

THE RELATION BETWEEN THE RATIO OF CHILDREN PER ACTIVITY AREA AND OFF-TASK BEHAVIOR AND TYPE OF PLAY IN DAY CARE CENTERS

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ABSTRACT: Given the explosion in growth of out-of-the-home child care, increasing attention is being focused on the developmental consequences of early childhood environments. The authors show that the ratio of children to the number of activity areas in the classroom is positively correlated with off-task time. There is also a marginal, negative correlation to engagement in constructive play. Use of hierarchical linear modeling allowed the authors to examine these processes in a repeated measures design, with controls for center and for family income.

Keywords: children; education; school; density; attention

Sixty-four percent of mothers with children under the age of six are currently in the labor force. As a result, nearly three quarters of children ages three through five are cared for by someone other than a parent (Children's Defense Fund, 2000). More than half of all preschool-age children are enrolled in a center-based program (U.S. Department of Education, 2002). Because large numbers of children spend a considerable portion of their day in day care centers, it is critical to learn more about the potential developmental impacts of these settings.

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An issue frequently overlooked on concerns about developmental impacts of nonparental child care is the impact of the physical setting on children's well-being. What, exactly, are the effects of environmental factors such as crowding and density on preschool-age children? Do children behave differently in environments varying the richness of play materials or resources? How does the spatial arrangement of the room affect their play?

Over the past few decades, environmental psychologists have attempted to answer some of these questions. The present study examines a topic from a different perspective, one on which researchers have previously found conflicting evidence: density and resources and their effects on children's play and nonplay activities. In particular, we are interested in understanding the potential role of resource availability in day care settings, focusing specifically on the ratio of children to activity areas in the classroom.

Although theories abound on the meaning of play in children's lives, modern psychologists such as Piaget and Vygotsky agree that play has an important role in the cognitive development of children, helping them learn and promoting abstract thought. Selfridge (1998) argues that play influences all aspects of child development:

Play promotes physical development[,] . . . enhances cognitive development[,] . . . improves imagination and creativity[,] . . . promotes memory and use of memory strategies...promotes storytelling and fosters reasoning abilities[,] . . . promotes communication development . . . [and] social development[,] . . . [and] helps children to develop emotionally. (pp. 50-51)

Though play is extremely important in the development of children, as expected, not all children's time is spent at play, even during so-called free play time in day care centers. Although children have the opportunity to play, many often engage in some form of nonplay, such as onlooking (watching others playing without participating) or other off-task behaviors. Certain children tend to engage in aggressive behavior, such as hitting other children. Duration and type of play behavior is influenced by several variables, such as age or socioeconomic status. The environmental psychology literature also

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catalogs a number of variables found within the physical setting that are associated with changes in play behavior. Many of these are summarized below.

Several studies have looked at the effects of crowding and of density (number of people in relation to the square footage) on preschool populations (see Gump, 1975 for a comprehensive review of these data). Maxwell (1996) found that children in both high-density homes and in day care centers were more susceptible to behavioral problems, as rated on a scale including hostile-aggressive, anxious-fearful, and hyperactive-distractable subscales. In this study, children in high-density day care centers also tended to score lower on a test of cognitive ability. Loo (1972) found that under high-density conditions, normal and low-anxiety five-year-old children tended to reduce their level of activity and face out (face the corner or the wall of the room). There were also fewer interactions with other children and more solitary play in the high-density situation, but there was no effect on onlooking. Loo and Kennelly (1979) found that under crowded conditions, five-year-olds experienced more distress and nonplay.

Rohe and Patterson (1974) performed an experiment examining density and level of resources in day care centers. They altered a day care environment to create two levels of density (low and high) and two levels of resources (low and high). They found that an increase in density in day care centers was associated with more time spent in unoccupied, aggressive, and destructive behaviors. This effect was moderated by resources with the impacts accentuated under the low-resource condition.

An early study of outdoor-play equipment examined playgrounds with varying levels of resources and found that less extensively equipped playgrounds tended to foster greater social contacts among children, but they experienced less exercise and play with materials and an increase in social conflicts (Johnson, 1935). With regard to indoor play equipment, one study found that when there is less play equipment per child, both aggressive behavior and rough-and-tumble play increased. Aggressive play increased because the majority of conflicts among children of this age appear to stem from possession of play materials (Smith & Connolly, 1977).

