The purpose of this study was to determine whether changes in physical space impacted preschool children's cooperative behavior. These changes in physical space included differentiated and undifferentiated ceiling height and wall color.

This study used an experimental design with subjects experiencing four conditions each. The sample consisted of 30 preschool children across four different half-day preschool classes in a preschool laboratory on a university campus. Children were assigned to small groups of four children. Each group was comprised of two boys and two girls. The groups experienced each condition for five minutes each week over a four-week period.

A multivariate repeated-measures analysis was used to determine whether the predictor variables: age, gender, and condition, were related to the outcome variable of cooperative behavior. There was a significant main effect for Condition on children's cooperative behavior. Post-hoc comparisons revealed the cooperative behavior scores of children in the condition with a differentiated ceiling and an undifferentiated wall color to be significantly higher than all other conditions. A polynomial contrast revealed a
nonlinear relationship between the conditions. Additionally, older children were more cooperative than younger children. Boys were more cooperative than girls.

In differentiated spaces, whether in ceiling height or in wall color, children’s cooperative behavior scores increased. Physical spaces where ceiling height and wall color were both undifferentiated or differentiated appeared to depress children’s cooperative behavior scores. The undifferentiated space may have not been stimulating enough to enhance children’s cooperative behavior, while the space with both differentiation in the ceiling height and wall color may have been overstimulating for preschool children. Administrators and planners of children’s play spaces must be aware of how overly simple or highly complex environments can negatively impact on children’s development.
The Impact of Space and Color in the Physical Environment on Children's Cooperative Behavior

by

Marilyn A. Read

A DISSERTATION

submitted to

Oregon State University

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Presented November 4, 1996
Commencement June 1997
Doctor of Philosophy dissertation of Marilyn A. Read presented on November 4, 1996

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Marilyn A. Read, Author
Acknowledgment

This project required the cooperation and support of countless people including faculty, Child Development Center staff, Bates Family Study Center staff, students, parents, and children. I am grateful for the unwavering commitment to the success of this project from all who were involved.

Specifically, I would like to thank members of my committee. Alan Sugawara has been the catalyst who made this research successful. I thank him for his continued expertise and encouragement through this process. Thank you to Jeanette Brandt for supporting this project through its duration.

In addition, Joanne Sorte, Sue Doescher, Sandy Bailey, and Alyce Blackmon contributed particular expertise related to child development. Six dedicated and responsible Human Development and Family Studies students coded the data, Shu-Chen Chen, Kristy Chipman, Erin Culley, Jen Ratchye, Ashley Ryerson, and Julie Snead.

I am grateful to my family for constant encouragement. My father would be quite proud of this work. Finally, I thank my friends who keep me laughing through the rough times: Sandy Bailey, Megumi Uehara, Elaine Pedersen, Bob Cromwell, Nancy Owens, Alyce Blackmon, Marilyn Filbeck, Marcy Person, and Karen Konecny. Your friendships keep me going. As with my previous research, I continue to rediscover the flowered banks.
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The Impact of Space and Color in the Physical Environment on Children's Cooperative Behavior

CHAPTER 1
INTRODUCTION

Design elements of the physical environment of child care facilities are thought to have important effects on children's behavior (Moore, 1987; Weinstein, 1987; Wohlwill & Heft, 1987). The physical environments of children have been investigated primarily in terms of spatial understanding (Heft & Wohlwill, 1987; Piaget & Inhelder, 1967), spatial density (Gump, 1987; Neill & Denham, 1982), accessible pathways (Kritchevsky, Prescott, & Walling, 1977), complexity of materials (Phyfe-Perkins, 1980), and teacher/child ratios (Field, 1980). These investigations, along with several others concerned with the above-stated variables, have yielded the following recommendations for optimal child care settings. They should be homelike, be related to the natural environment, and provide variety and balance of kinds of spaces (Kennedy, 1991; Kritchevsky et al., 1977; Moore, Lane, Hill, Cohen, & McGinty, 1979; Weinstein, 1987). These recommendations are prevalent throughout the early childhood education literature as well as the environmental psychology literature (Altman & Wohlwill, 1978; Gump, 1987; Weinstein, 1979; Wohlwill & Heft, 1987).

Moore (1987) concluded that there are no empirical studies that examine other features of the child's physical environment, such as acoustics, lighting, floor surfaces, wall surfaces, and color, and how they affect child development. He recommended investigation of the relationship between these physical features and child development.
Wachs (1989) reported that all stimulation in a child's environment is not social; the physical environment is extremely relevant to the child's experience. A recent evaluation of the status of preschool environments revealed that the spaces are attempting to reflect a homelike and natural atmosphere for children (Torrice & Logrippo, 1992). It was not apparent from the study whether or not there was an attempt to provide variety to the children in terms of space, color, and light.

Although studies are limited in this area, researchers have found differences between the behavior of girls and boys in the same physical environment (Cohen & Trostle, 1990; Field, 1980; Weinstein, 1982). Gender theory suggests that males and females perceive and react differently to events in the world (Kwolek-Folland, 1995). Thompson and Walker (1989) proposed that gender must be thought of as a separate concept that focuses on stable sex differences between women and men, as opposed to similarities between women and men. The design of the built environment has traditionally been a male-dominated field (Hayden, 1984). As a result, structures may reflect design that is more preferable to men as opposed to women. Focusing on the different outcomes of girls and boys in the physical environment would suggest that environmental variables may have a differential impact on gender.

Likewise, studies by Piaget and Inhelder (1967) suggested that the degree to which physical environments affect children's development may be due to children's age. Older children may be more capable of perceiving and understanding variations in physical space than younger children. Such differences in perceptual ability and
understanding due to age, therefore, may have a differential impact on children's behavior.

Assessing the relationship between children's development and their physical environment has been a difficult task for researchers. This difficulty may be associated with a lack of understanding of visual perception. Kennedy (1991) explained that adults impose their own perceptions on children, assuming that children have the same perceptions. An appropriate theory for investigating children's visual perception of the physical environment is Gibson's ecological approach to visual perception (J. J. Gibson, 1979/1986). This theory considers the primacy of the physical environment; it is both complex and rich. The variations in the attributes of the environmental layout, including the medium, in Gibson's terms, meaning the air, the surfaces, and the substances, convey information to the child (J. J. Gibson, 1979/1986).

Purpose of the Study

The purpose of this study was to determine whether changes in physical space impacted preschool children's cooperative behavior, taking into consideration their gender and age. These changes in physical space included differentiated and undifferentiated ceiling height and wall color.
Research Hypotheses

General Hypothesis

$H_1$ Children will show higher levels of cooperative behavior in differentiated spaces than in undifferentiated spaces.

Gender-specific Hypotheses

$H_2$ Girls will show higher levels of cooperative behavior than boys.

$H_3$ Girls will show higher levels of cooperative behavior than boys in a space with differentiated ceiling height and wall color.

$H_4$ Boys will show higher levels of cooperative behavior than girls in a space with undifferentiated ceiling height and wall color.

Age-specific Hypotheses

$H_5$ Older children will show higher levels of cooperative behavior than younger children.

$H_6$ Older children will show higher levels of cooperative behavior than younger children in differentiated spaces than in undifferentiated spaces.

Definition of Terms

The following terms and their definitions were used in this study.

Bright hue - a highly saturated color. The brightness or chroma distinguishes a strong color from a weak one (Munsell, 1905).
Cooperative behavior - working together to produce a product or resolve a problem (Paulson, 1974).

Differentiation - information is learned through changes in the physical environment (E. J. Gibson, 1991).

Environment - it consists of a medium, substances, and surfaces. The surfaces separate the substances from the medium, in this case, air (J. J. Gibson, 1979/1986).

Information - it is provided by sound, by odor, and by illumination (J. J. Gibson, 1979/1986).

Surface - it has an identifiable layout, texture, and reflectance. The ambient light is structured by the light reflected from a surface so that these characteristics are specified (J. J. Gibson, 1979/1986).
CHAPTER 2
REVIEW OF LITERATURE

This chapter begins with a review of research on children's environments followed by an explanation of Gibson's (1979/1986) ecological theory of visual perception, a brief summary of literature related to gender theory, and a review of the space literature related to children's environments. It concludes with a review of studies related to color perception, color and children's day care facilities, and color and affective variables.

Children's Environments

Sanoff (1989) reported that, when children's activity areas are spatially well-defined, children benefit in terms of social interaction, cooperative behavior, and exploratory behavior. Play is not interrupted by other children in well-defined spaces (Field, 1980). Researchers have found that well-defined spaces influence children's security and self-esteem because they are able to orient themselves in the setting independently (Moore, 1987; Prescott, 1987; Weinstein, 1987).

