AN INVESTIGATION OF YOUNG CHILDREN'S DYADIC SOCIAL PROBLEM-SOLVING STRATEGIES USING CONVERGENT AND DIVERGENT COMPUTER SOFTWARE FORMATS

by

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ABSTRACT

Title of Dissertation: An Investigation of Young Children's Dyadic Social Problem-Solving Strategies Using Convergent and Divergent Computer Software Formats

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This study compared the social problem-solving strategies of 24 peer dyads using convergent and divergent computer software formats. Randomly paired same-sex, same-age preschool and kindergarten dyads were videotaped on two separate days using either a convergent or a divergent computer software format. Measures of computer time, social interactions, cooperation strategies, conflict resolution strategies, and the flexible use of these strategies were computed for each computer software format. A series of multivariate analyses of variance with repeated measures on software conditions were performed to examine the contributions of age, software, and their interaction to these measures. Dyads in the divergent condition laughed more and divided

responsibility for the task less than did children in the convergent condition. Analyses revealed a significant multivariate software effect for cooperation strategies. Significant multivariate age x software interaction also appeared for cooperation strategies and flexibility. Older children in the convergent condition helped more and showed more flexibility than did younger children; but in the divergent condition, the direction of these differences were reversed. These findings suggest that even in children as young as 4-years-old cooperative strategies are adapted to the problem at hand. Social interactions are differentiated and used selectively for divergent and convergent situations. The implications of these results for early childhood educators and researchers interested in optimizing software use for young children are discussed.

DEDICATION

This dissertation is dedicated to the memory of my beloved mother and friend, Alice Elizabeth James Coleman, whose limited earthly possessions did not hinder her from abundantly giving her love, time, and patience. She imparted to her children the discipline of knowledge by teaching us the meaning of Proverbs 12:1-- "Whoso loveth instruction loveth knowledge...".

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TABLE OF CONTENTS

Section	Page
List of Tables	vi
Introduction/Rationale	1
Methods	16
Subjects	16
Pilot Study	18
Procedure	19
Design and Statistical Analyses	29
Results	29
Computer Time	30
Social Interaction	31
Cooperation and Conflict Resolution	33
Flexibility	36
Summary and Discussion	41
Implications of the Study	48
Appendix A Literature Review:	
Peer Interactions With Play Objects	52
Appendix B Instructions for Coding	
Videotapes	76
Appendix C Description of "Fantastic Animals"	
Divergent and Convergent Formats	80
References	82

List of Tables

Table		Page
1	Definitions and Examples of Codes	23
2	Means and Standard Deviations for Measures of Computer Time and Social Interaction	32
3	Means, Standard Deciations, and Univariate F and P for Cooperation and Conflict Resolution Strategies by Software	35
4	MANOVAS Social Problem-Solving Strategies	37
5	Means, Standard Deviations, and Univariate F and P for Flexibility in Strategies Use	39
6	Flexibility in Strategies Use	40
A	Studies Reporting Percentages of Play Behavior with Different Play Objects	59

INTRODUCTION/RATIONALE

Peer interaction has been widely acknowledged by psychologists and educators as a medium through which young children develop social competence (Weinstein, 1969; O'Malley, 1977; Hartup, 1979; White & Watt, 1973; Urbain & Kendall, 1980) and social skills (Rubin, 1986). Young children's social encounters with age-mates provide them with opportunities to cooperate, compete, negotiate, and resolve conflicts (Hartup, 1979). Children must practice these social skills to develop mature interpersonal strategies for functioning effectively in preschool and during later adulthood. For young children however, social interactions with same-age peers do not occur in a vacuum. Most peer contacts evolve around play objects, which may serve as a vehicle for enhancing or modifying the quality or quantity of peer interaction (Mueller & Brenner, 1977; Mueller & Lucus, 1975).

Observational and experimental investigations of the social value of traditional play objects provide evidence that certain play objects may have different influences on the social aspects of peer interaction. For instance, social play such as

cooperation is likely to occur with dramatic play objects and nonsocial or solitary play is likely to occur when children play with puzzles, playdough, and art materials (Pulaski, 1973; Rubin, 1977a, 1973; Hendrickson, Strain, Tremblay, and Shores, 1981).