Some researchers have combined the two aforementioned independent variables, looking at both the amount of physical resources and the spatial density and their effects on preschoolers. Smith (1974) found that decreasing the amount of play equipment led to increases in agonistic or aggressive behavior. However, he did not find a significant effect of spatial density on aggression.

Smith and Connolly (1986) also examined both density and resources in their experimental studies on English preschool environments. In contrast to Rohe and Patterson (1974), who had found an increase in unoccupied

behavior with greater spatial density, Smith and Connolly instead found that when there was more space per child, looking around in the distance and watching behavior increased.

The aforementioned apparent contradiction forms the basis of the current study. Spatial density has been found to be related both to more and to less unoccupied behavior. Because authors such as Rohe and Patterson (1974) found interactions with density and resources, the goal of the present study is to examine both of these variables with regard to children's unoccupied behavior. Because the measures of density (square footage per child) and of resources (high vs. low) used in past studies led to this discrepancy in results, a new measure was created: the ratio of children per activity area in the classroom.

Activity areas (known also as learning centers, interest areas, activity centers, or activity settings) are "section(s) of the learning environment described by specific materials and physical boundaries" (Sanoff, Sanoff, & Hensley, 1972, p. 4). They can be delineated sections of the room or rooms, specifically for arts and crafts, block building, dress-up play, and so forth. Greenman (1988) further defines this concept by stating that activity settings have "boundaries and entries[,] . . . exist to accomplish tasks[,] . . . have size and shape and height[,] . . . surfaces for work or play[,] . . . personality[,] . . . [and] signals" (p. 137). Others describe them in the following way:

Interest centers are clusters of functionally related materials. Some are located around large or relatively permanent objects such as a sink, work bench, play house or piano. Others, consisting mainly of easily portable and storable objects, such as puzzles, blocks, and drawing equipment, require only storage space and floor or table space. (Texas A&M University, 1971, p. 42)

One study specifically examined activity areas and children's play behavior (Moore, 1986). In this study, the behaviors of children in day care centers with either well-defined (those with a "high degree of spatial differentiation from other settings") partially defined, or poorly defined (those where the "actual or implied spatial definition is low, where the area is too large or too small for the group size, and/or where the resources and work surfaces are not readily available for the particular activity") behavior settings were investigated (p. 208). Though it was hypothesized that there would be a difference in engaged versus withdrawn or random (nondirected) behaviors in the different types of settings, this did not prove significant. However, the most intense level of engagement was found in the well-defined behavior settings. The highest degree of exploratory behavior and social interaction also took place in the well-defined settings. The independent variable of interest,

degree of definition of behavior settings, was related to the number of these settings in the room; specifically, the centers with better defined behavior settings also had more of them. However, the potential impact of the number of such settings was not analyzed.

To better understand how this particular variable might impact children's behavior, we chose to examine the ratio of the number of children in the space per number of activity areas. Instead of simply a sheer count of the number of activity areas in the room, this ratio measure was chosen because it seemed more comparable to that of density (square footage per person), as described above. Furthermore, several density studies have found that density, rather than amount of space or number of rooms or number of people is the prime predictor of adverse outcomes—problems regulating social interaction appear to be the root cause of crowding (Evans, 2001).

As cited previously, the research on density, access to resources, and spatial definition offered contradictory results with regard to amount of withdrawn and of unoccupied behaviors. Thus, in the present study, no direction was assumed; that is, it was unclear whether a difference in child-per-activity-area ratio would correlate with more or less off-task or unoccupied time among this sample of preschoolers. We also explored whether the type of play would differ with varying child-per-activity-area ratios.

METHOD

DESIGN

This study used observational data to assess children's behavior during free play in three different day care settings. The settings were varied in terms of layout, (e.g., total square footage, usable space, number of activity areas) general quality, and number of children. The particular independent variable of interest was the ratio of children per activity area. Specifically, this was the number of children in the classroom at the time of the observation divided by the number of clearly delineated spaces for different types of play activities, such as a reading corner with a bookcase and a carpet. Throughout this article, this variable will hereafter be referred to as the *child/activity area ratio*. To understand more clearly what is meant by an activity area, please see Figures 1 through 5 for photographs of examples of activity areas. Although the number of activity areas in each center was stable, the number of children in the classroom varied for each observation. Though each child was observed three times, the child-per-activity-area ratio was different for each observation.