Kennedy (1991) took a unique, qualitative approach to explaining the child's experience in a child care center. He described adults as having no idea of the child's perception of the physical environment. He proposed four characteristics of optimal child care centers: they would be homelike, have an unfinished character, have an open relationship to the natural world, and provide an overall variety and balance of kinds of spaces. With the exception of the fourth characteristic, Kritchevsky and others (1977)
proposed the same dimensions as indicators of quality physical environments in day
care settings. They focused specifically on the space arrangement of furniture for
assisting children's wayfinding abilities.

Winchip (1991) described how the senses react to spatial changes in the
environment. They are enhanced by moderate physical differentiation in ceiling
heights, scale, texture, temperature, and light. Light stimulates the child to experience
a variety of spatial changes under different conditions of illumination.

Investigators recommend that the physical environments of child care facilities
include well-defined spaces (Field, 1980; Sanoff, 1989), a home-like atmosphere
(Kennedy, 1991; Kritchevsky et al., 1977), natural elements (Moore, 1987; Weinstein,
1987), and variety and balance of kinds of spaces (Greenman, 1988). In addition, the
variety the elements offer, such as light, color, and surfaces may impact children's
behavior (Moore, 1987; Winchip, 1991).

While the impact of ceiling height has been recognized by several researchers
(Moore, 1987; Olds, 1989; Weinstein, 1987; Winchip, 1991), it has not been
empirically investigated to date. As well, the element of color has been investigated
primarily in terms of psychological affect with few studies examining the effect of
color in the physical environment on behavior. This lack of investigation may be due to
emphasis on social development as opposed to understanding the visual perceptions of
children. Very few studies truly attempt to understand the visual perspective of the
child (Kennedy, 1991). Eleanor and James Gibson have shed light on children's visual
perception through application of James Gibson's ecological approach to visual
perception. James Gibson (1979/1986) developed the theory and Eleanor Gibson (1991) empirically investigated and refined the theory emphasizing that people learn through differentiation within the physical environment.

Gibson's Ecological Theory of Visual Perception

Gibson (1979/1986) assumed that information about the environment is abundant and complex, as opposed to minimal and lacking. This perspective contradicts the view of Piaget (1954), who believed that the environment is created and constructed by the child. It only has meaning to the child because of the environment that the child creates.

For the Gibsons, perception is the process of obtaining information. The theory contains three components: what is learned, the processes involved in achieving differentiation (i.e., abstraction and filtering), and factors that select what is learned (E. J. Gibson, 1969, 1991; J. J. Gibson, 1979/1986; Heft, 1988; Pick, 1987). In perceptual learning, three systems are implicated: the world of events and objects in an environmental or physical layout, the information in ambient arrays of energy that specifies the happenings and layout of the environment, meaning the way the environment is presented to the observer through illumination, and the changing perceptions of the observer (E. J. Gibson, 1987, 1991).

The Gibsons (1969, 1979/1986, 1991) believed that all knowledge comes to the observer through the senses by way of shadings, differentiations, and subtleties of energy, in other words, as stimuli. Unique to this theory is that perceptual development
is always a matter of the relationship between stimulation and perception; it is strictly based on the relationship of the perceiver to his or her environment (E. J. Gibson, 1991).

Perception is an active, information-seeking process of searching ambient arrays of energy for information about the surrounding environment. The ambient array is rich in information that specifies layout, objects, and events in the world (E. J. Gibson, 1991; J. J. Gibson, 1979/1986).

The ecological approach to understanding the impact of the physical environment stresses the inseparability of perception and action. A perceptual system incorporates actions in the visual system (e.g., head and eye movements, accommodation), perception guides action, and action informs perception. Gibson (1991) concluded that it is an individual's relation with the environment that he or she must perceive in order to behave successfully (E. J. Gibson, 1991; Gibson & Schmuckler, 1989).

A spatial layout, such as a room, has walls, furniture, a floor, and light sources. Ambient light bounces around in this layout being reflected by everything there (J. J. Gibson, 1966, 1979/1986). An individual's eye in this room at any point will have a view of the spatial layout from that standpoint or perspective. Perceiving the spatial layout surrounding one as objective, or being able to take someone else's perspective or any perspective ("coordination of perspectives," in Piagetian (1954) terms), is an achievement that children eventually attain (E. J. Gibson, 1991; J. J. Gibson, 1979/1986).
The affordances of the environment are what the environment offers or affords the person, what it provides or furnishes, either for good or ill (E. J. Gibson, 1991). The term affordance refers to both the environment and the person in a complementary manner (J. J. Gibson, 1979/1986). For example, if a surface is rigid and horizontal, then the surface affords support. Because of the interactive relationship between the person and the affordance, affordances are neither objective or subjective; they are both (E. J. Gibson, 1991).

Gibson (1979/1986) concluded that perceptual learning is more concerned with what features of the environment afford individuals, as specified in the light, sound, and odor around them, rather than subjective recall or memories of what has been afforded in the past. Eleanor Gibson (1991) suggested that "perhaps all knowledge comes through the senses...by way of variations, shadings, and subtleties of energy which are properly to be called stimuli" (p. 295).

Eleanor and James Gibson evaluated visual perception as a means to gain information from a rich and complex environment. Their studies focused primarily on perceptual development in infants (E. J. Gibson, 1991). However, several studies by Eleanor Gibson investigated subjects across the lifespan (E. J. Gibson, 1991). The Gibsons did not specifically focus on preschool environments.

Extending the perceptual ideas of differentiation within the environment to a preschool space is a method to investigate the impact of physical environment variables on behavior. A preschool space that provides children with differentiation in ceiling height may afford a child-scaled space for cooperative play. A brightly-hued wall may
provide differentiation and, therefore, may afford a more dramatic space in which children can play. A space with both a differentiation in ceiling height and wall color may interact to afford an environment where boys are over stimulated, resulting in more assertive or aggressive behavior. Although the Gibsons did not evaluate children’s physical environments looking for differences between boys and girls, gender theory suggests that integrating visual perception and gender differences may explain variations in behavior between boys and girls in the same environmental layout (Hayden, 1984).

Gender Theory

Gender is a construct that builds on biological differences between men and women (Kwolek-Folland, 1995). In addition to these differences, gender is socially constructed according to ethnic, cultural, economic, religious, racial, and temporal differences (Kwolek-Folland, 1995; Walker, 1993). Hein (1993) stated, "It is quite possible that all or most experience is gendered, implying that one's activities are adverbially genderized" (p. 6). She suggested that this quality of gendered thinking includes behavior. While activities are performed by both sexes, they are not done the same way. Therefore, there is reason to believe that the outcome of visual perception in the physical environment may differ between the sexes. Girls and boys may perceive and react differently within the same environment. Their cooperative behavior may differ depending on the variables in the physical space, such as ceiling height and wall color.
Cooperative Behavior

Cooperative behavior is a type of behavior categorized within prosocial behavior (Perry & Bussey, 1984). Children work together toward common goals. Cooperative behavior is more likely to occur in a cooperative activity than in a competitive activity.

Aureli and Augusto Procacci (1992) found that children who attended day care were engaged in cooperative play more often than children reared at home. Influences outside the home, such as a preschool environment, may have a positive or a negative effect on social development. When children are encouraged to interact with others they develop many skills ranging from physical development to social cognition (Saunders & Green, 1993). Field (1991) found that the time children spent in high quality day care was positively related to parents' ratings of the children's emotional well-being and assertiveness.

Boschetti (1995) suggested that facility design for preschoolers can promote children's exploratory activities as well as social play. Phyfe-Perkins (1980) reported that a space must be able to absorb activity and noise if more cooperative and constructive play is desired. As described above, the researchers concluded that appropriate day care facilities can influence children's cooperative behavior.

Space

Space refers to features in the environmental layout that are designed in proportion to human scale. Studies of children's spatial understanding have revealed that they have difficulty with wayfinding (Blades & Spencer, 1987) and estimating or
approximating distances in controlled settings (Fabricius & Wellman, 1993; Piaget & Inhelder, 1967). Many empirical studies have used model spaces to determine whether children are able to transfer their understanding of the model space to the actual environment. These assessments suggest that children 2.5 years and older are able to comprehend the symbolic relationship between the model and the actual environment (Marzolf & DeLoache, 1994). Further investigations of the ability to transfer spatial understanding are necessary for validity and reliability.