SPECIFIC PLAY OBJECTS

Specific play objects, depending on whether they permit shared use, such as, housekeeping toys, blocks, puzzles, toy vehicles, paint and crayons, sand and water, wagons, slides, seesaw, balls, and more recently microcomputers, may determine whether or not peer interaction occurs (Quilitch & Risley, 1973; Hendrickson, Strain, Tremblay, & Shores, 1981). If peer interaction occurs, other object properties may determine whether or not this interaction is positive in tone or sophisticated in the social strategies emitted (Pulaski, 1973; Strayer & Strayer, 1976).

Although studies of specific play objects have made important contributions in documenting different types of play forms children engage in when using different play objects, these studies

yield only lists of particular objects and their effects on social behavior. They do not clarify what it is about these objects that affect social behavior and therefore do not provide general guidelines for choosing or designing play objects for the preschool classroom. Exactly how or why play objects influence children's social play behavior needs further investigation.

GENERAL DIMENSIONS OF PLAY OBJECTS

Researchers have recently begun to examine the influence of more general dimensions of play objects on peer interaction. Findings from these studies provide evidence that these dimensions of objects may modify the quality of peer interaction.

Complexity

To gain a better understanding of the dimensional aspect of objects, one of Berlyne's (1970) four collative variables--complexity, has been studied for its impact on children's play behavior. Complexity is defined as "...the amount of variety or diversity in a stimulus..." (Berlyne, 1970, p. 38). Berlyne (1970) proposed that children's preference for simple objects should

decline more rapidly with repeated exposure than their preference for complex objects.

Studies of the simplicity-complexity dimension suggest that a child's sustained responsiveness to a play object is a function of the play object's complexity (Gramza & Ellis, 1972; Scholtz & Ellis, 1975). Complexity of play objects has been operationalized in at least two ways: a) the number of parts an object consist of (Bishop, 1972; Gramza & Ellis, 1972; Scholtz & Ellis, 1975; Bloch, 1984); and b) the activity potential or number of things the object can do (Pepler, 1979; Pepler & Ross, 1980). Findings of studies examining these two aspects of complexity may provide a more complete understanding of the influence of play objects on peer interaction.

Number of Parts

Gramza and Ellis (1972) studied forty preschool children's responses to a traditional play object design, an A-frame climbing trestle differing in complexity. Complexity was defined by these researchers as, "... a measure of the number and variety of stimulus options and play functions

present within a piece of play equipment" (Gramza & Ellis, 1972, p.304). In this study, complexity was achieved by having one trestle left intact (X), a second trestle (C1) modified by adding sloping panels with hand-foot holes to both sides, while the third trestle (C2) had small and scattered panels with hand-foot holes on one side and horizontal bars left open for swinging on the other. A plank for walking was also added, along with a rope for swinging. It was found that children preferred the third trestle (C2) which had greater functional complexity (potential for responsiveness) than the intact trestle (X).

Scholtz and Ellis (1972) in a similar study, examined children's preference for objects differing in complexity and their preference for peers. It was found that with repeated exposure, children's preference for interaction with peers increased, while their preference for interaction with play objects decreased. However, this pattern was most striking when the play objects were lower in complexity. These researchers suggested that peer interaction may be sustained longer by high complexity objects than by low complexity objects

(Scholtz & Ellis, 1975); Gramza, Corush, & Ellis, 1972; Gramza, 1976).

Activity Potential--Convergent/Divergent Dimension

Pepler (1979) and Pepler and Ross (1980) studied a second aspect of complexity, the activity potential of an object, defined as the number of actions an object can perform. This feature was studied in a comparison of the effects of convergent and divergent play objects on children's problem solving behavior. These investigators defined convergent and divergent play objects as follows:

> **Convergent materials, such as puzzles, are those that elicit convergent processes to solve the problem posed by the materials to which there is only one answer. Divergent materials, such as blocks, on the other hand, pose no specific problem to be solved but elicit divergent processes by which the child may generate a wide variety of responses to the materials (Pepler, 1979, p.34).**

This definition was derived from Guilford's (1968) delineation of problem solving processes in his structure of intellect model. Convergent and divergent processes were viewed as two types of mental operations generated by organisms in processing information.

