THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF PSYCHOLOGY

SPATIAL DEVELOPMENT: HOW PARENT-CHILD INTERACTIONS, GENDER, AND ETHNICITY PLAY A ROLE

MACKENZIE KAGEL
Spring 2010

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Psychology
with honors in Psychology

Reviewed and approved* by the following:

Lynn S. Liben
Distinguished Professor of Psychology
Thesis Supervisor

Jeanette Cleveland
Professor of Psychology
Honors Adviser

* Signatures are on file in the Schreyer Honors College.

Abstract

The purpose of this study was to gain a greater insight into the extent to which parents encourage spatial development in their children. The data were collected during a short interaction between a mother and her preschool aged child while they played together with blocks. For the purpose of this thesis, 39 mother-child dyads were analyzed, 14 of whom were of Mexican American descent and spoke Spanish during the interaction, and the other 25 of whom were African American. Each dyad interacted in a small laboratory room and received a set of colored blocks containing pictures, numbers, and shapes. Dyads were instructed to play together as they wished. Behaviors coded included: types of spatial language used, which characteristics of the blocks were addressed, amount of time spent talking, and how the dyad physically manipulated the blocks. Additionally, potential differences based on the gender of the child or the ethnicity of the dyad were considered.

Table of Contents

Acknowledgements

I would like to take this opportunity to thank my thesis advisor, Lynn Liben for her support and guidance throughout this entire process. In addition, I would like express my gratitude to Adam Christensen for his patience and willingness to answer any and all of my questions. I am also grateful to the Psychology Department, specifically Jeanette Cleveland, who has served as both my honors advisor and my second reader for this thesis. Finally, none of this would have been possible without the encouragement of my friends and family, especially my mom, who has always pushed me to be the best I can be.

Introduction

The purpose of this thesis was to examine the variability in mothers and children's interactive behaviors that appear to be relevant to spatial development. Of particular interest was how behaviors may differ across culture and gender. A significant amount of research has been conducted concerning gender and its relation to spatial experiences, and relatively little work has been addressed to variations across cultures.

General Spatial Development

Piaget has long been seen as one of the driving forces behind the study of cognitive development. He developed the term "Coordination of Perspectives" to describe children's appreciation of the spatial position of objects (Piaget & Inhelder, 1956, cited in Fishbein, Lewis, & Keiffer, 1972). The theory is that children move through stages beginning with the sensory-motor-preoperational stage, followed by the concrete operational stage, and finally ending at the formal operational stage. Evaluating these concepts, Fishbein, Lewis, & Keiffer (1972) conducted an experiment where children were asked to describe the viewpoint of the researcher and the viewpoint of a doll. They were then evaluated based on whether they used egocentrism, nonegocentrism, or empathy. Children were believed to use a set of rules based on the coordination of perspectives.

Rule 1: "You see what I see,"

Rule 2: "If you aren't in my place you don't see what I see,"

Rule 3. "If I were in your place I would see what you see,"

As expected, the older the child, the more they used rule three and the fewer mistakes they made.

In addition to his theories of egocentrism, Piaget studied the principles of conservation and reversibility. Using what has become one of the most popular tasks to study conservation, Piaget gave children two equal sized pieces of play dough. After the shape of one of the pieces was changed so that it was flat, the child was asked whether the quantity of the reshaped piece had changed. Children before the age of about 6 or 7 maintained that the quantity of the play dough was different after it was reshaped (Inhelder, 1962). This represented their inability to conserve, an ability which like egocentrism becomes mastered as the child ages.

The understanding of graphic symbols also is an important contributor to cognitive development (Callaghan,1999). At the age of two, children are still unable to produce representational drawings. However, by the end of the third year most children understand the concept of picture-as-referent, then picture-as-object and finally the picture-as-symbol. Whether or not this ability can be improved with practice depends on the child's age. Three and four-year-olds are able to increase their understanding of pictures and symbols after participating in a sort of social learning, where they are both the teacher and the student (Callaghan, 1999). It appears that the age of three tends to be when children's cognitive understanding allows them to grasp the concept that pictures can function as symbols.

If the age of three is when the concept of symbols is grasped (Callaghan, 1999) than the age of four to five brings a fairly developed understanding of space (Stiles-Davis, 1988). The particular age at which children are said to master spatial concepts varies among researchers, in part because different researchers use different tasks in their experiments, and thus the tasks do not necessarily measure the same type of spatial

ability (Caplan, MacPherson, & Tobin, 1985). For this reason, Stiles-Davis (1988) centers the research around the abilities necessary to succeed on a task, rather than the actual outcome of the task. The task she uses, similar to the one used in this thesis, is free block play. Children are placed in a room with a set of blocks and allowed to direct the play, with researchers carefully measuring six distinct characteristics. As detailed below, the six factors focused on are spatial products, spatial loci, directions, number of relations, type of relations, and process.

1.) Spatial Products: Spatial products were the final structures completed by the child. Structures were classified in three ways: linear-vertical, linear-horizontal, and complex. Complex figures combined horizontal and vertical structures as well as more advanced connecting structures.

2.) Number of spatial loci: Structures could contain multiple loci depending on how complex the structure was, but all had to contain at least one loci. Multiple loci were determined by the complexity of the structure and the order in which the child placed the blocks.

3.) Directions: Measured the number of directions that each construction extended. The researchers used the locus to describe the center point of any direction. Therefore blocks placed on either side of a locus would be considered to be extending in two different directions. Blocks placed just to the left of the locus would just be one measured as one direction.

4.) Number of Relations: Stiles-Davis described four potential relationships between blocks: on, next-to, between, and lean against.

5.) Type of Relations: Focused on how different constructions, as opposed to individual blocks, related to each other and used the same four descriptors, on, next-to, between, and lean against, as number of relations.

6.) Process: Looked at how children chose to arrange the blocks into different constructions. There were three processes based on perceived developmental level. Process 1 was defined as when blocks extended from one locus in the same direction. Process 2 was when blocks were built sequentially, first in one direction then in another, or first from one locus and then from another. Process 3 was the same as Process 2 only the building was not done sequentially. Instead the child began to build in one direction or form one locus, switched to another, and then went back to the first construction

In her study, Stiles-Davis (1988) analyzed data from children between the ages of 18 months and 42 months. At 18 months she found that children's construction was unsurprisingly the most simplistic. Almost all constructions had only one locus, contained a small number of blocks, and were organized into stacks. The next age group was between 24-36 months. This group used markedly more complex structures that would extend from multiple loci and in different directions. There were also many more relations used, specifically with next-to relations as children built not just stacks but also lines of blocks. They also used process two, using a sequential method to group blocks into different constructions.