Researchers of spatial understanding and children's development have primarily focused on the seminal work of Piaget and Inhelder's (1967) studies of the child's conception of space and Piaget's theory on the child's conception of geometry. Among many other propositions, this work identified the difficulty that younger children have in perceiving distances: (a) the direct-indirect error, when a child judges a direct route to be the same distance as an indirect route because the ending point is the same for both distances, and (b) the interposed object error, when a route is perceived as shorter when an object is placed along the route, separating the distance into two segments. As children grow older, they are better able to judge distances than younger children.

Several studies have supported Piaget and Inhelder's (1967) findings and several have contradicted their propositions. Fabricius and Wellman (1993) recently found that children make the interposed object error because they are only focusing on one portion of the route: some were focusing on the endpoint and some were focusing on the start-point segments. They also found that, for the direct-indirect error, children did not scan lines of the route but focused on the shape of the route to determine that the distance
was longer (Fabricius & Wellman, 1993). Anooshian and Kromer (1986) looked at fourth, sixth, and eighth grade children's spatial knowledge. The younger groups tended to overestimate distances between landmarks separated by a barrier. This may be a result of both functional distance, having to walk around the barrier, as well as the grouping of landmarks that may result from the placement of barriers. The older age groups were consistently more accurate in distance and direction estimates than were the younger age groups. These findings are critical for giving insight into children's perceptions of distance.

It stands to reason then, that if a child is focusing on one portion of the segment, he or she may be misinterpreting the actual distance because of his or her viewpoint. A question that arises is whether this misinterpretation is only apparent with horizontal distance or is vertical distance also misinterpreted? It has been proposed that, if an adult is standing in a space with a lowered ceiling, the child perceives the adult as being larger than actual size (Greenman, 1988).

**Vertical Space**

Research on space and children's behavior has been concerned with horizontal space. An area in need of investigation is vertical space. The proportion of an average-height adult, 5'6", to an average-height ceiling, 8'0", transferred to an average child's height, 3'0", is a child-scaled ceiling height of 4'6". Very few child care settings offer lowered ceilings to children (Torrice & Logrippo, 1992). Moore and others (1979) reported that reduced heights encouraged quieter play while high ceilings, those above
8'0", encouraged more active play. Occasionally, preschool environments offer spatial variety in a loft or play equipment in which children can explore. General activity areas are usually placed in areas with 8'0" or higher ceilings (Greenman, 1988).

Olds (1989) is one of the preeminent researchers in the area of children's environments. She emphasized the importance of children’s sensory perception. "To design for aesthetic richness, the building's or room's elements (floors, walls, ceilings, horizontal and vertical supports, objects, forms, and architectural details) all should be conceived of as interactive surfaces" (p. 8). For spatial variety ceiling heights should be varied with mobiles, canopies, eaves, trellises, and skylights (Greenman, 1988). The success of the setting is proportional to the number and variety of areas that can easily be created in a room. Weinstein (1987) delineated the importance of enhancing children's self-esteem by providing child-scaled features in the environment. The ceiling can also be adapted to be child scaled; which also supports security in children (Moore et al., 1979).

Cooperative Behavior

A study related to space and cooperative behavior is one by Levitt and Weber (1989) that looks at the impact that barriers have on children's social interaction. Barriers placed between toddlers affected their social interaction. With the barrier between them, toddlers with toys were less involved with the peer on the other side of the barrier than were the toddlers with toys without the barriers (Levitt & Weber, 1989). With the barrier and no toys there was more social involvement, yet with less
social involvement than conditions without the barrier. Without the barrier, the toddlers interacted more than in the other conditions. This study reveals that 2.5-year-olds are affected by physical environment limitations.

**Gender.** Weinstein (1982) reported that, in an elementary classroom, boys' use of privacy booths within the classroom correlated negatively with teacher's rating of sociability, positively with teacher's rating of distractibility, and positively with teacher's rating of aggressiveness. For girls, use of privacy booths within the classroom correlated negatively with self-esteem and positively with popularity utilizing peer nominations. She also reported that, for girls, there was a positive relationship between privacy-seeking behavior at home and in school.

Field (1980) found that girls in a classroom with open space and a high teacher/child ratio were significantly less interactive with children and more interactive with teachers. The girls initiated fewer interactions than the girls or boys in the other classrooms, including spaces with high ratios and closed space, open space and low ratios, and closed space and low ratios. Boys in the open space with a high teacher/child ratio engaged in significantly less dyadic play. Children playing in groups of two exhibited less verbal interaction than children in the other classrooms. This study concluded that, for the four classrooms, girls were more verbal than boys and showed more cooperative and less associative play than boys. In the classroom with a low teacher/child ratio and partitioned play areas, children were interactive with peers and verbally interactive. In addition, they demonstrated fantasy play as well as
associative-cooperative play. Methodologically, this study could not determine reliable differences between the classrooms based on teacher/child ratios and space (Field, 1980). However, it does imply that space may impact children’s behavior.

**Age.** There is considerable disagreement among researchers regarding the age at which a child learns to perceive space objectively. Piaget and Inhelder (1967) concluded that children perceived space accurately at 7 to 9 years of age. Other researchers (Fabricius & Wellman, 1993) have suggested that space can be perceived as early as 3½ to 4 years of age.

Friedmann and Asher Thompson (1995) reported findings related to age and preference for types of intimate spaces for preschool children. Privacy boxes were placed within a preschool setting. One space was "cozy"; interior walls were painted in a white base with a slight tint of peach. The furnishings were soft elements and textures, such as pillows, a small mattress, and soft carpet. The other space was "slick." Interior walls were painted white with small geometric shapes in bright colors. Strong colors (red, green, blue, yellow) were used in the interior along with hard surfaces including carpet, wooden blocks, red plastic netting on the ceiling, and a hard foam pillow. The three-year-olds tended to prefer the cozy spaces while the five-year-olds preferred the slick spaces (Friedmann & Asher Thompson, 1995). Younger children seemed to prefer softer, more subtle environmental affordances than older children.
Related to privacy, Zeegers, Readdick, and Hansen-Gandy (1994) questioned 100 preschoolers regarding their preferences for privacy. Younger preschoolers responded more often than older preschoolers that they had a special place in their day care settings. This indicates that younger children are aware of the environmental layout at their day care settings.

Plumert (1994) reported the recall strategies of spatial organization of children aged 10-16, as well as of adults. Ten-year-olds used categorical organization to remember furniture. Twelve- and fourteen-year-olds used a combination of categorical and spatial organization methods for recall. Sixteen-year-olds and adults organized furniture spatially. In a second study focusing on the 10- and 12-year olds, when recalling objects, they both exhibited higher levels of categorical than spatial organization. However, when recalling objects and the locations of the objects, the twelve-year-olds showed more spatial than categorical organization (Plumert, 1994). This implies that development influences spatial and categorical organization strategies.

On a categorical-spatial continuum, age was positively correlated with spatial organization.

Socioeconomic status. The relationship of socioeconomic status and children's perception of space is unclear. Researchers have found that children from lower socioeconomic backgrounds show less pretend play than middle-class children (Udwin & Schmukler, 1981). Their physical and social environments at home may not offer the opportunities or spaces to them that support pretend play. In terms of social play,
Seagoe (1971) found that culture, as opposed to socioeconomic status, was a good predictor of level of social play.

Summary

Space in the preschool classroom has been evaluated along specific dimensions as identified above. The areas that need attention are in addition to teacher/child ratios, density, and pathways. Results from the study of toddlers' interactions when a barrier was placed between them suggests that toddlers can solve problems even when an intervening physical feature is placed between them. They also increase social interaction without barriers between them.

Most preschools are modified-open floor plans with partitions of various types to separate activity areas. These partitions are usually unable to reach the full length from the floor to the ceiling to separate an area completely. It seems that lowering the ceiling in certain areas would give children a feeling of security because the ceiling would be child scaled. Child-scaled features have been found to enhance children's self-esteem (Moore, et al., 1979). The art, dramatic play, and block activity areas could benefit from a lowered ceiling because if the child's self-esteem is increased, he or she may be more likely to interact socially with children in that setting.

Color

Another element of the physical environment discussed in a peripheral context is color. In an early work, James Gibson (1966) suggested that chromatic color had no meaning to the human. In a later discussion, Gibson (1979/1986) discussed that chroma
may impact visual perception. His concern was with the impact of the ambient light, the movement of the individual, and the ratio of the environment itself to the individual (E. J. Gibson, 1991); concluding that chroma is influenced by ambient light as well as the position of the observer.