In both studies, children ages 3- and 4-years-old were permitted to play with five sets of nine piece puzzles with formboards (convergent materials) and the same nine puzzle pieces without the formboards (divergent materials). It was found that as a divergent play object the children performed a greater number of actions with the puzzle pieces without the formboards, than when the formboards were present. As a divergent play object, the children showed more flexible manipulation strategies. When interacting with a convergent play object, children used two-thirds of their time filling the formboards. They engaged in significantly less investigative behaviors.

Group differences were greater among the 3-year-olds than the 4-year-olds. More flexible manipulation strategies occurred in the 3-year-olds divergent play group than in the convergent play group. When playing with divergent objects, the manipulation behavior of 3-year-olds was greater than that of 4-year-olds. When tested subsequently on their ability to solve convergent and divergent problems, the divergent play group performed better than the convergent group on divergent tasks. Thus,

the flexible nature of divergent objects may lead to more mental flexibility (Pepler & Ross, 1980) and more playfulness (Lieberman, 1977) in children's responses to play objects, and conceivablely in their interactions with peers.

Microcomputer Software

Microcomputers and their accompanying software are appealing objects that are becoming increasingly accessible to children at the early childhood level (Chin, 1984; Wright & Samaras, 1986). With an estimated 25% of all licensed preschools in the country having microcomputers, Chin (1984) predicts that all preschools will have access to a microcomputer by the year 1989. Microcomputers in the homes of prechool children are also rapidly increasing. With the proliferation of microcomputers, there is growing increase in computer software to operate computers as well. Surprisingly, few studies have examined whether different software promotes or diminishes positive social behavior in children.

Research on the influence of dimensional aspects of play objects on children's play

behavior--especially the distinction between convergent and divergent play objects--provides a way of identifying a dimension of microcomputer software that might influence young children's social interaction. The question is whether social interaction is affected by software formats that differ in this manner. Whether the distinction between convergent and divergent play objects is applicable to the interpersonal strategies of peer dyads is not certain. Conceivably, the mental flexibility shown in children's use of divergent play objects in solitary play situations may extend to social play situations. This flexibility may lead to more diverse social behavior, and more diverse solutions to social problems.

Computer Software--Convergent/Divergent Dimension

Two studies suggest that the convergent/divergent dimension may be ascribed to computer software to account for the influence of microcomputer software on peer interaction (Borgh & Dickson, 1986; Clements & Nastasi, 1985). These two studies of software features, can be classified according to the convergent/divergent dimension. Borgh and Dickson (1986) studied preschool

children's use of two types of computer software. "Counting Bee" (Eduware) is a task-oriented program in which a smiling or frowning face identified a child's right or wrong response. This software meets Pepler and Ross', (1980) definition of a convergent material. In contrast, "Hodgepodge" (Dynacomp) displays graphics with each key press to promote keyboard exploration and letter recognition; it does not present problems with a right or wrong answer. Because children are allowed to generate a variety of responses, this software might be described as a divergent material.

Borgh and Dickson (1986) found that children's pattern of interaction and verbal statements were influenced differently by these two types of software. The convergent type software elicited verbal interactions about right and wrong responses and facilitated more peer teaching. The divergent type software, on the other hand, elicited more hypothesizing and wondering about how the computer worked. The researchers stated that, "Software characteristics exert considerable influence on children's verbal interactions" (Borgh & Dickson, 1986, p.41).

In a similar study comparing the effects of Logo (divergent in nature) and Computer-Assisted Instruction (convergent in nature) on first and third graders social-emotional development, Clements and Nastasi (1985) did not find differences in frequency of children's sharing, comforting, or cooperative work. However, children working with Logo expressed more pleasure in their discoveries of new information and resolved interpersonal conflicts more successfully. Findings from this study suggest that divergent type software may enhance postive social interactions more than convergent type software.

Findings from these two computer studies are based on children's interactions across two different computer programs and, therefore, other features of these programs might account for these differences. When the computer software contains both convergent and divergent features that can be manipulated within the same content and display, a better assessment of the impact of this dimension on the quality of children's interaction might be obtained. The present study used the same software program in either convergent or divergent formats.