By 42 months there were many more changes to the types of structures built. Children were more likely to use process three and build different structures simultaneously. Their structures included more next-to relationships and also regularly included both lines and stacks. Stiles-Davis (1988) attributed the changes in children's

structures to their increased ability to process more abstract relations between structures. As they become older, their spatial understanding increases until they reach a point where they are able to consider multiple perspectives at one time.

The Role of Culture on Development

When it comes to studying development in children, research is invariably conducted far more frequently on the majority then the minority. However, some recent work has examined cognitive development across cultures and nations. One study conducted by Richland, Chan, Morrison, & Kit-Fong Au (2010) looked at the difference in analogical reasoning displayed by children in the U.S. and in Hong Kong. Analogical reasoning is important because it is seen as a good way to measure cognitive development. The study looked at whether differing cultural experiences would lead to a greater level of development for the children from the U.S. or from Hong Kong. The results of the study found that Chinese children scored higher when it came to complex relations. Richard et al. (2010) attributed this to the fact that Chinese children had a greater exposure to what they termed "socialized relational inputs." The most important finding was that experience was as important factor in the ability to analogically reason.

For Latino children, one of the words most prevalent amongst parents is educación. In contrast with education which is primarily academic, educación significantly emphasizes moral and social behavior. While Latino children are still young relatively few demands are placed on them due to a cultural belief that they are not mature enough to reason. This leniency however, only lasts until the age of 6 or so when children are expected to take on more adult responsibilities (Halgunseth, Ispa, & Rudy, 2006).

Parenting Styles and the way they contribute to Cognitive Development

Parental instruction can be as important as genetics when it comes to how children develop their verbal, spatial, and number ability (Bing, 1963). Bing studied how parenting styles and cognitive development in children was related. Results showed that level of interaction between the parent and the child was the key. However, although high levels of interaction improved verbal ability in children, they did not necessarily have a positive impact on spatial or number ability. Overall, "high verbal" mothers gave more help and also more frequently withheld help from their child, placed more pressure on their child to succeed, were stricter with them, and yet also more likely to provide support if asked.

Whether children seek out differences between active and passive exploration may also be related to their spatial abilities. This is not necessarily a cause and effect relationship. Active explorers are more likely to wander away from adult supervision and therefore may be more inclined to pay attention to the space they are in. In contrast, children with little confidence in their ability to find their way around are probably less likely to separate from adults and thus have little need to improve their spatial skills (Hazen, 1982). The consequence is that they avoid opportunities to improve their spatial skills. Parents also impact whether the child is more comfortable with active or passive exploration, as does the particular situation they are in.

The use of pictures to assess spatial development was a popular theme among experimenters. Ruffman, Slade, & Crowe (2002) conducted a study that asked mothers to discuss a set of pictures with their children. This study focused on how mothers impacted the theory-of-mind understanding of their children through their use of mental

state language, seen as an important step in cognitive development. The belief was that children might ask more questions if the mothers used a teaching approach and provided general descriptions of the events in the pictures. The study found that mothers and children's mental state utterances and theory of mind were correlated. Thus it appears that mother's mental state language directly facilitates theory of mind, further supporting the contention that mothers can impact the cognitive development of their children (Ruffman, Slade, Crowe, 2002).

The study of how play can affect children's cognitive development also can give some insight into how spatial ability is improved. There have been many studies that have shown that when mothers and their children play together, the level of play is more advanced (O'Connell & Bretherton, 1984, cited in Slade, 1987). Slade (1987) assessed this belief by studying play sessions where mothers either devoted their full attention to their child, or split it between the child and a researcher. The results showed that the child's level of play was at its most complex when the mother's attention was devoted solely to the child. However, the level of play did not remain as high once the mother was removed from the situation.

Gender and its Influence on Development

Currently there is a wealth of research on how gender and spatial development are correlated, with much of the focus centering on why boys so regularly outperform girls on spatial tasks. Levine, Huttenlocher, Taylor, and Langrock (1999) examined this assertion in a study they conducted analyzing both mental rotation and other spatial abilities in preschool children based on their sex. Mental rotation is a task where girls consistently lag behind boys. The task involved looking at a pair of 2-D pictures and the

deciding whether they depict two different 3-D forms or the same 3-D form that is simply oriented differently. The study found that girls were far more likely to receive a low score then boys on all spatial tasks by the time they were 4 ½. The extent of these differences may increase after the preschool years and into adulthood due to a combination of biological and environmental factors. For instance, brain development, coupled with a greater emphasis on block play and construction in preschool for boys could explain why they already display an advantage over girls at such a young age (Caldera et al., 1999; Levine, 1999). It is important to note that this emphasis may be child driven. However, the toys that boys tend to play with seem to have a much greater spatial component to them then do those that girls regularly engage in (Tracy, 1987).

The fact that the environment may influence spatial development has been addressed in many different studies. Specifically of interest is whether or not parents and teachers emphasize one sort of play for boys and another for girls (Eisenberg et al., 1985). Eisenberg et al. (1985) chose to conduct a study that looked at how mothers and fathers selected toys for their children to play with, and how, if at all, they reacted to sex stereotypic versus non-stereotypic play. They found that when given the option to select toys for their child, parents tended to pick toys that were specific to the child's gender. This was referred to as "channeling" because parents were able to channel their children towards playing with sex-consistent toys simply by selecting those toys for them.

Snow et al. (1983, cited in Eisenberg et al.) believed that the toy selection process was a mutual one, with the child influencing the parent as well as the parent influencing the child. When it came to parental feedback, it was significantly more positive with same-sex as opposed to other-sex play for older children. It appears that parents are more

relaxed with gender roles when children are younger. However, as the children age, they become more worried about them having an appreciation for gender "appropriate" behaviors.