Color is perceived differently by every individual. Empirical research indicates that humans react to color both physically and psychologically (Olds, 1989). Neither color nor space can be perceived at all without light. For purposes of this review, light will only be described as a sub-category of color. For example, a bright hue is perceived as bright only if it is seen in adequate light; hues with the brightest chroma are perceived as dull if they are seen in low light.

The three perceptual attributes of color: hue, the actual color name; saturation, the dullness or brightness; and value, the lightness or darkness, are interactive dimensions. When classifying color stimuli, subjects actively use hue, saturation, and value. Perceptually, they prefer to use these dimensions over other possible dimensions in the color space (Melara, Marks, & Potts, 1993).

Melara, Marks, and Potts (1993) discussed that integral stimuli (chroma and value of a Munsell chip) are perceived as wholes. Separable stimuli (e.g., size and brightness of a square) are seen as specific features. They found that saturation and brightness are interacting dimensions. This supports Munsell's (1905) theory of color perception. He concluded that the eye can discriminate hue, saturation, and value.

Mounts and Melara (1995) suggested that chromatic information is significantly less affected than achromatic information by interruptions in light source (e.g.,
shadows). Human observers perform best when objects are defined by chromatic rather than achromatic differences. Similarly, experiments performed by Wurm, Legge, Isenberg, and Luebker (1993) concluded that color improves object recognition.

Lights of different colors influence biological changes in children including blood pressure, brain activity, and pulse and respiration rates (Olds, 1989). Previous research recommends optimal light as full-spectrum interior lighting, which is considered to be the closest replication of actual sunlight. Types of lighting will dramatically affect the colors used in the interior space (Greenman, 1988). Gifford (1988) found that brighter light encouraged more rather than less intimate communication, and brighter lighting stimulated more general communication.

Moore, McCarty, and Jelin (1995) suggested warmer tones in quiet areas in children's environments for a calmer atmosphere. It should be noted that this suggestion was for children growing up in crime-ridden areas. In recommendations for infants and toddlers, Olds (1989) suggested that warm tones should be used for high activity areas and cool tones for quiet and soothing areas. To promote security, children should be able to see warm colors from the entry to the classroom (Moore et al., 1979). While the literature consistently recommends warm colors and tones for children's environments, an empirical base is not evident.

Color in Day Care Facilities

An evaluation of design in day care facilities revealed that the most predominant interior colors of the 126 sites were blue (106), white (86), yellow (86), red (70), beige
(65), green (54), orange (52), brown (36), grey (24), violet (12), and black (5). Colors were most prevalent on the walls at 110 sites, floors (48), accessories (29), furniture (27), ceilings (9), windows (7), and none of the above at 5 sites (Torrice & Logrippo, 1992). Colors for the sites were selected by architects, childcare providers, interior designers, owners, and directors. Recommendations from this study are to incorporate colors from nature, both light and dark. Torrice and Logrippo (1992) suggested that active children tend to prefer settings with calming colors.

**Cooperative behavior.** There are no specific studies found to date that focus on the influence of color on children's cooperative behavior. Many environmental researchers have made recommendations for colors in certain areas of the preschool without empirical investigation of children; they are often adult-imposed preferences (Kennedy, 1991).

**Gender.** Cohen and Trostle (1990) found that boys and girls responded differently to color. Girls showed preferences for more dramatic hues than did boys for indoor and outdoor settings. Girls selected more intense color arrangements, more multidimensional shapes, significantly brighter lighting combinations, and more complex use of scenic arrangements (Cohen & Trostle, 1990). This suggests that girls prefer environmental stimuli that are more diverse and dramatic than stimuli preferred by boys.

Karp and Karp (1988) assessed concepts that fourth-graders identified when given color names. There was no difference between males and females on choices of
concepts (i.e. anger, happiness, honesty) related to color names. Males and females both associated red with anger, pain, happiness, and love; blue with sadness, yellow with honesty, and black with fear. There was no selection of positive or negative meaning for colors for gender. This study contradicts some of the stereotyping made by adults when relating gender and color.

**Age.** Cohen and Trostle (1990) found that older subjects, 6.5 to 7.5 years, preferred dramatic colors and more intense lighting effects more than younger subjects, 5.5 to 6.4 years did. Younger subjects preferred large-scaled environmental characteristics across interior and exterior settings. Morgan, Goodson, and Jones (1975) found that children and adolescents, 6, 12, and 18 years of age, related color meaning differently. Eighteen-year-olds were more likely to associate colors with traditional words, for example, hot with red and cold with blue. Twelve-year-olds consistently associated only hot with red, and six-year-olds made no more conventional associations than by chance. This study suggests that cultural influences may play a role in color meaning because, as children age, they tend to use conventional associations with colors.

**Affect.** Unfortunately, the current research on the relationship of color and affect is limited. Norman and Scott (1952) reviewed the literature on color and affect. They determined that colors were associated with certain mood-tones. Affective meaning of color is related to color names. Wexner (1954) found that color and mood-associations among university students related red with exciting and stimulating; blue
with secure, comfortable, tender, and soothing; purple with dignified and stately; orange with distressed; yellow with cheerful and jovial; and black with powerful, strong, and masterful. Another study that resulted in similar findings was conducted by Schaie (1961). He found that there were strong associations between mood-tone and colors (e.g., red and protective, defending, powerful, strong, masterful; orange and exciting, stimulating; yellow and exciting, stimulating, cheerful, jovial, joyful, pleasant; blue and pleasant, secure, comfortable, tender, soothing; purple, dignified, stately; white and tender, soothing; gray and despondent, dejected, melancholy, unhappy; black and distressed, disturbed, unhappy, stately, powerful, strong, masterful). A factor analysis revealed four factors (a) activity-passivity, (b) quality of emotional tone, (c) mood-strength, and (d) emotional control. Meanings of these colors are helpful in selecting colors for children's environments. For instance, to enhance security and joy, one could possibly use warm tones of blue and yellow. Wexner (1954) found no significant differences between gender for comparisons of mood associations and gender, using university students as subjects.

Valdez and Mehrabian (1994) reported results for three different experiments on color and emotions. They found that blue, blue-green, green, red-purple, purple, and purple-blue were the most pleasant hues, whereas yellow and green-yellow were the least pleasant. Green-yellow, blue-green, and green were the most arousing, whereas purple-blue and yellow-red were the least arousing. Green-yellow induced greater dominance than red-purple. Cooler tones were more pleasant to subjects than warmer tones.
Summary

Studies of children's reactions to color in the environment are sparse. If cultural influences play a factor in children's preferences for color, then preference for warm tones may be a cultural or an adult-imposed influence. If blue is calming, then it may be an inappropriate color to use in areas where social interaction is desirable. Bright accents are often recommended in children's interior environments (Greenman, 1988; Weinstein, 1987). If, for example, bright accents were used on one wall of four the intensity would be enough for interest yet not overwhelming to the children as well as to the caregivers. The color overload in a setting is of primary importance because not only do the stationary planes have different colors but the children are usually wearing bright and colorful clothing. The combination of color and movement can over-stimulate people in the setting.

Studies should focus on the impact that the differences between a bright hue and a neutral hue have on children's social interaction. From this review of literature it might be hypothesized that girls will be more socially interactive in bright-hued spaces than boys in those spaces. Older children might also be more interactive in these spaces than younger children.

Focus of this Study

Gibson's (1979/1986) theory suggests that differentiation within an environmental layout influences the information gained by a person through perceptual learning. Differentiation includes variations in space and color. The review of literature
on vertical space and color found that more investigation is necessary before conclusions can be suggested regarding their impact on children's behavior.

Differentiation in vertical space and color chroma varying along a bright and neutral continuum warrants further research. In addition, in a study of the impact of variations in physical space (i.e., differentiations in vertical space and color) on children's behavior, the gender and age of children must be taken into account. The children's behavior of interest in this study is cooperative behavior.
Chapter 3

METHODS

Design of the Study

This study used an experimental design with subjects experiencing four conditions each. Data were collected by the researcher utilizing videotape recordings. This investigation took place at the Child Development Center in the Bates Family Study Center at Oregon State University. The half-day preschool classes at the Child Development Center were divided into two two-and-one-half hour blocks of time--9:00 a.m. - 11:30 a.m. and 1:00 p.m. - 3:30 p.m. Tuesday through Friday. Children were offered a period of free-play time each day. The study took place during this time.