Cooperation and Conflict Resolution Strategies

Borgh and Dickson (1986) suggested that the different software programs may influence verbal interactions and actions relevant to the computer task at hand. While one computer task elicited more helping and peer teaching, the other elicited verbal statements on how the program operated. Dyadic interactions with different computer software may include a variety of positive interactions in a cooperative effort to operate the program. On the other hand, Nastasi and Clements (1985) found that with the divergent type software, children resolved conflicts more successfully. These studies suggest that young children may display different forms of cooperative and conflict resolution strategies when engaged in different software formats.

Paulson et. al (1970) delineated cooperation and conflict resolution strategies relating to the interpersonal functionings of 3-and-4 year-olds. The cooperation strategies consisted of distributing, exchanging, and combining skills and resources. The conflict resolution strategies were decision mechanism, compromise, distraction, adaption, intervention, separation, intimidation,

fighting, and conning. Other studies have used similar definitions of these interpersonal strategies in the social interactions of young children and have documented their increasing sophistication (i.e. Getz, 1970). The extent to which different software formats influence the frequency and flexibility of young children's use of these cooperation and conflict resolution strategies was the focus of the present study.

Purpose of Study

The purpose of the present study was to compare dyadic social problem-solving strategies of young children when using different computer formats. More specifically, the study compared the frequency and flexibility of cooperation and conflict resolution strategies of young same-sex, same-age peer dyads while engaged in a divergent or a convergent computer format.

The present study was designed to address the following research questions:

1. Will peer dyads spend significantly more time at the computer when they are

engaged in the divergent format than when they are engaged in the convergent format?

2. Will there be a significant difference in time spent in interaction when peer dyads are engaged in the divergent format compared to the convergent format?

3. Will peer dyads engage in significantly more cooperative and conflict resolution strategies in the divergent format than in the convergent format?

4. Will peer dyads display significantly more flexibility in their use of cooperation and conflict resolution strategies when they are engaged in the divergent format compared to the convergent format?

5. Will older peer dyads display significantly more cooperation, more conflict resolution strategies, and more flexibility than their younger counterparts?

The following hypotheses were assessed: 1) dyads will spend more time at the computer when engaged in the divergent condition than in the convergent condition; 2) dyads will spend more time in social interaction in the divergent conditon than in the convergent condition; 3) dyads will display significantly more cooperation strategies and conflict resolution strategies in the divergent condition than in the convergent condition; 4) dyads will display significantly more flexibility (greater variety) in cooperation and conflict resolution strategies when using the divergent format than when using the convergent format; 5) older peer dyads will display more cooperation and conflict resolution strategies, and more flexibility in these behaviors than younger peer dyads.

METHOD

Subjects

Forty-eight children in two preschool (AM and PM) classes and one kindergarten (PM) class enrolled at the University of Maryland, Center for Young Children participated in the study. There were sixteen children each from three classrooms equally balanced by sex. The children came from middle- and upper-middle-class families of diverse ethnicities and ranged in age from 49 to 72 months (mean age = 58.8 months). Twenty-four randomly paired same-age, same-sex dyads were observed. Two age groups consisted of twelve same-sex younger (mean age = 53.8 months, range 49 to 57 months) and older (mean age = 63.8 months, range 60 to 70 months) dyads. All children had prior computer experiences since the center has a microcomputer curriculum. During the previous semester, one to two computers were usually brought into the classrooms at least two days per week. The children had experienced a variety of age and developmentally appropriate computer software during this class time. The computer software used in the present study was unfamiliar to the children.

Stimulus Materials

An Apple IIe computer with color monitor and standard keyboard was used to run the computer software. The software used in the study was "Fantastic Animals" (Bantam Software, 1985). "Fantastic Animals" contains both convergent and divergent features built into the program. The program provides practice in recognizing animals by their body parts (see Appendix C for a description of each format for "Fantastic Animals").

