Spatial Learning: Beyond Circles, Squares, and Triangles

By Mark Tompkins

For most adults, spatial thinking is an everyday part of life. Every time we tie our shoes, line up the silverware to set the table, or draw a map to guide a friend to our home, we are solving spatial problems. All of these tasks require a basic understanding of spatial relationships.

Spatial knowledge is acquired through years of experience and intellectual maturation. Preschoolers are just beginning to develop an understanding of spatial concepts.

In this article, we'll suggest ways to support the development of children's spatial thinking. One aspect of spatial thinking that is emphasized in many preschool settings is the identification of shapes and patterns. Typically, adults teach about shapes by decorating the room with cutouts of different shapes, reading books about shapes, using shape flash cards, encouraging children to play lotto shape games, and asking children to identify the shapes of objects they are playing with.

Children learn about shapes by doing—by actually working with objects. Thus, it's important to provide lots of materials that encourage activities involving spatial thinking.

With enough practice, children *do* learn to identify circles, squares, and rectangles. But this skill makes only a small contribution to the overall development of children's spatial thinking. In High/Scope programs, we want children to do more than just *identify* shapes. We want them to acquire an *understanding* of how shapes work; how things fit together and can be taken apart; how things can be transformed, enclosed, and positioned.

When we watch children at play, we recognize that they learn about space (and shapes) by doing—by working with objects, not by talking

about pictures or identifying cutout shapes. Thus, the best way adults can support children in learning about spatial relationships is to set up a play environment rich in materials that encourage spatial thinking. Within such an environment, the adults work alongside children and talk with them about what they are doing and discovering.

How Spatial Thinking Develops

Our perspective on how spatial thinking develops comes from two main sources: the work of child development theorists, like Piaget, who have documented the developmental changes in children's spatial thinking, and the findings of brain researchers who have identified the right hemisphere of the brain as the site for spatial processing. These theorists and researchers contend that spatial thinking is a largely nonverbal process that develops over time, primarily through children's active explorations and transformations of objects.

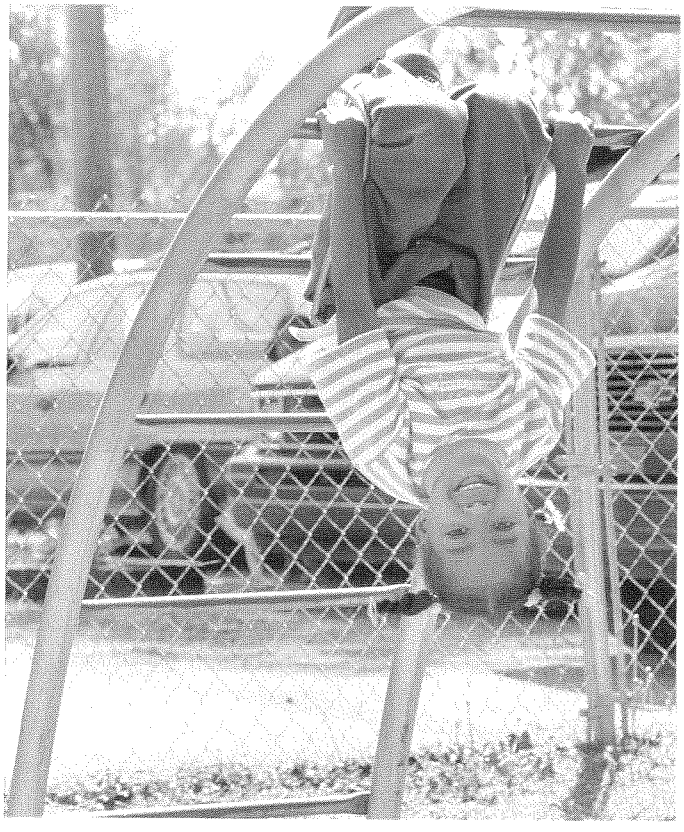
Preschoolers are in the process of mastering some of the spatial concepts that adults take for granted. For example, preschoolers don't fully understand the relationships of *proximity* and *separation*—how close together or far apart things are. A child may say that the sand table is close to the door, until someone places another object between the two; then the child may think that the sand table and door are farther apart. Preschoolers are also learning to recognize where things are *located* and the *directions in which things are moving,* although by adult standards their judgments are not always accurate.