The researcher met with the preschool director prior to contact with teachers, parents, or children. A meeting was convened with the director, the head teachers, and the researcher to review and make recommendations for successful execution of the investigation. Request for human subjects approval was obtained from the Internal Review Board at Oregon State University in March 1996 (Appendix A).

Sample

The sample consisted of 30 preschool children, 15 boys and 15 girls. Subjects comprised children in four different half-day classes at the Child Development Center in the Bates Family Study Center at Oregon State University. The ages of the subjects ranged from 3 years 9 months to 5 years 7 months. The Child Development Center services many international children as well as ethnically-diverse U.S. children. These
groups were not divided evenly among the four classrooms in terms of gender. Because gender was central to this study, a limitation that resulted was inclusion of only Anglo-American children. The researcher and the Health Coordinator determined from records which children were considered Anglo-American.

All parents of the subjects were asked to sign a consent form (Appendix B) permitting their child to participate in the study. Subjects were then matched by age within each of the four classrooms.

**Age.** Children were divided into three age groups for the study. Younger children (coded 0) ranged from 3 years 9 months to 4 years 3 months (n=14), middle children (coded 1) ranged from 4 years 4 months to 4 years 11 months (n=13), and older children (coded 2) ranged from 4 years 12 months to 5 years 7 months (n=5).

**Gender.** Children were divided into two gender categories. Girls (n=15) were coded (0) and boys (n=15) were coded (1).

**Socioeconomic status.** Hollingshead's (1975) Four Factor Index of Social Position (FFIS) was used to determine the socioeconomic status of families from which children came. Mother's and father's level of education and occupation are used to calculate a family's socioeconomic status. Raw scores, ranging from 8 to 66 representing five socioeconomic classes from lower to upper, can be calculated to determine a family's position on the socioeconomic scale. In addition to this measure of socioeconomic status information, the general family income level was obtained
Twenty-four children had socioeconomic scores above 45 and 6 children had scores below 45. The variable was dichotomized. Low-middle socioeconomic class was coded 0 and middle-high socioeconomic class was coded 1.

**Groups.** The final groups consisted of two girls and two boys in each group. Initially, the groups were pure-age groups of younger, middle, and older children. The final groups were primarily mixed ages because children did not want to participate or the head teacher recommended that the task would be especially difficult; this occurred in two cases. Two groups had two children (one boy and one girl) who participated twice. One girl and one boy were replaced because of the difficulty of the task. They were unable to stay in the space for five minutes. Although girls were evenly divided among the classrooms, Anglo-American girls were not evenly distributed across all four classrooms; therefore, several groups were not divided into age categories as originally planned.

The resulting groups were as follows: Group A - 2 younger girls and 2 middle boys, Group B - 2 younger girls, 1 younger boy, and 1 older boy, Group C - 2 older girls and 2 older boys, Group D - 2 middle girls and 2 middle boys, Group E - 2 middle girls, 1 middle boy, and 1 younger boy, Group F - 1 younger girl, 1 middle girl, and 2 middle boys, Group G - 2 younger girls, 1 younger boy, and 1 middle boy, and Group H - 2 younger girls and 2 younger boys. Only three groups had pure age group identification; Group C was older, Group D was middle, and Group H was younger. Four young children from 3 different classrooms did not participate because
of the difficulty of the task. This was the most problematic aspect of the sampling procedure.

**Congenital color vision defects.** Prior to inclusion in this study, subjects were tested for congenital color vision deficiency or color blindness. While there are several types of color vision defects, the three most common types are protanopic, inability to distinguish red; deutanopic, inability to distinguish green; and tritanopia, inability to distinguish blue-violet (De Grandis, 1986; Overheim & Wagner, 1982).

The researcher tested the children in the Child Development Center during free-play activity. Subjects were asked individually to look at a series of Standard Pseudoisochromatic Plates (Ichikawa, Hukami, Tanabe, & Kawakami, 1978). An ophthalmologist informed the researcher that the researcher would be able to detect gross differences in color vision for boys only; differences in girls would not be detectable although the plates could be used as a screening device for future testing among girls (S. J. Hufsmith, M. D., personal communication, December 13, 1995). Because detecting differences in girls is more difficult, the researcher planned to eliminate any girls unable to identify figures for the Screening Plates as discussed below. All girls were able to identify the figures. These plates give accurate discrimination of subjects with color deficiency from those with normal vision.

Subjects were asked whether or not they were able to see a figure on the plate and, if so, what figure did they see. Ten Screening Plates were utilized for screening congenital red-green deficiency. Numbers were read differently by normal and color
defective subjects (Ichikawa et al., 1978). The five Classification Plates, utilized to classify protan and deutan, were not part of this examination.

The following describes the protocol for assessing congenital color vision defects (Ichikawa et al., 1978). Illumination was a combination of natural light from the west and south directions for two classrooms and west and north directions for two classrooms. The plates were placed approximately 30 inches from the eyes of the subject during the examination. Typically, one plate would be shown for a maximum of 3 seconds; however, because of the young age of the subjects, they were asked to trace the figure with their finger or with a manipulative they were using. This process took between 3 and 15 seconds for each plate. All screening plates were presented to the subjects. Using the scoring sheet (Appendix D), the researcher circled the number on the record sheet that corresponded to what the subject read out or traced. When the subject read or traced two numbers on the plate, the researcher circled the number that was better read or traced. When the subject misread the number as a letter (e.g., verbalizing “3” as “E”), the letter or number read out by the subject was written beside the printed figure. If 8 or more out of 10 responses were accurate for the screening plates, the subject was determined to have normal color vision. All 30 subjects were determined to have normal color vision.

The Treatment

Room 128 in the Bates Family Study Center at Oregon State University was utilized for this study. The dimensions of the room were 15'4" long x 6'11" wide with
a 9'0" ceiling height. There was one one-way observation window with mirrored glass on the north wall. A clear glass window was on the east wall. This window was covered with two layers of foam core in order to control the natural light. A solid wood door was on the west wall. A layout of the room is shown in Appendix E. It was modified to the following conditions.

**Condition I.** The space consisted of a 9'0" ceiling with a neutral-hued (off-white) fabric east wall, three neutral-hued gypsum board walls, and a neutral-hued ceiling (Figure 1). Fabric for all four conditions was attached to the suspended ceiling with sticky-back hook and loop fastener (Figure 1).

**Condition II.** The space consisted of a ceiling that was differentiated from 9'0" to 5'6". This was done by attaching, with sticky-back hook and loop fastener, two pieces of white foam core 3'6" in width and 4'0" in length, and 4'6" deep (or off the ceiling). The bottom of the differentiated section was open because of a sprinkler system attached to the ceiling. The walls were neutral as in condition I (Figure 2).

**Condition III.** The space consisted of a 9'0" ceiling as in condition I with a bright-hued east wall. Red, Munsell 5R 5/10; medium value with highly saturated chroma (Munsell, 1905) fabric was attached to the suspended ceiling (Figure 3).

**Condition IV.** The space consisted of a ceiling with a differentiated ceiling height, as in condition II. The east wall was differentiated with brightly-hued red fabric, as in condition III (Figure 4).
Figure 1. Condition 1.
Figure 3. Condition 3.
Figure 4. Condition 4.
In each condition, neutral-colored blocks and cylinders were placed on a 36" square piece of white foam core in the center of the room. To counteract the children's boredom in the conditions, the manipulatives on the foam core with the blocks were changed in a counter-balanced manner in each condition. Manipulatives placed on the foam core in the center of the space were four animals, four wooden dolls, four different colors of clay, and multi-colored Legos.

Data Collection Procedures

Prior to collecting the data, the researcher visited the children's classrooms daily for two weeks so the children would be familiar with her. She visited the classrooms throughout the data collection period. Data were collected over a five-week period in May and June 1996. The researcher went into the classrooms daily for the five weeks to see if the subjects were available to participate in the study. Ideally, the groups would experience one condition each week for four weeks. However, only one of the eight groups completed the task in this manner because children were often absent. To familiarize the children with the space, each group was introduced to the space one week prior to the evaluation.

After rounding up the four subjects of a group, the researcher notified either the head teacher or an assistant in the classroom that they would be gone for 10 minutes. As a group, the subjects walked with the researcher down the hall to the room. As the subjects completed more than one condition, they were more likely to run down the hall or direct others in the group toward the room. The subjects were told by the
researcher, "Here are some toys for you to play with and I will be back in 5 minutes."

Because completing the four conditions was an intensive task, children were given one small manipulative to take home after completion of each condition (i.e., animal stickers, a star eraser, a rubber boat or car, a dinosaur eraser). All children were given the same manipulative for each condition (i.e., animal sticker after completion of Condition 1). The order of the conditions for each group was rotated in order that the groups were not experiencing the conditions in the same order.