Figure 1: Couch/Reading Activity Area in Center A

Largely to serve as controls, other information about each child was assessed through a small survey given to parents. This included the parent's highest level of education, total household income before taxes, child's birth date, and the length of time he or she had been in day care.

Quality of the center was determined by using a modified version of the Early Childhood Environment Rating Scale (ECERS) developed by Harms, Clifford, and Cryer (1998). This included an assessment of space and furnishings, room arrangement, and resources for activities.

PARTICIPANTS

Participants recruited for this study were children age four- and five-years old, chosen from three day care centers. Those eligible for the study were enrolled in classrooms of children three- to five-years old and had been attending their center for at least 6 months. Children who had disabilities or



Figure 2: Pretend-Play Activity Area in Center B

other conditions (e.g., autism) that could have affected their play behavior (as described by the teacher) were not included. Overall, 21 children (8 male and 13 female) participated in the study. The average age of the participants was 48.6 months ($SD = 7.9$). The average length of time in day care for the sample was 28.9 months ($SD = 15.2$).

Parental consent forms were obtained for all children participating in the study. In all, only two of the parents recruited for the study refused participation for their children (i.e., an 8.7% refusal rate).

SETTING

Three day care classrooms of three- to five-year-olds were selected for this study, each in a separate day care center. They were all located in small towns in upstate New York. Two of the centers contained additional classrooms for younger children as well, and the third was a home-based center enrolling only the age group targeted for this study.



Figure 3: Manipulatives Activity Area in Center C

Center A was located in the so-called downtown area of a small town. Its fees were based on a sliding scale, ranging from \$392 to \$628 per month in 2001. The classroom from this center used in the study had a total of 12 children. This main classroom, where the majority of observations took place, was 760 square feet and was divided into four activity areas (craft table, pretend play, couch and reading, and open carpet).

Center B was located in a more suburban or rural area of the town. The classroom was registered for 18 children but typically enrolled 14 at a time. This room was 672 square feet and was divided into four areas (open carpet, pretend play, reading, craft tables). Fees for care at this center in 2001 were also based on a sliding scale, ranging from \$504 to \$652 per month.

Center C was located in the lower level of the director's house in a suburban neighborhood and enrolled up to a maximum of 14 children at any given time. This center cost \$550 per month for full-time care that same year. It was 498 square feet and had six activity areas (craft table, blocks, painting and sand table, reading, pretend play and music, and manipulatives table).

DEPENDENT MEASURES

The outcome measures in this study were off-task behavior and type of play. Operationalized, off-task behavior was defined as the number of



Figure 4: Pretend-Play/Music Activity Area in Center C

seconds out of a 15-minute observation that the child was not actively engaged in any play activity, such as building with blocks, painting, or pretend play. Examples of off-task behaviors included onlooking (watching



Figure 5: Reading Activity Area in Center C

others play without participating or interacting), aggressive actions, lying on the floor, staring at the wall, and so forth.

Type of play, coded at 2-minute intervals, used the Parten-Piaget taxonomy (Johnson, Christie, & Yawkey, 1998; Rubin, Maioni, & Hornung, 1976; Rubin, Watson, & Jambor, 1978). This breaks play down into social categories of solitary, parallel (two or more children playing with the same material but not engaging each other), and group play. The activity is further conceptualized as being one of three cognitive types—functional (e.g., jumping, running, or moving a toy back and forth), constructive (e.g., block-building), or dramatic (pretend play).

There were two observers coding the children in the study, with each child having independent observations; the same child was not watched by both observers at the same time. The principal investigator trained the assistant extensively on the coding procedure in a university laboratory classroom. This room was equipped with an observation booth hidden by two-way mirrors so as to not pose much intrusion during the training period. Interobserver reliability (Ebel's intraclass correlation) was assessed to be .82 for the off-task time measurements. Reliability for social and for cognitive type of play (using kappa) was .43 and .81 respectively. According to Landis & Koch (1977), these are moderate and almost perfect levels of reliability.