Children's innate preferences for manipulative, block play can also contribute to greater visual-spatial ability (Caldera et al., 1999). When using blocks, girls use more unique shapes while building whereas boys build more structures. However, there was no difference in visual-spatial skills at the time (preschool age). A study conducted found that play with blocks was not directly related to a child's spatial ability; however involvement in art activities was (Caldera et al., 1999). The likely reason for this is that children with high spatial skills prefer art activities, which then contributes to their spatial development.

Not all researchers have found convincing evidence that a gender difference exists in cognitive and spatial development. Caplan, MacPherson, & Tobin (1985) analyzed several studies that have found little gender difference in spatial ability, but received little attention. Additional studies discovered no evidence that spatial development or ability was impacted by gender (Fairweather, 1976, cited in Caplan, MacPherson, & Tobin, 1985). Other researchers have found differences but not until the child is around the age of 6, at the very youngest (Johnson & Meade, 1987, cited in Kerns & Berenbaum, 1991).

One of the main reasons such disparity is found from study to study is the difficulty there is in finding a universally agreed upon definition for spatial ability or how to measure it (Caplan, MacPherson, & Tobin, 1985, Stiles-Davis, 1988). This ambiguity is one of the greatest problems that each of the researchers seems to address at some point in their studies. Further evidence of this problem comes from the disparity in findings on

mental rotation ability in males vs. females. Master and Sanders (1993) stated that the reason for this could be that different mental rotation tests evaluate more than one type of spatial ability. According to Linn and Peterson (1985) spatial ability can be defined as the ability to "represent, transform, generate, and recall symbolic information." However, they acknowledge that this is a broad definition due to the difficulty in determining the most accurate test for spatial ability. Therefore, future research should center on accurately pinpointing those characteristics that directly signify spatial ability.

The Present Study

The purpose of this study was to look at how both ethnicity and gender interact to effect spatial development. The study was designed using one of the simplest examples of spatial toys, building blocks, thereby avoiding the use of ambiguous tests that may or may not be related to spatial development. In order to study ethnicity mothers and children of Mexican American and African American descent were used. The hypothesis was that for both ethnicities, mothers would be more likely to engage in block play with their sons than their daughters. Additionally, it was expected that mothers that engaged in more block play would also use more spatial language and have children who used more spatial language.

Girls in contrast were anticipated to pay more attention to the pictures on the blocks as well as the colors, numbers, and other block descriptors. Thus, it was assumed that they would engage in less actual building behavior than boys. This was not expected to differ across ethnicities. Overall, the use of multiple ethnicities was to stimulate further questions rather than just to answer them.

Method

Subjects

In total 39 mother-child dyads were analyzed in this study. 14 were of Mexican American descent and 25 were African American. A translator was used for the videos with the Mexican American dyads, who spoke primarily Spanish or a combination of Spanish and English, so that their speech could be accurately coded.

Procedures

Each dyad was placed in a room which contained a couch and a wide open play area. The entire interaction was videotaped and lasted a total of five minutes. The mother was given a set of blocks in an enclosed bag which contained a piece of paper with directions/suggestions on how to play with them. The blocks came in stacks of six, each which was a different color. On the sides of each of the blocks were different pictures, numbers, letters, and shapes. Participants were given no specific verbal instructions as to how to play with the blocks, or whether to place them in order by number or letter. Rather the interest was in how they used the blocks in a free play setting.

Measures

There were several different areas that were looked at, including spatial language use, level of interaction between the mother and the child, the types of structures that were built, and whether the mothers or children addressed the images on the sides of the blocks. There were separate codes for the mothers and the children so that differences in their behavior could be analyzed, as well as whether one influenced the other as time went on. The full coding system can be found at the end of this paper.

Spatial Language. An area that was very interesting was how frequently mothers and children used what was termed spatial words when referring to the blocks or to building. The descriptors for each of these words came from the Spatial Language Coding System, designed by Cannon, Levine and Huttenlocher (2007). For the purposes of this study three categories of words were focused on: dimension words, orientation words, and directional words.

Dimension Words: Any word that refers to the size of the blocks or to the structures being built. (Big, Little, Large, Small).

Orientation Words: Refers to the words the mother or child uses to describe what they are doing with the blocks. (Flip, Turn, Rotate)

Directional Words: Words that describe where the blocks are placed in relation to other blocks or objects. (On, Off, Above, Below)

In addition to these three categories, a code was added in to measure every time the mother or child counted the number of blocks or structures. This counting code was not used when the mother or child referred to the number on the sides of the blocks.

Block Descriptors. In addition to studying the type of language used, codes were created to discover whether the dyad referred to the pictures, numbers, letters, or shapes on the blocks or the color of the blocks. Specifically of interest was whether the mothers would try and teach their children by asking them to identify letter and numbers.

Extension. Extension codes were used when the mother used a characteristic of the blocks to discuss something entirely unrelated to block play. This code was added after the first round of trial coding to separate out mothers and children who tended to focus on factors unrelated to block play.

Color Extension: “What color is your shirt”

Number Extension:“What number comes after 4?”, “Can you count from 1 to 10?”

Picture Extension: “When was the last time you were on an airplane?”

Letter Extension: “What comes after this letter?”, “What comes after D?”, Speaking or saying the alphabet

Shape Extension: “What shape is our house?”

Interaction Codes. These codes were designed to see the level of interaction between the mother and the child. It also made it easier to see who was dominating the conversation and who was spending more of their time building/playing with the blocks.

Talking: Measured every time the mother and child talked and how long it was for.

Building Codes. Building codes were developed from the original code playing. They cover the four block behaviors that were seen most frequently during the play session.

Block On: Coded every time a block or a group of connected blocks was placed on top of another block.

Block Off: Coded every time a block or group of connected blocks was removed from a block.

Throws Blocks: Coded every time the mother or child threw a block.

Steals Blocks: Coded when the mother or child “stole” blocks from another tower or structure. This code was used to convey that the individual was taking the blocks without asking and often over some objection.

Structure Codes. Coded every time the dyad built a tower, the most basic structure. Towers are several blocks which are connected together in a line. The blocks initially came in structures that resembled towers; however these were not coded for. The mother or child had to break apart the original structure and then rebuild it in order for it to count as a tower. If they just played with the blocks the way they came we included it in playing, but did not code any structures built.