Videotaping

The videotape camera permanently mounted on the north wall was lowered to 3'6" above the finished floor. The camera recorded the children's activities. It was controlled from a room on the second floor of the Bates Family Study Center. The camera, video tape recorder, audio tape recorder, and video monitor were turned on prior to the children entering the room and turned off after at least five minutes of unstructured activity within each condition.

The Instrument

The Oregon Preschool Test of Interpersonal Cooperation (OPTIC) was utilized to rate the cooperative behavior of the children (Paulson, 1974). It is an observational protocol permitting recording of seven levels of behavior. The levels are full cooperation, pre-cooperation, active interaction, parallel play, watching, minimal interaction, and obstructive interaction. Interrater agreement has been high, varying
between 89 and 100 percent (Paulson, 1974). The scoring criteria for Paulson’s (1974) seven levels of social interaction are as follows. Researchers have found difficulty in determining differences between levels 5 and 6; therefore level 6 and 5 were combined to result in the following levels: level 5 - Cooperation - children jointly produce a product or resolve a problem, level 4 - Active Interaction - children respond to one another (they may use similar materials or engage in similar activities), level 3 - Parallel Play - a child plays in the same area as another with similar materials and each child’s attention is focused primarily on his or her own materials, level 2 - Watching - a child watches or listens to another child, he or she may talk briefly to the other child, level 1 - Minimal Interaction - a child plays alone and independently with toys that are different from those used by others, and level 0 - Obstructive Interaction - a child engages in verbal and/or physical behavior preventing attainment of the goal.

Scoring

Videotapes were scored by six trained raters. Raters were undergraduate students solicited from upper division Human Development and Family Sciences courses at Oregon State University. Training consisted of studying definitions and scoring practice videotapes. Initially, raters were permitted to discuss their ratings of practice tapes. They were ultimately required to reach 70% agreement without discussion of tapes. After initial training, four of the six raters reached an interrater reliability of 72%. Four of the segments scored by the non-reliable raters were rescored by raters scoring above the 72% mark. Raters coded the videotapes at 10-
second intervals. For each five-minute segment there were 30 different scores. After scoring the third videotape segment, interrater reliability was reestablished by coding a randomly-sampled segment of videotape. Interrater reliability was reestablished for all six raters at 87%. One of the raters developed a scoring sheet (Appendix F).

The raters completed the instrument for all the children in one condition. A rater would first rate one child, then another child, and so on, until all four children within that condition or segment had scores for cooperative behavior. Each rater scored 5-6 segments. In this study, the average rating of children within and across conditions was used in the data analyses. Average ratings ranged from 0 to 5.

This was an effective method of scoring children's cooperative behavior. The raters were diligent and responsible with the scoring and care of the videotapes. The anonymity of the children was preserved, however, it was important to remind raters of the importance of discretion when evaluating human subjects.
CHAPTER 4

RESULTS

The primary purpose of this study was to determine whether changes in physical space impacted preschool children's cooperative behavior. These changes in physical space included differentiated and undifferentiated ceiling height and wall color. Undifferentiated ceiling height included a space with a ceiling height of 9'0". Differentiated ceiling height included a space with a partially-lowered ceiling height of 5'6". Undifferentiated wall color included one wall covered with white fabric along with the other three neutral-hued walls. Differentiated wall color included one wall covered with red fabric along with the other three neutral-hued walls.

Multivariate Repeated-measures Analysis

The data analysis utilized a multivariate repeated-measures analysis of variance in the SAS System of linear models. The repeated measures represented various combinations of changes in physical space including Condition I - undifferentiated ceiling height and wall color, Condition II - differentiated ceiling height and undifferentiated wall color, Condition III - undifferentiated ceiling height and differentiated wall color, and Condition IV - differentiated ceiling height and wall color. Groups of subjects experienced the conditions in alternating order so that no groups entered the conditions in the same order.

In the preliminary analysis, the predictor variables of Gender, Age, Socioeconomic Status, Manipulatives, and Order were entered into the multivariate
repeated-measures equation to determine their contributions to children's cooperative behavior. F-values for Socioeconomic Status, Manipulatives, and Order were not significant; therefore, they were not included in the final analysis. However, Gender and Age (i.e., older, middle, and younger) were included in the final repeated-measures analysis due to their significance. Table 1 summarizes the findings from the final repeated-measures analysis. Means and standard deviations associated with this analysis are found in Table 2.

There was a significant main effect for Condition on children's cooperative behavior scores (F=3.01, df= 3, 24, p < .05). Post-hoc comparisons revealed the cooperative behavior scores of children in Condition II to be significantly higher than those in Conditions I (p < .01), III (p < .05), and IV (p < .01). In addition, the mean effect of Conditions was evaluated using a polynomial contrast to describe the relations among the conditions. Findings revealed the mean effect of Conditions II (F=6.43, df=1, 26, p < .05) and III (F=4.24, df= 1, 26, p < .05) to be significant. These findings indicate the existence of a nonlinear relationship between the conditions. The cooperative behavior scores of children from Condition I to II extended upward, from Condition II to III, downward, and from Condition III to IV still downward, leveling off at Condition IV.

These findings taken together provide only partial support for Hypothesis 1, indicating that children will show higher cooperative behavior scores in differentiated spaces than in undifferentiated ones. Indeed, when children were in a space with either differentiated ceiling height or differentiated wall color, their cooperative behavior
Table 1

Multivariate Repeated-measures Analysis for Conditions

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*p < .05.
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Table of Means

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scores were higher than those in which both ceiling height and wall color were undifferentiated. On the other hand, when both ceiling height and wall color were differentiated, children’s cooperative behavior scores were not significantly different from those obtained when children were in a space with both undifferentiated ceiling height and wall color. Thus, a curvilinear relationship rather than a linear one appears to exist relative to the differential impact of varying degrees of differentiated space on preschool children’s cooperative behavior.

Gender-specific Effects

There was a significant main effect for gender on children’s cooperative behavior scores (F=4.80, df=1, 26, p < .05). The cooperative behavior scores of boys were significantly higher over all conditions than girls. This finding is opposite than predicted by Hypothesis 2. In addition, there were no Condition X Gender interaction effects; thus Hypotheses 3 and 4 regarding the differential impact of Conditions on boys and girls were not supported as expected.

Age-specific Effects

There was a significant main effect for age on children’s cooperative behavior scores (F=3.39, df=2, 26, p < .05). The cooperative behavior scores of older preschool children over all conditions were significantly higher than younger children. This finding supports the prediction of Hypothesis 5. There were no Condition X Age interaction effects; therefore Hypothesis 6, regarding the differential impact of
Conditions on older and younger children, was not supported as predicted. Finally, no
Gender X Age or Condition X Gender X Age interaction effects were found.
CHAPTER 5
DISCUSSION

Major findings associated with the variables of this study are discussed, with particular emphasis placed on the theoretical frameworks used in guiding this study. Following this discussion, the study’s limitations and suggestions for future research, as well as implications of the study’s findings, are presented.

Condition Effects

According to Gibson’s ecological theory (1979/1986) of visual perception, environments of children harbor within them information that is abundant and complex. The richness of such environmental information is, in part, communicated to children through differentiations in physical space. Such differentiations can have an impact on children’s behavior. On the basis of Gibson’s theory, it was predicted that differentiation in physical space, whether in ceiling height or wall color, would have a significant impact on children’s cooperative behavior. More specifically, it was predicted that preschool children would display higher levels of cooperative behavior in differentiated spaces than in undifferentiated spaces. Findings of the present study provided only partial support for such a proposition (Hypothesis 1). The cooperative behavior of children was found to be significantly higher in a space with a differentiated ceiling height and undifferentiated wall color (Condition II) than in a space with undifferentiated ceiling height and wall color (Condition I). This finding
provides some support for the idea that differentiated spaces, particularly ceiling height, can contribute to children’s cooperative behavior in positive ways.

The cooperative behavior of children in a space with differentiated ceiling height and undifferentiated wall color (Condition II) was also significantly higher than those in a space with undifferentiated ceiling height and differentiated wall color (Condition III), as well as those in a space with both differentiated ceiling height and wall color (Condition IV). These findings were not expected on the basis of Gibson’s theory. However, examination of the mean cooperation scores of children across the four conditions and the use of polynomial contrasts revealed that physical spaces that were the least (Condition I) and the most (Condition IV) differentiated, in that order respectively, had the lowest mean cooperative behavior scores, while those children in the physical spaces that were differentiated in ceiling height (Condition II) or wall color (Condition III), in that order respectively, had higher mean cooperative behavior scores. This suggests that a curvilinear relationship may exist between differentiated spaces and children’s cooperative behavior.