PROCEDURE

To assess the relation between child/activity area ratio and preschoolers' play behaviors, three separate 15-minute observations of each child were performed. These took place on different days over a period of 3 months. After an initial count of the children in the room before each observation, time spent in off-task behavior was assessed over the 15-minute period using a stopwatch. The social and the cognitive types of play were coded seven times during the 15-minute observations at 2-minute intervals.

RESULTS

Table 1 depicts the zero-order correlation matrix for all the major variables.

Descriptive analyses showed that the child/activity area ratio ranged from 1.25 to 4, with a mean of 2.2 ($SD = .61$), and off-task time ranged from 17 to 510 seconds, with a mean of 203 ($SD = 126$). Because these two variables of interest were correlated ($r = 0.44, p < .000$), the direction of this relationship was determined. An initial plot of this relationship revealed a linear, positive trend, with more off-task time occurring when the child/activity area ratio was higher (i.e., when there were more children per activity area).

A proc mixed procedure was then performed using the software program SAS (Singer, 1998). Because there was a time-variant independent variable in a repeated measure design, proc mixed also enabled us to statistically include child as a random-effect variable. Day care center was initially put in the model as an additional control, but because it was not significant, it was not included in the final model. Table 2 shows the results of the analyses. Each beta is independent (as if last entered).

As can be seen, an increase of one in the child/activity area ratio would yield an increase of 67.77 seconds in off-task time. This is independent of income. Initial tests revealed no interactions of either gender or income with the child/activity area ratio.

The other dependent variables measured—social and cognitive types of play—were recoded as percentage of time (number out of seven times coded) that the child engaged in each type of play. Of the six types of play (functional, constructive, dramatic, solitary, parallel, and group) only constructive play marginally increased when the ratio of child to activity areas was lower ($b = -.13, SE = .08, t = -1.61, p < .11$).

TABLE 1
Correlation Matrix

	ECERS	Square Feet	Usable Square Feet	Gender	Age	Time in day care	Income	Education	Child/Activity Area Ratio	Off-Task Time
ECERS	1.00									
Square feet		1.00								
Usable square feet			1.00							
Gender				1.00						
Age					1.00					
Time in day care						1.00				
Income							1.00			
Education								1.00		
C./A.A. ratio									1.00	
Off-task time										1.00

NOTE: ECERS = Early Childhood Environment Rating Scale; C./A.A. ratio = child/activity area ratio.

* Correlation significant at the .05 level (two-tailed).

** Correlation significant at the .01 level (two-tailed).

TABLE 2
Linear Regression of Income and of Child/Activity Area Ratio on Off-Task Time

<i>Effect</i>	<i>b</i>	<i>SE</i>	<i>df</i>	<i>t</i>	<i>Probability</i>
Intercept	175.59	90.79	19	1.93	.0681
Child/activity area ratio	67.77	24.68	41	2.75	.0089
Income	-37.55	17.15	41	-2.19	.0343

DISCUSSION

The initial hypotheses of this study were that the ratio of children per activity area would influence the amount of time spent in play, as well as the type of play. Based on observations of preschoolers at three day care centers, these hypotheses were supported. There was indeed a significant relation between the ratio and the time children spent off-task. Specifically, the higher the ratio (meaning the more children per activity area) the greater the time they spent off-task, or not at play. This is similar to Rohe and Patterson's (1974) finding that an increase in density was associated with an increase in time spent in unoccupied behavior.

To clarify the findings of the present study, because the independent variable was a ratio, higher levels could mean either that there were more children in the space, that there were fewer numbers of activity areas, or a combination of both the numerator and the denominator. Because neither the number of children in the room nor the number of activity areas alone predicted off-task behavior after controlling for the many demographic and center-related variables, it is evident that there was an important connection regarding how many children shared space and resources within a day care center and how they behaved.

The results imply that when there are fewer children to share delineated spaces for play, or rather, when there are more choices of private areas to go within the classroom, children's attention toward their play is held longer. Because there was no difference whether children played alone or with others, this does not mean that children are seeking places to be alone to concentrate on their play. Instead, they merely play longer in spaces where there are greater opportunities and choices of low-density activity areas. Likewise, when there are many children in the space and not many choices of areas, the children do not play as much.

