

Children's Gender Behavior at Science Museum Exhibits

KRISTIN BENNE KREMER, RESEARCH AND EVALUATION CONSULTANT

OHIO DEPARTMENT OF MENTAL HEALTH

GARY W. MULLINS, ASSOCIATE PROFESSOR

SCHOOL OF NATURAL RESOURCES, THE OHIO STATE UNIVERSITY

Science museums offer interactive experiences designed to enhance children's science readiness. But to whom? And how effective are they? Since research has determined that children ignore activities that they feel involve inconsistent gender behavior (Carter, 1987), museums need to understand what role gender behavior plays in the elective learning environment they encourage.

Girls enter preschool with verbal, fine-motor, nurturing, one-to-one, role rehearsal, adult-modeling, and impulse-control experiences. Boys enter with spatial, gross-motor, inventive, managing, group, career and life options, direction, instruction, and self-worth experiences (Greenberg, as found in Sprung, 1987; Greenberg and Lake, 1991). The traditional male gender strengths better prepare boys for careers in science and technology (Barr, 1985; Weitzman, 1985; Carter, 1987; Greenberg and Lake, 1991).

Research studies of families in elective learning situations indicate comparable findings of gender differences among adults. A study in a zoo setting revealed that males consistently led the groups, and females expressed multiple social roles (Rosenfeld, 1980). Observations in two science centers found that mothers were least likely of all family members to choose exhibits and most likely to follow others (Diamond, 1980). In a science museum study conducted by Cone and Kendall (1976), fathers were observed ignoring their daughters. The authors suggested that this may be partly responsible for the girls' relative passivity and hypothesized that science museums may be a "male environment" and are social settings where stereotypical gender behavior occurs (Cone and Kendall, 1976).

In elementary science and math classrooms, boys receive preferential treatment and are asked more higher-order questions than are girls (Barr, 1985). In traditional school settings, girls generally have positive attitudes toward science and scientists until about age 12 (Erb, 1981; Kahle, 1983a; Greenberg and Lake, 1991), but once science becomes optional, it is considered “men’s work and boring” with too many facts to memorize (Kahle, 1983b). Some girls begin to screen themselves out of further science and math courses and choose not to pursue science and technology careers (Linn, 1981). Although women comprised almost 50% of the U.S. work force by 1987, only 12.8% of the scientists and engineers were women (Dix, 1987).

Staff of the Children’s Museum in Boston have observed that “boys and girls racing through the exhibits are similarly active, similarly rambunctious, and similarly interested in model cars and model kitchens until they reach the first grade or so” (Shapiro, 1990, p. 57). However, no research has addressed the occurrence of children’s gender behavior in science museums and its effects on early science learning. The purpose of this study was to explore the relationship between gender behavior and interaction with participatory exhibits.

RESEARCH SETTING AND DESIGN

The study was conducted during the summer of 1988 at the Center of Science and Industry (COSI) in Columbus, Ohio. Big KIDSPACE, an area on the third floor, was the setting for the study. The exhibits were designed to enhance the developmental abilities of kindergarten to third-grade children, focusing on their intellectual, emotional, social, and physical growth (Appendix). In 1991, COSI expanded Big KIDSPACE to encourage family interaction, and the area is now called Familiespace.

The Setting—Children’s interactions at five exhibits were observed.

Water Jets: Red plastic targets hang from the top of a rectangular-shaped glass case. Six jets steadily streaming water are in the case along its sides. Visitors can manipulate the jets from outside to aim for the targets. *Objectives:* To improve motor skills, spatial awareness, and understanding of the properties of water.

Bubbles: Two large tubs contain soapy water and five rings of various shapes and sizes that are used to make the bubbles. On the wall between the tubs are an air dryer and sink to wash and dry hands. *Objectives:* To understand spatial relationships; to exercise and enhance motor skills; to enhance problem-solving skills; to understand the properties of water and bubbles.



(Photographs courtesy of the Center of Science and Industry; photograph lower right by Chris Kremer.)

Face Paints: Four or five chairs are placed at a round table. Mirrors are placed on the table in front of the chairs. On the table are paints and sponges. **Objectives:** To teach and talk about why certain people use make-up; to identify facial and body components; to use mirrors to talk about reverse imagery.