Preschoolers are also learning to understand and use the *spatial language* that is attached to such concepts. Adults often don't realize that preschoolers are confused by the large number of spatial terms used in everyday conversation. Many children, for example, find it difficult to follow adult directions like these: "Put this in Luke's cubbie. . . That's the one in the second row, in the middle. Pull the cubbie all the way out, and put the toy in the back half of the container." Likewise, a child trying to fit a puzzle together is only confused by advice such as "Try turning that piece upside down" or "This piece goes at the top instead of the bottom."

To develop spatial thinking and language, children need opportunities to experience for themselves how things take up space, how they move, how they look and feel, how they fit together, how they may be transformed when they are reshaped or repositioned. The following list of **space key experiences** provides a summary of the important spatial activities through which preschoolers develop their spatial thinking.

- **Filling and emptying**
- **Fitting things together and taking them apart**
- **Changing the shape and arrangement of objects (wrapping, twisting, stretching, stacking, enclosing)**
- **Observing people, places, and things from different spatial viewpoints**
- **Experiencing and describing positions, directions, and distances in the play space, building, and neighborhood**
- **Interpreting spatial relations in drawings, pictures, and photographs**

These six key experiences, which have been derived from research on spatial thinking as well as from observations made by High/Scope teachers, can help you observe, assess, and support children's emerging spatial thinking. The block area, discussed in the remainder of the article, is a prime spot for this observation, assessment, and support.



Observing things from different spatial viewpoints! This child is thoroughly enjoying one of High/Scope's six space key experiences.

Save the Block Creations

Ben is in the block area, building a farm with unit blocks and the large, hollow blocks. Five minutes before the end of work time, a teacher comes over and begins to play with Ben, helping him build a fence to "keep the cattle in." The teacher then notices the time and reminds Ben it is almost time to clean up. After cleanup time is announced, the teacher helps Ben put away the blocks.

As teaching adults, most of us don't think twice about tearing down block creations like Ben's. We routinely dismantle children's constructions when we put away building sets, toy figures, and other reusable materials at the end of work time. By contrast, the creations children make from expendable materials—paintings, sculptures, and collages—are put on display or sent home to parents.

While it's obvious why we treat art projects differently, it's important to remember that Ben values his farm just as much as other children value their artwork. Yet the child whose work remains on display—at home or in the classroom—can't help but feel a greater sense of ownership of the creation. Since a child's painting or sculpture remains available for others to see, the child may also feel it has more value to others than the block creation that comes down immediately. In addition, the child who makes a permanent creation may find that recall experiences are more meaningful, because the object to be talked about is available to look at and touch.

While blocks do have to be put away eventually and can't be sent home with children, it is possible for adults to help children attach a greater sense of ownership and permanence to their temporary creations. Some ideas:

- **Reserve space for temporary displays of children's work with blocks (and other reusable materials)** on a tabletop, bookshelf, cabinet top, or section of the floor. If you have separate morning and afternoon programs each day, then have two small display tables/spaces. By displaying block structures, you show children that their creations are valued. Keep in mind that the more blocks you have in the block area, the longer a structure may be kept up. In most classrooms, two days is the normal limit for a block display.
- **Attach signs and names to products.** The sign may show the child's name or personal symbol or a short mes-

The Block Area

A laboratory for spatial thinking. As children work with blocks and other building materials in the block area, they encounter and experiment with many spatial concepts. Consider, for example, the spatial concepts (indicated by highlighted words) that Luke, Elle, and Wynn are working with in the following examples:

Luke is playing with a set of six cloth blocks in the toddler room. A few days ago he was observed stuffing them ***into*** *a box, taking them* ***out****, and repeating the process.*

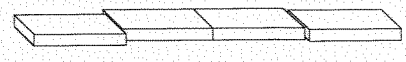
sage: "Ben's farm." Such signs help children see the importance we place on their work. The sign is also a symbol of permanence that serves to protect the structure for a while.

- **Take photos, make videotapes, or have children draw pictures of things they have made.** Display photos and pictures on walls, send them home to parents, or organize them in albums. Children and parents love to look through these albums and often order reprints of particular pictures. Photos and drawings are also good "story starters" for encouraging children to describe orally or in writing what they have been doing.

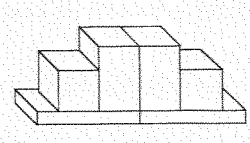
An added advantage of "saving" block creations, particularly in pictures or photos, is this: For adults, the saved block creations can document the child's stage of development in understanding spatial relationships. Research on block play reveals that children progress through these stages as their understanding of spatial relationships increases:

1. Stacking, knocking stacks over, restacking.

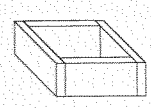
2. Making block rows (often representing roads).