One reason this may occur is withdrawal. Consistent with crowding research, when there are many people in a space, withdrawal behavior occurs because of overstimulation (Evans & Lepore, 1993). If there are too many

children in each activity area in a day care center, they may cope by tuning out and by not playing or interacting with others. Or they may want to play but cannot because there are other children already in the space using the resources. Though it is not possible to know the thought processes that the children are using when they are deciding what to do, some anecdotal evidence from the observations may shed light on this topic. One girl who was observed literally withdrew from the group, walked over to the wall, and stood staring at the wall for several minutes. A more common situation occurred when children would go toward a small craft table where two or three others were sitting playing, look over their shoulders at the activity for a short period of time, and then go to a different part of the room to play.

The second hypothesis, which was only marginally supported, was that type of play would differ accordingly with the child/activity area ratio. As explained in the results section, only constructive play was marginally related to the child/activity area ratio, with this type of play more likely to occur when the child/activity area ratio was lower. That there would be a relationship with constructive play makes sense; constructive play is typically dependent on both resources and space. One needs specific types of materials and some amount of open space to build a structure out of blocks or to create an art project. It is also helpful to have a clearly delineated activity area that is not too crowded so that other children do not interfere with the project (e.g., imagine a child constructing a large building out of blocks in an open area and others knocking it down accidentally). However, a larger sample size would be necessary to draw clearer, more definitive conclusions.

Though the major hypothesis of this study was supported, there are some clear limitations of the research design. One problem is the lack of random assignment to conditions. Parents choose the center in which to place their child. On the other hand, as noted, in an initial two-level hierarchical linear modeling analysis, center was not a significant factor. It is also worth reiterating that we controlled for income.

Second, there is always the question of intrusiveness when there is an observer watching subjects. Aside from having a stranger in the classroom watching the children, the presence of any extra adult in the room could impact children's behavior. Especially because the study's independent variable was a measure similar to crowding, more people in the room may certainly be a salient issue. It should be noted that the children's response to the observers varied between centers. In Centers A and B, the observers were almost entirely ignored throughout the whole study. However, in Center C, during each observation, some children immediately came over to talk to the observers, sit in their laps, and try to get them to play with them. To decrease observer reactivity, the observers first allowed a few minutes to elapse before

the observations so that the children could become comfortable with the initial presence of new adults in the room. During the observations, they tried to remain as unobtrusive as possible, sitting still in the corner or behind a bookcase when possible. Eye contact with the child being observed was also minimized.

Creating a longitudinal study over a longer time period might also strengthen this study. Ideally, more than three observations per child and a larger number of centers could be examined. Another valuable addition to the research design would be to include general at-risk children (e.g., those of difficult temperament). This would enable us to examine whether certain characteristics of children make them more vulnerable to elevated levels of the child/activity area ratio.

Henry Sanoff (1995) has previously suggested that indoor play and learning environments contain five to six of the following types of learning centers: art, block play, cooking, construction, dramatic play, indoor active, listening, large group, manipulative, math, music and movement, reading and prewriting, sand and water, and science. He also recommends the following:

Circulation paths that are meandering rather than straight will discourage children from running. This is further enhanced by subdividing the playroom with furniture, partitions, and varying floor levels. Avoiding large open spaces will decrease aggression and minimize children's excessive motion. (p. 41)

Certainly, other aspects of activity-area design might be important, such as their size, visual access to other areas of the room, adjacencies (which activity areas are next to each other), or the flexibility of use within the activity area. Variety and complexity of the activities may also have an impact (Kritchevsky & Prescott, 1969). Additionally, Kounin and Sherman (1979) suggested that holding power of play settings may be dependent on type of activity or resources present.

To summarize the results of the present study, among preschool-aged children, higher child/activity area ratios were associated with greater levels of off-task time and with a somewhat lower likelihood of engaging in constructive play. These relations held true after controlling for income. Further research is needed to determine whether there is a causal relationship between these variables, but they seem to imply that certain design guidelines are in order. Specifically, if the number of children using the space cannot be decreased, the preschool classroom should be broken down into many well-defined spaces for different activities. Even if the room is small, it appears that the ratio of children per activity area is more important when predicting

off-task time than are square footage or density. Because previous studies have conflicting data on density and play, it is not possible to offer designers recommendations for spatial requirements. Instead, how the space is arranged, and how many activity areas there are may be important. Well-defined activity areas that provide a range of age-appropriate materials and that are numerous enough to keep the child/activity area ratio small are likely to foster more play in day care centers.

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