The preliminary coding system was very much modeled after the one developed by Cannon, Levine and Huttenlocher (2007). Their coding system consisted of many categorizations of spatial terms, five of which were initially used to code these videos. After several rounds of coding, quantifying words were eliminated from the coding system. Quantifying words where those that described how much of something was utilized. The most commonly found examples were words such as some and all; however these were very rare and didn't seem to capture anything interesting. Shape words another category in their coding system was retained for this study but on the coding system it was placed under the block descriptors. This was done because the blocks also contained shapes on them. Therefore many shape words were actually meant to refer to the shapes on the blocks rather than shape of the blocks, structures etc. However, when it came time to run analysis, shape words were considered spatial language.

Another change made was that playing was removed when the coding system was reworked. Playing encompassed any behavior that involved the blocks and was ultimately too broad to measure anything significant. To takes its place, codes to measure every time the mother or child placed a block on a structure or took one off, as well as when they "stole" blocks and when they threw blocks were created. These were

much more accurate at targeting exactly how the mothers or children used the blocks in the free play session.

The final change that was made was to expand on the codes of letters, numbers, pictures, and color, by adding an additional code for extension. The purpose in doing this was to identify when the mother or child was expanding on the discussion beyond the blocks. Many of the mothers used the blocks as tools to stimulate discussion and it was important to separate out these behaviors because often they indicated a different interaction style between the mother and child. The code was added after there was difficulty classifying how a child singing the alphabet should be coded. It also helped to identify times when mothers tried to turn the block play into an educational experience by asking their child to count from 1-10 or name an object that was the same color as a particular block.

Results

Spatial Language Usage

One of the target questions in this study was whether the gender of the child would have an impact on the amount of spatial language used in the play session. Of particular interest was whether there would be more spatial language on the part of the mother and/or child if the child was a boy. A finding of this nature would lend support to the theory that boys display more advanced spatial ability at a young age due to external stimuli.

Spatial Language consisted of five categories of codes, orientation, dimension, and directional words, as well as shape and shape expansion. Dimension words were used the most frequently, with both boy (n = 14) and girl (n = 13) children. While no other type of words came close to dimensions frequency for boys, shape extension (n=13) was seen often with girls. Analysis of the mothers' language usage showed no gender bias towards more spatial talk with boys, F (1, 35) = .006, p = .98. There was also no effect of ethnicity on how much spatial language was used, F (1, 35) = 16.508, p = .199.

Since statistical significance was not found with mothers' language usage it is not surprising that it was also not reached with child spatial language. When it came to the gender of the child, there was no significant effect on the amount of spatial language that they used, F (1, 35) = 1.40, p = .36. Similarly, the ethnicity of the dyad did not have an impact on the amount of spatial language F (1, 35) = .00, p = .993.

Construction Language Usage

In order to ascertain to what extent shape language, words like square and circle, impacted the measures of spatial language, a separate category was created called

construction language. Construction language included just three codes, orientation, dimension, and directional words, pulled directly from the Cannon, Levine and Huttenlocher (2007) coding system.

For children, there was no statistical significance found for gender F (1, 35) = .494, p = .61 or ethnicity F (1.36) = .170, p = .765. Parent construction language usage based on the gender of the child was also found not to be significant F (1, 35) = 5.046, p = .303. However there was an interesting finding with ethnicity. When looking at the average amount of spatial language used in a play session, African American mothers (M= 2.28, SD = 2.44) used more than the Mexican American mothers (M = .92, SD = 1.43). While not statistically significant, there did appear to be a trend toward significance F (1, 35) = 15.59, p = .075. The fact that this trending was not seen with parent spatial language is interesting because of how similar the two categories are.

Non-Spatial Language Usage

While the hypothesis was that there would be differences between genders and ethnicity with respect to spatial language, the most interesting results actually came from looking at non-spatial language usage. Non-spatial language was a category that combined block descriptors and counting. For mothers, number, number extension, color, color extension, shape, shape extension, picture, picture extension, letter, letter extension, and counting were included in the analysis. For children, all these same codes were used except color extension and number extension, since these were never expressed by children.

An ANOVA found no significant effect of gender F (1, 35) = 53.31, p = .56, or ethnicity F (1, 35) = .9, p = .94 for child's non-spatial language usage. However, tests

did reveal a significant interaction between gender and ethnicity F (1, 35) = 1022.112, p = .015, as shown in Figure *I*.

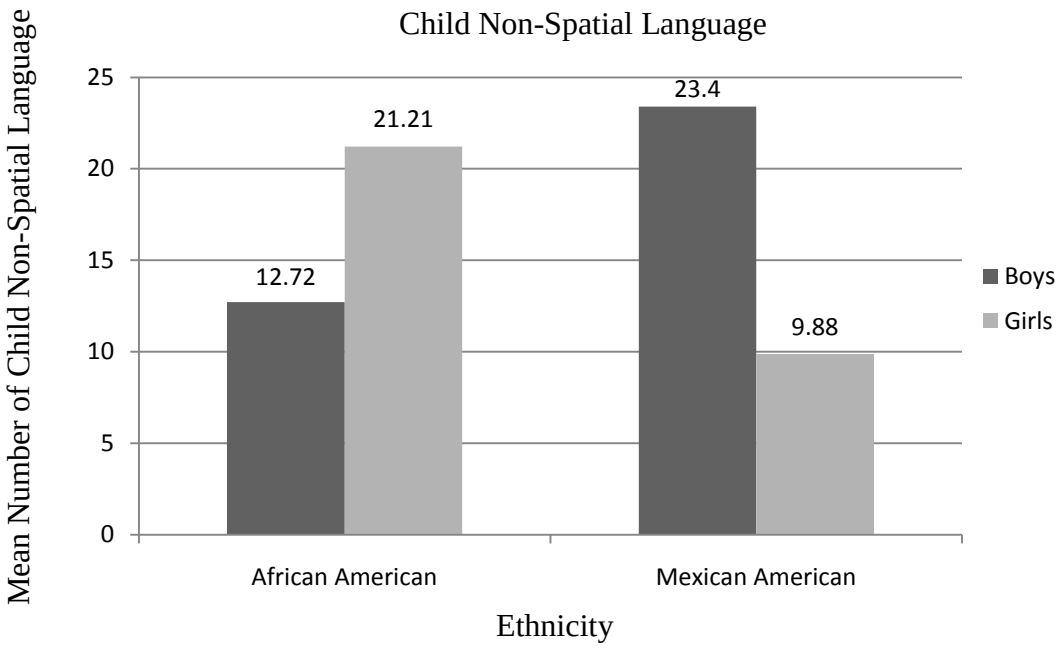

Figure I. Interaction between Ethnicity and Gender for Child Non-Spatial Language

The mean number of non-spatial language used in the session was much greater for Mexican American boys (M = 23.4, SD = 12.5) than the African American boys (M = 12.73, SD = 11.2). However, a completely different trend was seen for girls, with the African American girls using more than twice the amount of non-spatial language (M = 21.21, SD = 15.57) as the Mexican American girls (M = 9.89, 7.50).

