such activities rarely last as long as the one we analyze in this paper.

Children also do not experience the same level of interactional support for learning in peer activities as they do in parent-guided activities. Unlike parents, peers may not monitor for opportunities for teaching and learning. To the extent that children's activities are monitored, peers are more likely to see shortcomings and

provide correction than recognize innovation or respond with elaboration. These qualities of peer play do offer opportunities to develop skills at argumentation and negotiation--part of the collaborative practice of science.

Another possibility is that rich opportunities for learning may occur but not get developed in the direction of disciplinary knowledge. For instance, in the block-measuring activities described above there is no movement toward investigation of why the tape measure flies. Over the course of the repeated tries girls encounter 'information' about the physical workings of the tool; however, they do not seem to engage in purposeful or principled experimentation in order to find out more. Without the involvement of knowledgeable adults or peers there is little opportunity to link this activity to disciplinary principles or practices.

Conclusion

The distinction between formal and informal learning takes on a peculiar status when applied to the lives of very young children. Though formal education reaches into the mostly informal lives of young children in many ways, "school" does not neatly map onto "formal" and "home" does not neatly map onto "informal". In fact, due to the particular social configurations of preschools (versus middle class homes), they seem to offer *more* opportunity for the highly informal learning arrangement of uninterrupted, child-organized group play.

In light of the affordances and limitations of informal peer-group interaction for science learning discussed above, it remains to be determined exactly what role participation in this type of activity might play in a trajectory of 'becoming a scientist' or even in building the disciplinary knowledge needed to succeed in science learning later in school. Our analysis supports pedagogical practices that take advantage of the opportunities for peer learning afforded by the preschool classroom setting by allowing children the freedom to self-organize into groups and pursue activities of their choice. On the other hand, our analysis also suggests that strategic adult support, provided at key moments in children's peer play, could provide disciplinary connections and promote deeper learning of a kind that may not happen when children play together without intervention.

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