Animal Lab: The exhibit is divided into two sections in an L shape. In one section, animals are in glass cages approximately a foot off the ground so that children can reach in and touch or hold them; the animals include rats, chicks, turtles, and a cockroach. In another section, animals can be watched through the glass; they include lizards, worms, fish, and rats. **Objectives:** To encourage learning and appreciation of nature and animals through physical interaction; to promote positive relationships with animals.

Build-a-House: A miniature three-room bilevel house built with wood beams contains building materials—curtains, carpet squares, foam bricks, and plastic pipes. Features of the house include a light switch, doorbell, play sink, and stairs. **Objectives:** To exercise building, motor, mathematics, and coordination skills; to encourage interaction with a variety of materials.

Qualitative Methodology and Data Analysis—A total of 419 children were observed interacting with participatory exhibits. One

boy was fully observed from beginning to end of interaction with an exhibit, followed by observation of the next girl who approached. Overt behavior was recorded and documented. These data were organized by exhibit and then separated by gender. Each child's interaction was further broken down into "interaction with peers" and "interaction with adults."

Quantitative Methodology and Data Analysis—Holding power (length of time at the exhibit), number and gender of adults and peers initially present with the child, and number of male and female children at the exhibit when the child initially approached it (the exhibit's gender ratio) were recorded. An overall gender ratio (periodic count of the number of boys and girls present in the entire Big KIDSPACE area) was taken to compare with the individual exhibit gender ratios to determine whether boys and girls preferred different exhibits. The mean holding power of each exhibit for boys and girls was calculated and t-tests were computed. Percentages of adults and peers present were also calculated for each exhibit.

Establishing Trustworthiness—Testing for the trustworthiness of the qualitative data was conducted according to Guba and Lincoln's (1985) definitions of credibility, transferability, dependability, and confirmability. Credibility was established through persistent observation of the subjects, debriefings of the observer by another researcher, and the research advisors' review of raw data. Transferability, or generalizing the research results, was not the intention of the study. However, the observations may assist other museums in developing studies to assess the impact of gender behavior. Dependability and confirmability were addressed by using different supportive research methods and a panel of research advisors as auditors to reduce interpretive errors. Reviews by auditors of the raw data and a research diary provided an opportunity to reconstruct the data and to review the analysis process for accuracy.

RESEARCH QUESTIONS AND OBSERVATIONS

Five research questions guided the qualitative study.

1. *Do boys and girls interact differently with the exhibits, and do they tend to display gender behaviors at these exhibits?*
2. *Does the presence of adults tend to encourage gender behavior?*
3. *Does the presence of peers tend to encourage gender behavior?*

4. *Can design elements of the exhibits be interpreted by the children as means by which they can express gender behavior?*
5. *Do boys and girls prefer different exhibits?*

The table that follows indicates the holding power (time spent at an exhibit) and the size of the sample.

Water Jets: Twenty-one out of 74 boys referred to guns by mimicking shooting actions and sounds as they aimed the jets at the targets; this is considered masculine gender-consistent behavior (Reingold, 1975; Barr, 1985; Carter, 1987; Shapiro, 1990). Only 1 of 71 girls did so. The mean holding power for boys was almost 10 seconds longer than for girls. A behavior pattern of female adults was actively urging children to move on to another exhibit, possibly indicating lack of interest in participating. Male adults accompanied male children most often here, and male peer interaction was most prominent at this exhibit—group comments and games centered around guns and shooting. No female groups displayed this behavior.

Face Paints: Out of 21 girls, 7 applied the paint as make-up; imitating the application of make-up and concern with physical appearance are traditional feminine gender traits (Weitzman, 1979; Linn as found in Skolnick, et al. 1982; Carter, 1987; Shapiro, 1990). Thirteen drew rainbows, balloons, hearts, and animals. When female peers were present, the girl observed often would seek approval for what she had drawn. Only girls were observed wiping the paint off as if dissatisfied with what they had drawn. In contrast, 14 out of 21 boys drew stripes and dashes randomly, often without looking in the mirror. Girls spent significantly more time than boys at the exhibit. Fathers rarely accompanied their children to the paints exhibit. Of the two who did, one ignored his daughter. They generally displayed no interest in becoming involved, while mothers often helped children apply the paints. Mothers accompanied children to the exhibit 43.8% of the time; fathers accompanied children 10% of the time. More boys came alone to this exhibit than

Table 1. Holding power and the sample size.