Following the ANOVA an Independent Samples T-test was conducted. While not significant, girls non-spatial language usage did appear to represent a trend t (21) = 2.023, p = .056 based on ethnicity. This same trend was not seen with the boys t (14) = -1.7, p = .111. The fact that for girls the p-value was very close to significant is an indicator that

further tests should be run once additional data is coded. It is possible that with a larger population sample, statistical significance could be reached.

An analysis on the mothers non-spatial language also found no significant effect for gender F (1, 35) = 60.467, p = .58 or ethnicity F (1, 35) = 1.19, p = .94. However, similar to the child non-spatial language there was an interaction between gender and ethnicity F (1, 35) = 828.47, p = .047, displayed in Figure *II*.

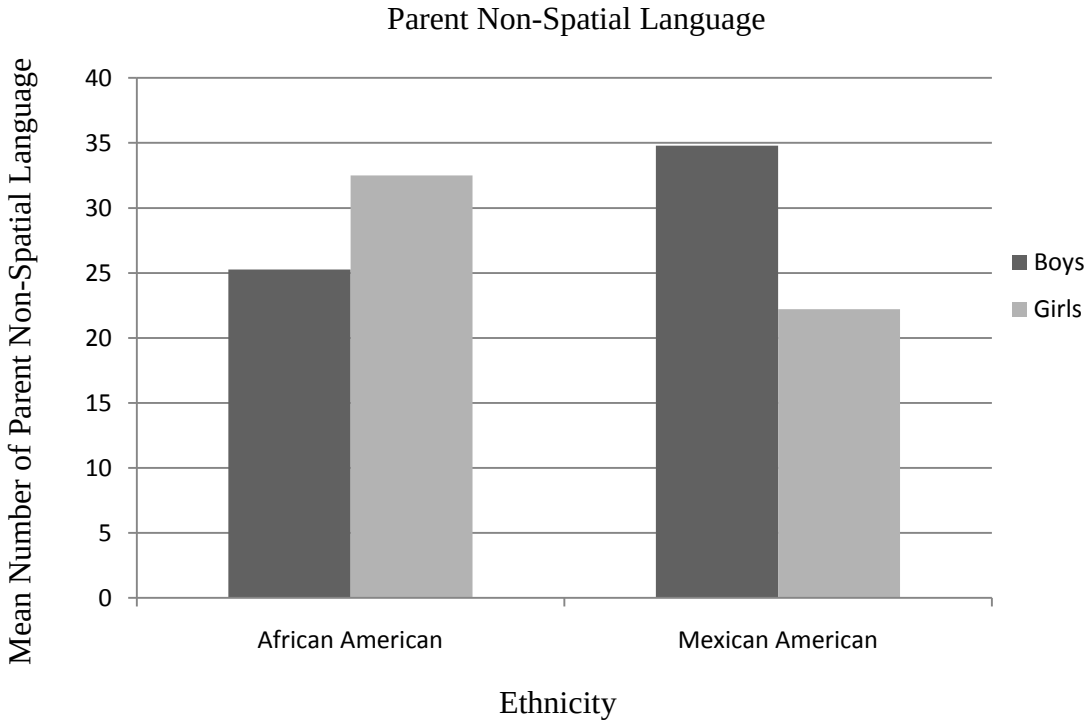

Figure II. Interaction between Ethnicity and Gender for Parent Non-Spatial Language

Mothers of African American girls were more likely to use non-spatial language (M = 32.5, SD = 16.66) than mothers of Mexican American girls (M = 22.2, 10.46). In contrast, mothers of Mexican American boys were more likely to use non-spatial language (M = 34.8, SD = 11.25) then mothers of African American boys (M = 25.27, 13.69). However, an Independent Samples t-test showed that these results were not

significant t (21) = 1.64, p = .115 for mothers of girls and t (21) = -1.3, p = .197. Again, the lack of significance could be due to a power issue resulting from the small sample size.

Building Behaviors

Another area of focus was on the actually physical building behaviors of the children and their mothers. In order to run an analysis the codes, block on, block off, throws blocks and steals blocks, were combined into one category called block play. The hypothesis was that dyads with male children would be more active with the blocks then those with female children.

An ANOVA found that the gender of the child was trending toward significance with regards to the amount of parent block play F (1, 35) = 709.5, p = .073. Mothers played with the blocks more when the child was a boy (M = 31.25, SD = 18.98) then when they were girls (M = 19.78, SD = 10.66). While this difference was not statistically significant, the fact that it was close to significance means that further studies with a greater sample size may result in significance. There was no effect of ethnicity on parent block play F (1, 35) = 505.5, p = .128.

Analysis on child block play found no significant effect of gender F (1,35) = 42.61, p = .63 or ethnicity F (1,35) = 327.45, p = .18. Interestingly, an interaction was found between ethnicity and gender F (1, 35) = 1719.3, p = .004, shown in Figure *III*.