Differentiated spaces in the present study, whether in ceiling height or in wall color, appeared to increase children’s cooperative behavior scores. Physical spaces where ceiling height and wall color were both undifferentiated or differentiated appeared to depress children’s cooperative behavior scores. Perhaps the space with undifferentiated ceiling height and wall color was not stimulating enough to enhance children’s cooperative behavior. The space with differentiated ceiling height and wall color was too stimulating for preschool children, particularly when considering the
small size of the room in which the differentiation took place (15’4" x 6’11"). It may be that a larger room with a variety of environmental space differentiations would have a different impact on children’s cooperative behavior (Gump, 1987).

Gender-specific Effects

According to gender theory (Kwolek-Folland, 1995; Walker, 1993), differential socialization experiences exist for boys and girls in our society. Such socialization experiences have an impact on children’s behavior. For girls, socialization experiences reinforce more prosocial and cooperative behaviors while, for boys, these experiences reinforce more aggressive behaviors. On the basis of gender theory, it was predicted that girls would display more cooperative behavior than boys (Hypothesis 2). Findings from the present study provided opposite results; boys were found to have significantly higher levels of cooperative behavior than girls. Such a contradictory finding was confusing in light of past theory and research, however, a number of explanations can be offered for this discrepant finding.

First, the cooperative behavior of children in this study was assessed in mixed-gender group situations involving two boys and two girls. In any group situation, gender theory (Hein, 1993) would suggest that, due to their socialization experiences, boys will display more assertive behaviors than girls, since boys have been allowed more freedom to express these behaviors than girls in social interaction situations involving both boys and girls. Girls are likely to show more withdrawal behaviors than boys in such situations. If cooperative behavior can be interpreted to be among
behaviors associated with social assertiveness, then boys would be expected to display more of them than girls in such mixed-gender group situations.

The above discrepant finding may be due to the sampling procedures used, particularly with respect to boys in the present study. In inviting children to participate in the present research project, boys who refused to participate were not forced to become participants. Only boys who showed a willingness to participate in this study were used as subjects. As a result, the sampling procedures used may have favored the selection of more cooperative boys than average. For girls, problems in sampling selection did not occur since all girls that could did participate in the study. The oversampling of cooperative boys in the sample can be used to explain the high cooperative behavior scores among boys in this sample in comparison to girls.

Condition X Gender Effects

On the basis of both gender theory and Gibson's ecological theory, it was also predicted that the interaction between Condition and Gender would make a significant impact on children's cooperative behavior scores. Girls were expected to show higher levels of cooperative behavior in a space with differentiated ceiling height and wall color (Hypothesis 3), and boys were expected to show higher cooperative behavior scores in a space with undifferentiated ceiling height and wall color (Hypothesis 4). Findings of the present study provided no support for such hypotheses.

There are few studies relating gender to space. The above-stated hypotheses were predicted based on a limited number of studies. However, as indicated previously,
due to the oversampling of highly cooperative boys in this study, such a proposition
could not be adequately tested. Therefore, future investigation of this relationship
would be beneficial to illuminate the interaction of gender and visual perception theory
on understanding children's cooperative behavior.

Age Effects and Condition X Age Effects

On the basis of developmental research on children's cooperative behavior
(Paulson, 1974) and Piaget and Inhelder's (1967) ideas on children's perceptual
abilities, it was predicted that both Age and the interaction effect of Condition and Age
would make a significant impact on children's cooperative behavior scores. More
specifically, older children were expected to show higher levels of cooperative behavior
than younger children (Hypothesis 5), and older children were expected to show higher
levels of cooperative behavior in differentiated spaces than younger children
(Hypothesis 6).

Hypothesis 5 was predicted on the basis that the social abilities of young
children occur developmentally from solitary to cooperative play behaviors (Paulson,
1974) during the preschool years as they become less egocentric and more capable of
taking the perspective of others (Piaget, 1954). Thus, older children would be expected
to be more cooperative than younger children. Findings of the present study supported
this proposition, indicating that cooperative behaviors emerge developmentally during
the preschool years.
Hypothesis 6 was predicted on the basis that, as children grow in their cognitive capacities, they are much more able to use their cognitive capacities to adapt to differentiated environments, thus facilitating their behavioral development (Piaget & Inhelder, 1967). Due to their increasing cognitive capacities, older children are more capable of utilizing information gained from changes in the physical environment for their development than young children. Younger children may not be able to fully comprehend the complexity of differentiated environments. Therefore, older children were expected to show higher levels of cooperative behavior in differentiated spaces than in undifferentiated ones. Findings from the present study did not provide support for this hypothesis. A possible reason for this may be due to the relatively small sample size used in this study to examine the interaction effects of this study. A larger sample would have allowed for a more adequate test of the interaction between age and space differentiation on children’s cooperative behavior.

Limitations and Suggestions for Future Research

Although attempts were made to control for a number of limitations associated with this study, a number of other limitations were encountered that may have influenced the results of this study. These are summarized below and provide the basis for some future research suggestions.

First, the nature of the sample used in this study had a number of problems. The sample consisted of children from the Oregon State University Child Development Center, consisting of Anglo-American families predominantly of the upper-middle
class. Generalization of findings beyond this sample would be impossible. Future studies could use a more varied sample including children from various cultural and socioeconomic class backgrounds to examine the contributions of these variables and their interaction with physical space to children's cooperative behavior. A study by Hall (1966) on the relationship between culture and space suggests that such a study would be worthwhile. Furthermore, the small size of the sample used in the present study did not allow for an adequate test of some of the interaction effects of physical space and the variables of age and gender on children's cooperative behavior. Larger samples relative to these variables would allow for a more adequate test of these propositions.

Second, necessary changes in the study design that occurred due to unexpected circumstances led to additional study limitations. The use of two children who participated in two groups twice, as well as the replacing of one boy and one girl in the other groups, certainly affected the results obtained. In addition, the oversampling of boys who were highly eager to participate in the study, while others refused, appeared problematic in adequately testing several of the gender-specific hypotheses proposed in the study. Furthermore, the difficulty of establishing pure age groups of older, middle, younger children, rather than some mixed-age groups of children, made it difficult to adequately decipher the Age X Condition interaction effects of interest in this study. The procedures utilized in future studies should take care in seeing that these limitations are minimized.
Third, a few problems in data collection were encountered that need to be discussed. Although the videotaping of most of the children's cooperative behavior occurred without incident throughout the study, in a few circumstances, due to the stationary nature of the video camera in the room, the range of the camera was not able to record the behaviors of a few children outside its range. These children's overall average scores were used to fill these missing data points. T-tests revealed no significant differences between the average scores of children as a result of these mean substitutions. Future studies should be cognizant of the range of the video camera equipment so that no data are lost in videotaping. The most difficult aspect of the data collection procedures was children's absences from school. There were several days during which data collection could not occur because of the absence of children in the preset experimental groups that were scheduled to be videotaped on a particular school day. This extended the data collection period over a longer period of time than expected. Future studies could use a different data collection design; randomly selecting groups of children on each day for exposure to the Experimental Conditions.

Fourth, some suggestions relative to training the raters of the videotapes containing children's cooperative behavior are presented. The presentation of clear and concise definition of terms, ample amount of time for questions, and practicing using Paulson's Preschool Test of Interpersonal Cooperation Scale (1974) is imperative. In the present study, raters were able to reach a satisfactory level of interrater reliability at two points in the data collection process; however, reliability increased from 72% agreement to 87% at the second reliability assessment, indicating that the pre-rating
reliability could have been increased beyond 72% agreement. Future studies, therefore, should expect raters to reach at least 80% agreement prior to rating the actual data. It should also be noted that the raters used in this study were all female college students. The fact that all females were utilized in rating the data may have affected the results obtained, particularly in light of the finding associated with cooperative behavior scores of boys. Future studies should include men in addition to women as raters.