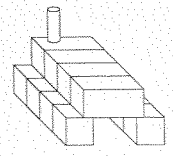
3. Combining stacking and row-making (structures usually lack interior spaces).



4. Making enclosures (usually designed to contain things or people).



5. Making enclosures that include arches and other forms (structures may represent a variety of objects).



Today he has discovered that one block can be set ***on top of*** *another. He tries to put yet another block on top, but the stack falls* ***over,*** *to his delight.*

In the preschool, Elle and Wynn are using blocks to make a house that the doll family can live ***in****. They use several* ***large*** *blocks to make the walls. Then they put* ***shorter*** *blocks* ***inside*** *the house to make rooms for the furniture and dolls. Later,* ***beside*** *the house, they build a garage that has a* ***long*** *ramp for the cars to use when they drive* ***up to*** *the house.*

Through experiences like these, children learn that blocks may be placed flat, on edge, or on end. They develop an understanding of how these block positions may be combined to produce different characteristics in their structure. As they experiment with different building methods and materials, children are also learning how variables of balance, weight, size, shape, thickness, width, and length affect the structures they are creating.

While this article focuses primarily on spatial thinking, it's important to note that block-area play is also rich in **creative representation** key experiences. Children use blocks to build representations of houses, stores, trains, bridges, offices, and boats. As they build these structures, children are not only working with construction problems; they are also exploring the roles of moms, dads, animals, drivers, farmers, and workers.

Block-area materials. To encourage productive play experiences like these, the block area must be well equipped and carefully planned. Many kinds of materials may be used for building, and a well-stocked block area includes as wide a variety as possible. Large hollow blocks may be your best block investment. Though the initial cost is high, they are very durable and promote a host of productive play and learning experiences. The size of the blocks enables young children to build structures that are life-sized (for them); these large structures often give rise to dramatic play that is very personal, physical, and compelling to a young child. Other children prefer unit blocks, which offer fewer physical challenges but allow children to create whole cities or farms.

In addition to a variety of blocks, props like steering wheels, carpet squares or pieces, bedspreads, sheets, tubes, rope, small trucks, and farm animals are also important to remember when stocking the block area. These props encourage creativity and add to the realism of the structures children construct. Once the blocks and other materials are selected, make sure all materials are stored in clearly labeled containers and shelves. To make a comfortable, sound-absorbing work surface, cover the floor of the block area with low-nap carpet.

Spacious, carefully designed, and well-stocked, the block area can be one of the most intensive learning areas in your room. A final ingredient for an effective block area is appropriate **adult support.**

The adult's role when children are building. Adults can support children's play in the block area by using the same nonintrusive strategies they use throughout the classroom, center, or home. That is, they **observe** what children are doing, **imitate** their actions, **wait to be invited** to join them, and then **participate** *as partners* rather than as leaders in the play.

Puzzled About Puzzles?

Several children in our group have gotten very frustrated recently when playing with the puzzles. I'm not sure what to do. Should I show them how the pieces fit, or should I ignore their frustration and let them figure it out for themselves?

—A preschool teacher

To prevent children from getting frustrated, first make sure you have available a wide variety of puzzles suited to all ability levels. These might range from knobbed, board-style puzzles of 4 or 5 pieces, to simple jigsaw puzzles with 15 or 16 pieces.

Once you are sure you have an appropriate range of puzzles, take your cue from the individual child as to how much help you should give. As a general rule, it's best to let children figure out problems for themselves. Providing too much help gives children the message that if they have a problem, adults can fix it for them. So if Callie is having a difficult time with a puzzle, don't intervene at first. Just observe and see if she comes to you for assistance. If she then asks you for help, ask her to describe or show you what she has done. If she is very frustrated, encourage her to talk about these feelings, and then suggest she try out some new strategies. Encourage her to come up with some ideas, but if she doesn't, you can make suggestions. The adult's role is one of observer and supporter—-not of puzzle problem-solver.

If after you go through this process, the child still can't make the pieces fit, that's okay. Sometimes it takes lots of practice or some help from a peer to solve a problem like this. To paraphrase Piaget, *thinking takes time*. The child who progresses the furthest is often the one who was most confused initially.

To understand the adult's role in children's block play, consider this recent example from the High/Scope Demonstration Preschool.