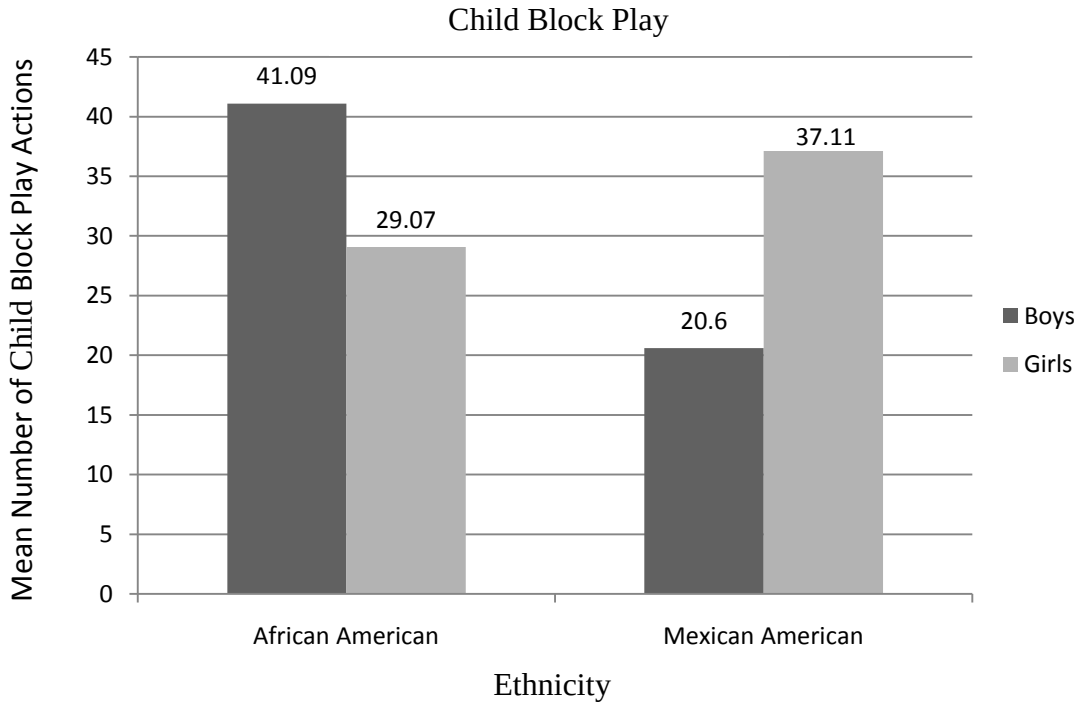

Figure III. Interaction between Ethnicity and Gender for Child Block Play

One finding was that Mexican American girls used more block play (*M* = 37.11, *SD* = 12.25) than did African American girls (M = 29.07, SD = 13.05). However, according to an Independent Samples T-test, this difference was not significant *t* (21) = -1.48, *p* = .16.

The relationship between ethnicity and gender and the amount of block play for boys was the inverse of what it was for girls. African American boys averaged more than two times as much block play (M = 41.09, SD = 15.15) during the five minute play session as did Mexican American boys (M = 20.6, SD = 11.08). A t-test for males found that these differences were significant *t* (14) = 2.693, *p* = .017.

Discussion

The most interesting results were found from the analysis of the non-spatial language and block play. For non-spatial language there was no significance found for gender or ethnicity for the mothers or the children. However, the interaction between sex and ethnicity was significant. African American mothers were more likely to use non-spatial language with girls than they were with boys. It was not surprising then that African American girls were also more likely to use non-spatial language than their boy counterparts. When it came to block play, African American mothers participated in far more of it with boys than with girls. Again somewhat unsurprisingly, African American boys used more block play than did African American girls. Whether the mothers were influencing the child's actions and language or the child was the initiator is a matter for further study.

For Mexican Americans the trend was quite different. In contrast to the African American mothers' behaviors, Mexican American mothers used more non-spatial language with their sons than with their daughters. In response Mexican American boys used more non-spatial language than did girls. Also in reverse of the pattern seen with African American children, Mexican American girls were more likely to use block play than boys. This is despite the fact that their mothers used more block play with the boys than the girls.

Culturally, it is hard to explain why African American mothers put more emphasis on non-spatial language for their girls while Mexican American mothers did not. Since Mexican American mothers used more non-spatial language and block play with their sons it is possible that overall, mothers in the Mexican American culture are

more interactive with their sons. This needs to be investigated further before any conclusions can be drawn.

The overall emphasis on block play for boys is not surprising. Many studies have addressed the fact that boys are encouraged to play with more spatial toys than are girls. However, as with non-spatial language, it is important not to attribute this entirely to the mother's actions. It is also possible that the mothers followed the child's lead. If this were the case however, then the finding that Mexican American girls used more block play would lead one to assume that Mexican American mothers also used more block play with girls. Since they did not, the fact that Mexican American girls defied the trend and engaged in more block play then the Mexican American boys is another area where further research is needed.

The pattern seen with solely child behavior is also worthy of discussion. As stated above, African American girls were more likely to use non-spatial language than the African American boys and less likely to participate in block play. For Mexican American children the exact opposite trend was seen. One factor to consider when addressing this is that frequently non-spatial language came about when mothers directly asked their children a question about something on the blocks. Therefore, it is possible that by using more non-spatial language children had less of an opportunity to participate in block building.

Another area of focus throughout this study was the measurement of spatial language. Although it was hypothesized that boys would use more spatial language than girls, no difference was found. Perhaps the most likely explanation for why there was a lack of spatial language was that the blocks contained pictures, letters, and numbers and

were different from plain building blocks. In many cases, the mothers decided to use the blocks as a language-, arithmetic- or symbolic- educational tool rather than a spatial-educational tool and therefore did not encourage building with the child. Instead, they focused on the letters, numbers, etc, by asking their child to say the alphabet or to count to ten. Even if the child did start to build they were often interrupted by their mothers asking them a question. Since building with the blocks was not always emphasized, spatial terms were less frequent because they had less use in the conversation.

In order to have a way of measuring language that was directly related to building blocks, the composite category "construction language" was created. Although the only difference between construction language and spatial language was the removal of shape words and shape extension, the results it yielded were worth further discussion. While the relationship between ethnicity and spatial language had no significance, analysis on construction language and ethnicity found a trend toward significance. This finding suggests that the fact that there was no ethnicity difference in spatial language may have been due to Mexican American mothers' reliance on shape words. In many cases these words may not have been directly spatial but were used to refer to shapes on the blocks. Thus it is possible that African American mothers used more directly spatial language in reference to the building of the blocks. Since significance was $p = .075$, further studies are needed to see if with a bigger sample size, a significant effect would emerge.

If this study were to be repeated, one factor that might increase the amount of spatial language would be to use blocks that were plain on the sides. In this case, mothers and children would be more likely to focus on building rather than addressing

the pictures or other symbols on the blocks. It is likely that the act of building in itself would encourage more spatial language since there would be a greater need to address where blocks would go and how to build certain structures. Using fathers as well as mothers would also allow researchers to look at whether the gender of the mother had any influence on the child's behavior.