	Water Jets		Face Paints*		Bubbles		Animal Lab*		Build-a-House	
	Min. Sec.	No.	Min. Sec.	No.	Min. Sec.	No.	Min. Sec.	No.	Min. Sec.	No.
Girls	.40	71	5.48	21	1.50	48	1.59	40	4.04	28
Boys	.50	74	3.27	20	2.25	49	1.08	40	5.02	28

* Holding power means were significantly different between boys and girls ($p < .05$).

to any other. One explanation could be that they viewed face painting as a solitary activity and inappropriate for peer interaction.

Bubbles: The exhibit encouraged experimentation with rings of various shapes to make bubbles. Some girls made negative comments about becoming involved; 7 out of 48 showed disinterest because interaction required getting wet. Neatness in habits and interest in appearance are considered gender-consistent behavior for females (Eakins and Eakins, 1978). Linn and Thier (1975) found that girls chose activities requiring neatness in a hands-on science program. Only 1 out of 49 boys chose not to interact because he did not want to get his brochure wet. On average, boys stayed almost 30 seconds longer than girls.

One male and 11 female adults were involved in cleaning and drying children's hands—perhaps an indication that they thought the exhibit was “messy.” Adults of both sexes were present most often at the Bubbles exhibit, and interaction with it and with children was more predominant than at any other exhibit observed. Peer groups also interacted extensively while teaching each other bubble-making skills.

Animal Lab: Out of 40 girls, 14 expressed nurturing behavior toward the baby chicks compared to 2 out of 40 boys. Girls often made affectionate remarks and showed concern for the chicks' welfare and spent significantly more time than boys at the exhibit, supporting research findings that at an early age, girls acquire nurturing and care-giving skills (Barr, 1985; Weitzman, 1985; Carter, 1987; Shapiro, 1990).

Mothers, more than fathers, appeared to be teaching nurturing and caring skills, predominantly to the girls. No solitary fathers were observed accompanying girls to the activity. The exhibit did provide an opportunity for peer groups to interact; girls tended to engage in conversation and action relating to nurturing more so than boys.

Build-a-House: Out of 28 boys, 12—in contrast with 2 out of 28 girls—displayed physical and sometimes destructive behavior (throwing and kicking bricks, knocking down other children's structures, and climbing) and encouraged aggressiveness in play, which is considered typical male behavior in natural play settings (Skolnick, et al., 1982; Carter, 1987; Shapiro, 1990). In contrast, 2 observed girls engaged in play as homemakers with their peers. Carter (1987) writes that not only do children in groups play with same-gender peers more often than with opposite-gender peers, they also tend to display gender-consistent behavior. Children's

peer groups—much more so than adults’—pressure members to behave according to gender norms (Carter, 1987).

Design can encourage gender-consistent behavior, for example, at Water Jets (shooting, competitiveness) and Face Paints (applying make-up). Design was also observed encouraging the use of cross-sex skills as at Animal Lab and Bubbles. Out of 40 boys, 2 did express nurturing skills with the animals, and 9 out of 48 girls engaged in extensive “messy” interactive behavior at the Bubbles exhibit.

The exhibits possessing the higher holding power and gender ratio were also the exhibits where consistent gender behavior was most predominant. For example, the gender ratio at the Water Jets exhibit does indicate that more boys than girls were initially attracted to it at any one time. The overall gender ratio in Big KIDSPACE was 1.0 (on average, an equal number of boys and girls), yet at the Water Jets exhibit, the gender ratio of 1.7 indicates that almost twice as many boys as girls were initially attracted to the exhibit. In contrast, the gender ratio at the Face Paints exhibit was .52, indicating that almost twice as many girls as boys were initially attracted to it. The Bubbles exhibit had the most even ratio (1.04).