Finally, issues can be raised associated with the adequacy of space used to define the Experimental Conditions of this study. At points, the researcher felt the space appeared somewhat small for four children to play in comfortably. This was particularly noticable when the researcher was present in the room at the beginning and end of the Experimental Condition treatment time. Future studies, therefore, might wish to use a larger space, or different sizes of space in conducting this kind of investigation. In addition, only one change in ceiling height and/or wall color was used to define the Experimental Conditions. Although this was done for experimental purposes, changes in physical spaces in children’s classrooms are much more elaborate and complex. Future investigations might wish to capture and define more realistic kinds of physical spaces to do research with young children. For example, an ecological study in which spaces and color are varied in children’s actual preschool classrooms would be worthwhile. Most studies on the effect of physical space on children have been done on what Kennedy (1991) suggests as the impact of adult-imposed designs on children as opposed to understanding the effects of space from children’s perspective. A significant future investigation might involve a qualitative
study focused on interviewing children about their own preferences regarding spaces that would provide useful information to administrators and planners of environmental spaces for children.

Implications of Findings

This study was an investigation into the relationship between differentiation in the physical environment and children’s cooperative behavior. The results of this study suggest that differences in ceiling height or wall color positively affected children’s cooperative behavior. Such findings can be used to alert administrators and planners in the design of preschool facilities to become more aware of how changes in the physical space can affect children’s behavior. For example, in the present study, simply lowering a portion of the ceiling height did have a positive impact on children’s cooperative behavior. Thus, differentiating space using different ceiling heights in children’s classrooms can be used to facilitate children’s behavior. Differentiated wall color also made a positive impact on children’s cooperative behavior. The simple addition of one colored wall in the physical space appeared to have a positive impact on children’s cooperative behavior. Use of different colors in children’s classrooms, therefore, is another way in which to facilitate children’s behavioral development. Changes in ceiling height and wall color need not be overly expensive or permanent. Netting or fabric attached to ceilings and wall areas can help to define spaces for children. Similarly, selected walls can be inexpensively painted to provide differentiation in environmental layout.
Caution must be taken relative to these changes in children's physical space. The combination of changes in physical space including ceiling height and wall color together, like those with no differentiation in space or color, appeared to depress the display of cooperative behavior among children. Perhaps, where spaces are undifferentiated, providing no positive stimulation to young children, more highly differentiated spaces are overwhelming to young children, thus inhibiting their behavioral development. Administrators and planners of children's play spaces, therefore, must be cognizant of how overly simple or highly complex environments can negatively impact on children's development.

Aside from findings associated with the relationship between the physical environment and children's cooperative behavior that were obtained, additional findings related to the variables of gender and age of children and children's cooperative behavior should be taken into consideration by administrators and planners of children's environments. Both gender and age differences were found relative to children's cooperative behavior. While the gender differences found were opposite those expected on the basis of previous theory and research, possibly due to the oversampling of cooperative boys in this study, the development of physical spaces which enhance the development of children of both genders, rather than favoring one over the other, would be most worthwhile. If administrators and planners want to create physical environments that facilitate the development of children of all ages, their developmental abilities must be taken into account in designing these environments.
BIBLIOGRAPHY


APPENDICES
APPENDIX A

Human Subjects Approval Letter

March 12, 1996

Principal Investigator:
The following project has been approved for exemption under the guidelines of Oregon State University's Committee for the Protection of Human Subjects and the U.S. Department of Health and Human Services:

Principal Investigator(s): Jeanette Brandt
                        Alan Sugawara

Student's Name (if any): Marilyn A. Read

Department: AIHM

Source of Funding:

Project Title: The Impact of Space and Color in the Physical Environment on Children's Cooperative Behavior

Comments:

A copy of this information will be provided to the Committee for the Protection of Human Subjects. If questions arise, you may be contacted further.

Sincerely,

Mary E. Nunn
Sponsored Programs Officer

cc: CPHS Chair
March 15, 1996

Dear Parent,

An interesting research activity is being planned for Spring term 1996. As part of my doctoral program I will be conducting a Space/Color project. I am a doctoral student in Apparel, Interiors, Housing and Merchandising. My program is being supervised under the guidance of Jeanette Brandt, Professor of Housing, and Alan Sugawara, Professor of Human Development & Family Sciences.

The Space/Color project will look at child interactions in varying environments. Your child will be assessed for color deficiency or color blindness. Then your child will go with a small group of classmates to a room here at the Center. The room will present toys and blocks that children enjoy. The small group sessions will last about 10 minutes. We will be changing the room space and color to find out whether such changes will affect children's cooperative behaviors. If at anytime your child does not wish to participate in the activities, he or she will not be required to do so. Usually, however, children enjoy the game format of these experiences.

Children will be videotaped during the sessions. Later, trained observers will view the videotapes to assess children's cooperative behaviors. Observers will not know the identity of the children in the videotapes. In this way your child's anonymity will be preserved.

We need your permission in order for your child to participate in the space/color project. Please fill out the form attached and return it to me at the Child Development Center by Friday, March 29, 1996.

The design of preschool environments is a growing area of interest to educators and many parents. Your child's participation will help us learn more about the effects of space and color. We very much appreciate you and your child's involvement in this project!

If you have any questions, please contact me at (541) 737-0982, Jeanette Brandt at (541) 737-0994, or Alan Sugawara at (541) 737-1078.

Thanks most kindly.

Sincerely,

Marilyn A. Read
Doctoral student

Alan I. Sugawara
Professor

Jeanette Brandt
Associate Professor
APPENDIX C

Parent Consent Form

Space and Color Research Project

My child ____________________________ may participate in the space/color research project at the OSU Child Development Center. I understand that my child may choose not to participate at any time.

Please sign here ____________________________________________ (parent)

date ____________________________
APPENDIX D

Socioeconomic Status Information Sheet

OSU Child Development Center

Background Information

The following information pertains to your immediate family background and helps staff and researchers at the center better describe the background of families who attend the OSU Child Development Center Preschool Program. All responses are held strictly confidential and are reported summatively to represent all enrolled families.

1. Please indicate your marital status. Check.

   ______ Married ______ Single ______ Other

2. What is your occupation? (Specify)

3. What is your spouse's occupation? (Specify)

4. Occupation part-time or full-time? (Check one)

   Mother ______ part-time ______ full-time

   Father ______ part-time ______ full-time

5. Estimate the number of hours worked each week:

   Mother _______ Father ______

Estimate your occupational income:

   Mother (check one) ______

   ______ Under $8,000 ______ $ 8,001 - $20,000 ______ $20,001 - $30,000 ______

   ______ $30,001 - $40,000 ______ $40,001 - $50,000 ______ $50,001 - $60,000 ______

   ______ $60,001 and up

   Father (check one) ______

   ______ Under $8,000 ______ $ 8,001 - $20,000 ______ $20,001 - $30,000 ______

   ______ $30,001 - $40,000 ______ $40,001 - $50,000 ______ $50,001 - $60,000 ______

   ______ $60,001 and up

6. What is the last grade you (as well as your spouse's, if it applies) completed school? Check one.

   Wife ________

   none ________ 1-6 grade ________ 7-9 grade ________ 10-12 grade ________

   12 grade or GED ________ College non-graduate ________ College graduate ________

   College graduate ________ Graduate training ________ Graduate degree ________

   Husband ________

   none ________ 1-6 grade ________ 7-9 grade ________ 10-12 grade ________

   12 grade or GED ________ College non-graduate ________ College graduate ________

   College graduate ________ Graduate training ________ Graduate degree ________
## APPENDIX E

### Congenital Color Deficiency Score Sheet

**Score Sheet**

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<td>19</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

| Total     |        |            |

**Result:** Normal

Protan

Deutan

Others

**NB:**
1) Nos. 1—4 are demonstration plates.
2) Encircle the number read by the subject.
3) When two numbers are identified, encircle either of the two that is better read.
4) Obtain the sum of the circles in each column and if normal response is 8 or more, the subject is determined as normal.
5) Classify as protan or deutan according to the greater number of the circles in those columns.

[Standard Pseudoisochromatic Plates  IGAKU-SHOIN]
APPENDIX F

Floor Plan of Space

SCALE 1/4" = 1'0"
<table>
<thead>
<tr>
<th>Tape #:</th>
<th>Space/Color Project Scale</th>
<th>Coder:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5: Cooperation, 4: Pre-Cooperation, 3: Parallel, 2: Watching, 1: Minimal Interaction, 0: Obstructive Interaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name/Time</td>
<td>Minute 1</td>
<td>Minute 2</td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>1</td>
<td>1 2 3 4 5</td>
<td>10 20 30 40 50</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
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<td>5</td>
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<td>6</td>
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<td>7</td>
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<td>8</td>
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<td>9</td>
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<td>10</td>
<td></td>
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<tr>
<td>11</td>
<td></td>
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</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Note:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>