Trey (whose father is a bus driver) had been building a "bus" with the large wooden blocks. This attracted other children, who began playing "bus" with Trey. Barbara (one of the teachers) had been observing this game and was soon invited to sit on the "bus." Once she and several other children were on board, they had lots of decisions to make—what kind of food to bring, where to sit, where to go. The group quickly decided that the "bus" was too ***small****, so they made it* ***bigger*** *by adding many more seats. The children worked hard at* ***fitting*** *the big wooden blocks* ***end-to-end*** *to make the "bus"* ***longer****. They then made a "driver's seat"* ***up front*** *and made a "steering wheel" to fit* ***on top*** *of the "dashboard." They also decided to build a "refrigerator" in the* ***back*** *of the pretend bus. Trey said it needed to be "on the* ***back*** *wall, but in the* ***middle*** *of the aisle."*

Barbara did not make any of these decisions for the children; rather, she helped them work together to figure out solutions to the spatial problems that arose. Her primary role was that of a play partner who, through

her understanding of the High/Scope key experiences, helped children engage in spatial thinking by the support she gave.

This extended play activity is typical of the spatial learning experiences that result when adults provide a stimulating environment and appropriate support for the development of children's ideas.

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A Visit to a "Space Station"

What Should Adults Say?

Here are some examples of adult language that encourages children's spatial thinking:

Child: *This refrigerator won't fit!*

Adult: *The refrigerator won't fit? Ummm. . . What do you think we should do?*

Child: *Move the mirror sideways?*

Adult: *Let's try it. . .You move the mirror sideways, and then we can try to fit the refrigerator into that small space.*

* * *

Adult: [Observes and imitates a child who is filling and emptying containers at the water table, then initiates a conversation.] *I'm filling it up, to the top. Where should I pour it out?*

Child: *Over there. Watch this.*

Adult: *I see you're pouring only a little bit of water in this time.*

Child: *Yup. I'm going to swish it around and then dump it!*

* * *

Child: [Stands on the deck on the playground climber.] *I can see it.*

Adult: *What can you see, Jack?*

Child: *The top of the tire thing.*

Adult: *The top of the tire climber? What does it look like from way up there?*

Child: *It looks scary up here; it's bigger than this one.*

One of the best ways for adults to understand the spatial key experiences is to encounter them during a game or problem-solving activity. When challenged to solve adult-level spatial problems, participants experience the complexity of spatial thinking. They begin to realize that children have not yet learned the spatial concepts we take for granted.

Any one of the three games below may be used for the activity. After the game is completed, the trainer focuses the group on children's spatial thinking and how adults can support its development through the key experiences.

Making Sculptures

This activity can be done outdoors or indoors. If you are outside, make sure there are plenty of loose materials available: sticks, stones, cardboard, leaves, etc. If you are indoors, make sure you're in a classroom with plenty of everyday materials.

1. Divide the group into teams of four or five.
2. Ask each team to build a sculpture with the materials at hand.
3. When the sculptures are complete, each team looks at their sculpture and at all the others from as many spatial viewpoints as possible.
4. Each team then looks at the list of spatial key experiences and discusses how each one occurred during the activity. Then they share their findings with the whole group.
5. The trainer points out that when children are building or creating, they are engaged in spatial thinking. The trainer focuses the discussion on the power of active learning as the "teacher" of spatial thinking.

Unconventional Measuring Units

1. Divide the group into teams of four or five.
2. Ask each team to come up with several "unconventional measuring units" for measuring things in the room and then use their units to measure five things. For example, the easel could be "93 car keys" tall. Or, the distance across the room could be "134½ Pepsi cans."
3. Each team lists their measurements and presents them to the whole group. Then the group discusses how children measure, how they describe the size of something in comparison to something else, and how the measurement words we use (feet, inches, small, big) may have a different meaning for children.

Working With Elastic

1. Divide the group into small groups of four or five. Provide each team with a piece of elastic (4–6 ft).
2. Give each team an index card with the following directions:

- *Team members make a circle by tying the two ends of the elastic together. Each team member then holds on to the circle, using the hands, foot, neck or some other part of the body.*
- *The team makes the elastic circle as large and as small as possible.*
- *The team gets inside the circle and makes the circle high and then low.*
- *The team thinks of some other things they could do with the elastic.*

3. After the teams have carried out the directions, pass out the list of spatial key experiences to each team and ask them to identify those that occurred during the activity. □