In addition, having knowledge of the mother's level of spatial ability would provide a unique insight into how mothers with greater spatial skills may or may not encourage their child differently. It is possible that none of the mothers analyzed were spatially skilled and therefore perhaps even a change of blocks would not have elicited a greater response. However, there may have been mothers who had a high spatial ability but thought the five minutes would be better spent asking their child about the numbers and letters on the blocks. Indeed, it is likely that many of the mothers thought that they were expected to use the blocks to quiz their children since many actually interrupted their children when they were building to scold them for not putting the blocks in numerical or alphabetical order.

Despite the limitations of this study, there were still a number of interesting results. The significant interaction found between sex and ethnicity is something that should continued to be explored in the future. The finding that some behaviors differed in relation to ethnicity supports the initial suggestion that ethnic variables warrant further research. In conclusion, this study has provided a solid starting point for potential areas of further research into the field of spatial development in children.

References

Baenninger, M., & Newcombe, N. (1989, March). The role of experience in spatial test performance: A meta-analysis. *Sex Roles, 20*, 327-344.

Bing, E. (1963, September). Effect of childrearing practices on development of differential cognitive abilities. *Child Development, 34*(3), 631-648. Retrieved from http://www.jstor.org/stable/1126757

Caldera, Y. M., Culp, A. M., O'Brien, M., Truglio, R. T., Alvarez, M., & Huston, A. C. (1999). Children' play preferences, construction play with blocks, and visual-spatial kills: Are they related? *International Journal of Behavioral Development, 23*(4), 855-872. Retrieved from http://jbd.sagepub.com/cgi/content/abstract/23/4/855

Callaghan, T. C. (1999, November/December). Early understanding and production of graphic symbols. *Child Development, 70*(6), 1314-1324. Retrieved from http://www.jstor.org/stable/1132308

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

Caplan, P. J., MacPherson, G. M., & Tobin, P. (1985). Do sex-related differences in spatial abilities exist? A multilevel critique with new data. *American Psychologist, 40*(7), 786-799.

Eisenberg, N., Wolchik, S. A., Hernandez, R., & Pasternack, J. F. (1985, December). Parental socialization of young children's play: A short-term longitudinal study.

Child Development, 56(6), 1506-1513. Retrieved from http://www.jstor.org/stable/1130469

Feldman, A., & Acredolo, L. (1979, September). The effect of active versus passive exploration on memory for spatial location in children. *Child Development, 50*(3), 698-704.

Fishbein, H. D., Lewis, S., & Keiffer, K. (1972). Children's understanding of spatial relations: Coordination of perspectives. *Developmental Psychology, 7*(1), 21-33.

García Coll, C., Lamberty, G., Jenkins, R., McAdoo, H. P., Crnic, K., Wasik, B. H., & Vázquez García, H. (1996, October). An integrative model for the study of developmental competencies in minority children. *Child Development, 67*(5), 1891-1914.

Halgunseth, L. C., Ispa, J. M., & Rudy, D. (2006, October). Parental control in latino families: An integrated review of the literature. *Child Development, 77*(5), 1282 – 1297.

Hazen, N. L. (1982, June). Spatial exploration and spatial knowledge: Individual and developmental differences in very young children. *Child Development, 53*(3), 826-833.

Inhelder, B. (1962). Some aspects of piaget's genetic approach to cognition. *Monographs of the Society for Research in Child Development, 25*(2), 19-40. Retrieved from http://www.jstor.org/ stable/1165529?origin=JSTOR-pdf

Johnson, E. S., and Meade, A. C. (1987). Developmental patterns of spatial ability: An early sex difference. *Child Development. 58*, 725–740.

Kerns, K. A., & Berenbaum, S. A. (1991). Sex differences in spatial ability in children. *Behavior Genetics, 21*(4). Retrieved from http://www.springerlink.com/content/v20632u126995748/fulltext.pdf

Levine, S. C., Huttenlocher, J., Taylor, A., & Langrock, A. (1999). Early sex differences in spatial skill. *Developmental Psychology, 35*(4), 940-949.

Linn, M. C., & Peterson, A. C. (1985, December). Emergence and characterization of sex differences in spatial ability: A meta-analysis. *Child Development, 56*(6), 1479-1498. Retrieved from http://www.jstor.org/stable/1130467

Masters, M. S., & Sanders, B. (1993). Is the gender difference in mental rotation disappearing? *Behavior Genetics, 23*(4), 337-341. Retrieved from http://www.springerlink.com/content/ p128326282275112/fulltext.pdf

O'Connell, B., & Bretherton, I. (1984). Toddler's play, alone and with mother: The role of maternal guidance. In I. Bretherton (Ed.), Symbolic play (pp. 337-366). Orlando, FL: Academic Press.

Quintana, Q. M., Aboud, F. E., Chao, R. K., Contreras-Grau, J., Cross, W. E., Jr., Hudley, C., Liben, L. S. (2006, September/October). Race, ethnicity, and culture in child development: Contempory research and further direction. *Child Development, 77*(5), 1129-1141. doi:10.1111/j.1467-8624.2006.00951.x

Richland, L. E., Chan, T.-K., Morrison, R. G., & Kit-Fong Au, T. (2010, January/February). Young children's analogical reasoning across cultures: Similarities and differences. *Journal of Experimental Psychology, 105*(1-2), 146-153.

Ruffman, T., Slade, L., & Crowe, E. (2002, May/June). The relation between children's and mothers' mental state language and theory-of-mind understanding. *Child Development, 73*(3), 734-751. Retrieved from http://www.jstor.org/stable/3696247

Slade, A. (1987, April). A longitudinal study of maternal involvement and symbolic play during the toddler period. *Child Development, 58*(2), 367-365.

Stiles-Davis, J. (1988). Developmental change in young children's spatial grouping activity. *Developmental Psychology, 24*(4), 522-531.

Tracy, D. M. (1987). Toys, spatial ability, and science and mathematics achievement: Are they related? *Sex Roles, 17*(3), 115-138.