RESEARCH IMPLICATIONS

Discovery learning through creative play appears to be a positive asset in all exhibits studied because there were defined goals of aiming at targets, making bubbles, painting, learning about animals, and building in the house. However, the Face Paints exhibit may be lacking in adequate science objectives to overcome female gender traits that should not be reinforced in a learning environment.

Such an observation suggests that for some children learning could be more directed to promote comprehension of scientific concepts and specifically to help girls identify with science more readily. Similarly, the lack of time boys spent learning nurturing skills and the lack of adult males present at the Animal Lab exhibit indicated that boys as well as girls need greater direction in achieving gender-balanced education experiences.

The observations suggest that designers can promote a gender-balanced science learning environment by creating exhibits that emphasize the use of cross-gender skills. For example, at the Bubbles exhibit, boys used social and verbal skills, while girls manipulated objects and exercised spatial visualization skills. The entire museum environment can reflect a commitment toward being gender-balanced. The holistic Big KIDSPACE experience showed girls

that science is fun and that they can be a part of it just as boys can. Big KIDSPACE assistants were both male and female, presenting themselves as role models, specifically showing that girls can be and are interested in science. Indeed, there is a strong parallel between the overall Big KIDSPACE objectives and recommendations made by educators interested in encouraging young girls in science (Skolnick, et al., 1982; Barr, 1985; Sprung, 1987).

Science exhibit design and educational departments are urged to consider the following recommendations.

1. Become familiar with how traditional gender skills and traits are learned, what they are, and how gender experiences impact science learning.
2. Reduce the elements of design and educational programs favoring one gender over the other in order to make information equally attractive to boys and girls. This can be accomplished by monitoring exhibits' gender ratio during the formative evaluation phase.
3. Establish and maintain an environment that promotes the use of cross-gender skills.
4. Formulate educational programs that target girls and encourage their interest in science.
5. Retain female interpreters as role models for female visitors and males as role models at exhibits that emphasize traditional female learning skills.
6. Develop workshops and symposia on parent/child relationships, curriculum design, and media development related to gender.
7. Support research to assess how museums can achieve a gender-balanced learning environment.

This study was descriptive and exploratory rather than causal. Investigation of children's stated preferences and their verbal reactions are needed to establish guidelines for providing a gender-balanced science museum learning environment that will enhance both boys' and girls' interest in science. Once the impact of children's gender behavior is understood, science museums may state with confidence that a museum visit can plant the seeds of scientific inquiry in all children's minds.

APPENDIX: Big KIDSPACE Program Objectives

The purpose of the exhibit area was enhancing the developmental abilities of children—both girls and boys—through the third grade. Big KIDSPACE assistants, both male and female, presented themselves as role models, specifically indicating that interest in science is appropriate for both sexes.

Intellectual Growth and Stimulation:

- * To offer transitional exhibits designed to build on experiences in other areas of the museum.
- * To foster the acquisition of scientific, mathematical, and social sciences concepts through active discovery.
- * To develop positive attitudes toward learning and discovery.
- * To offer concrete experiences that enhance age-appropriate problem-solving abilities.
- * To sharpen sensory awareness through exploration, observation, listening, touching, and balancing.
- * To facilitate the development of concepts and understanding of the world around the school-aged child.
- * To offer experiences with the simple functions of objects.
- * To provide active experimentation with tools, materials, and equipment designed to enhance learning and discovery (solving problems, questioning, novel and divergent material use, organizing information).
- * To provide exhibits appropriately divergent and open-ended enough to stimulate growth in the entire span of early school-age development.

Emotional Growth:

- * To build a positive self-concept through successful learning experiences.
- * To offer an environment that fosters confidence in self-ability.
- * To provide exhibits that facilitate independence and self-reliance.
- * To develop confidence in others—children and adults.
- * To facilitate success in persistence of effort.
- * To provide an environment that enhances positive family interactions.
- * To provide a transitional environment for school-aged children and their families.

Social Growth:

- * To help build positive relationships with family, peers, and persons outside the home.
- * To facilitate peer teaching through sibling interactions.
- * To provide an experience in respecting the rights of others.
- * To give practice in accepting the responsibility of caring for the property of others.
- * To offer experiences in group dynamics.
- * To stimulate parent-child experimental interactions.

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