Voyer, D., Voyer, S., & Bryden, M. P. (1995). Magnitude of sex differences in spatial abilities: A meta-analysis and consideration of critical variables. *Psychological Bulletin, 117*(2), 250-270

Appendix A

Means and Standard Deviations for Dyads with Girl Children

	Mean	Standard Deviation
Child Spatial Language		
African American	1.0	1.83
Mexican American	1.77	3.92
Parent Spatial Language		
African American	2.57	3.13
Mexican American	1.66	3.90
Child Non-Spatial Language		
African American	21.21	15.57
Mexican American	9.88	7.55
Parent Non-Spatial Language		
African American	32.50	16.66
Mexican American	22.22	10.46
Child Construction Language		
African American	.50	1.16
Mexican American	.88	1.45
Parent Construction Language		
African American	1.78	2.15
Mexican American	.77	1.30
Child Block Play		
African American	29.07	13.05
Mexican American	37.11	12.25
Parent Block Play		
African American	20.57	10.08
Mexican American	18.55	12.02

Appendix B

Means and Standard Deviations for Dyads with Boy Children

	Mean	Standard Deviation
Child Spatial Language		
African American	1.36	1.62
Mexican American	.60	1.34
Parent Spatial Language		
African American	3.09	2.73
Mexican American	1.20	1.78
Child Non-Spatial Language		
African American	12.72	11.23
Mexican American	23.40	12.52
Parent Non-Spatial Language		
African American	25.27	13.69
Mexican American	34.8	11.25
Child Construction Language		
African American	1.27	1.55
Mexican American	.60	1.34
Parent Construction Language		
African American	2.90	2.73
Mexican American	1.20	1.78
Child Block Play		
African American	41.09	15.14
Mexican American	20.60	11.08
Parent Block Play		
African American	35.45	18.60
Mexican American	22.00	18.19

Appendix C

Coding System

1. **Block Descriptors** – Does the parent or child address the color of the blocks, or the pictures and numbers on the blocks?

a. Color: referring to the color of the blocks or asking about what color the blocks are.

i.e. “This block is blue”, “What color is this block?” or even just “Red”

b. Color Extension: expanding on the concept of color with more abstract statements or questions not directly related to the blocks

i.e. “What color is your shirt”

c. Number: referring to the number on the sides of the blocks

i.e. “What number is this?”, “Can you find me a block with an eight on it”, “7”

d. Number Extension: expanding on the concept of numbers with more abstract statements or questions not directly related to the blocks

i.e. “What number comes after 4?”, “Can you count from 1 to 10?”

e. Picture: referring to the pictures on the sides of the blocks

i.e. “What is this picture of?,” “Airplane,” (as an example of a picture)

f. Picture Extension: expanding on the pictures on the blocks with more abstract statements or questions not directly related to the blocks

i.e. “When was the last time you were on an airplane?”

g. Letter: referring to the letters on the sides of the blocks

i.e: “What letter is this?,” “Is this an A?,”

h. Letter Extension: expanding on the concept of letters with more abstract statements or questions not directly related to the blocks

i.e. “What comes after this letter?”, “What comes after D?”, Speaking or saying the alphabet

i. Shape: Referring to the shapes of the blocks, or shapes in general. (Circle, Square)

i.e. “Is this a square?”, “What shape is this?”, “Can you find me a block with a circle on it?”, “Square”

j. Shape Extension: expanding on the shapes on the blocks with more abstract statements or questions not directly related to the blocks

i.e. “What shape is our house?”

2. **Interaction Codes** – These codes are designed to see how much the mother and child are interacting, and who is dominating the conversation and who is building more,

a. Talking: Separate codes for every time the mother and child speaks and for how long. These are duration codes.

3. **Construction Language**

a. Dimension Words: Referring to the size of the blocks or of structures A being built. (Big, Little, Large, Small)

i.e. “That’s a big tower”, “Who’s tower is bigger?”, or even just the words “big, little”

b. Orientation Words: Referring to descriptors of what the mother or child is doing with the blocks (Flip, Turn. Rotate)

i.e. “Can your turn that block around?” “Lets flip that block over”

c. Directional Words: Referring to the placement of the blocks. (On. Off, Above, Below)

i.e. “Lets put that block on there”

d. Counting: Refers to when the mother or child is counting the number of blocks they use out loud.

i.e. “1,2,3,4”, “1 block, 2 blocks, 3 blocks”

4. **Structure Codes**

a. Tower: Separate codes for whether the mother or child is building the blocks into a tower shape.

5. Building Codes

a. Block On: Code every time a block or a group of connected blocks is placed on top of another block. If the place a group of three blocks on an already built tower then you code once since the three blocks are all connected.

b. Block Off: Code every time a block or group of connected blocks is removed from a block. If the child or mother breaks a tower in half then code that as block off. However if the child grabs three blocks off of the mothers tower then that is stealing and not block off.

c. Throw Blocks: Code every time the mother or child throws a block.

d. Steals Blocks: Code when the mother or child "steals" blocks from another tower or structure. Don't code if they grab them from a pile on the ground that belongs to someone else.

6. Mother and Child Codes – Every action is coded separately for the mother and the child

a. Mother: If the mother performs the action

b. Child: If the child performs the action.

Academic Vita

Mackenzie Kagel

908-399-4283
mek5061@gmail.com

Current Address
255 South Atherton Street, Apt. 402
State College, PA 16801

Permanent Address
22 Lexington Road
Annandale, NJ 08801

Education

Schreyer Honors College, The Pennsylvania State University
B.A. Psychology, The Pennsylvania State University, 2010
Minor, Sociology, The Pennsylvania State University, 2010
Thesis: Spatial Development: How Parent Child Interactions, Gender, and Ethnicity Play a Role

Research

Research Assistant, 2008 - Present
Cognitive and Social Development Lab

Honors and Awards

Phi Eta Sigma National Honor Society
Undergraduate Research Exhibition, First Place (tie) in Social and Behavioral Sciences
Psi Chi National Honor Society

Leadership

Penn State Lion Ambassadors, Philanthropy Chair 2009 - Present
Fresh START Director of Service Sites, 2008 - 2009
Omega Phi Alpha National Service Sorority, Service Director 2006 – Present

Activities

Leadershape Participant, 2008
Blue and White Society, 2007 - Present
Second Mile, 2006 - 2008

References

References are available upon request