Experimental Setting

The children were videotaped in a research room adjacent to their classrooms. The 8 x 12 ft. room was equipped with a Panasonic videotape recorder, a 9- inch monitor, two wall-mounted video cameras with split screen special effects, and two ceiling suspended microphones. Cameras equipped with split screen special effects were used to produce simulataneous vidotaping of each child at the computer, and what they produced on the computer monitor. An Apple IIe computer with a color monitor was set up in the center of the room on a child size table with two chairs side by side.

The experimenter remained seated at a low table with a 9-in. monitor and videotape recorder in back of the children. To minimize distractions, the video monitor screen viewed by the experimenter was not visible to the dyads. The same set-up was used for both convergent and divergent software conditions.

Pilot Study

One year prior to the main study, a pilot study was conducted with four same-sex, five-year-old (5.1 to 5.4 mo.) dyads enrolled in the kindergarten program at the Center for Young Children. The youngest five- year- olds of this kindergarten class were randomly paired by age with a same-sex partner. Since this group was closer in chronological age to four-year-olds, they were useful in helping the experimenter determine the appropriateness of the computer software for use with 4-and-5-year olds. Also, they were useful in assessing the appropriate length of time for computer sessions in the main study. The pilot study conducted prior to the study also revealed that this was sufficient time for the dyads to become familiar with each game and to be able to operate it.

Summary of Pilot Study

Each of the four dyads participated in both computer conditions on two separate days. The children were successful in operating both programs by the second round of each game. Each dyad played both computer games for the full fifteen minutes. All dyads expressed a desire to continue with the computer game when the experimenter announced that it was time to return to their classroom. For this reason, the experimenter allocated more time--20 minutes-- for each computer game session in the main study.

Procedure

Pre-experimental Session

Prior to the pre-experimental session, the experimenter attended two 15-minute group-time sessions in each of the three classrooms in order for the children to become familiar with her.

Each dyad was escorted to the research room by the experimenter. When dyads entered the room the title screen to the computer game was displayed on the computer monitor. Dyads were told, "This is a

new computer game that you both can play. I will show you how to play the game." Each child was given a turn playing the game during a five-minute practice session. No prior instructions were given to dyads on how they should organize turns since dyads' skill in managing turns was under investigation.

Experimental Session

All dyads participated in both the convergent and divergent computer games condition with order of presentation counterbalanced. After the five-minute practice session, the dyads were told, "You both can play the computer game while I do some work over there" (pointing to a table in back of dyads). The alloted time for each session was twenty minutes, with approximately five to seven days between sessions. Children stayed at the computer until either they were informed by the experimenter that their twenty minutes were up or until one or both partners indicated to the experimenter that they wanted to leave. The children were then escorted back to their classroom.

Videotape Technology and Data Coding

Videotapes of the twenty-four dyads in both software formats were analyzed using an interactive videotape technology system. This system was designed for coding and storing data collected on videotapes. First, frame codes were placed on the vidotapes using a Binary Code Device (BCD). This device overlays frame codes in 1,800 frames per second onto videotapes. Second, **"HANDY"** an experimental authoring language developed by Don Nix of IBM was used for actual coding. Through the initial procedure, and a series of **"Handy"** commands and scripts, the videotapes could be systematically coded. By keeping a record of frame numbers corresponding to segments of the videotape, the frame codes acted as an address for locating specific frame intervals. This facilitated the collection of reliability data since it guaranteed that each coder was viewing the exact same intervals. It also eliminated errors in the transcription of data, because codes were automatically stored in an ascii file for calculations and statistical analysis. Using the **"HANDY"** program, videotapes were coded in 30-second

time intervals for all occurrences of interaction strategies according to the subcategories involved (see Appendix B Instructions for Coding Sample Videotapes).

The computer-run observational instrument recorded four behavorial categories: Cooperation, Conflict, Conflict Resolution, and No Interaction. Cooperation was further coded according to the strategy exhibited: division of labor, sharing ideas, laughter, helping, or taking turns. Conflict was coded as either cognitive or social. Conflict Resolution was also coded according to the strategy used: decision mechanism, compromise, conning, distraction, separation, or fighting. No Interaction was coded when dyads did not interact at the computer during a 30-second interval (see Table 1 Codes and Definitions).

Insert Table 1 about here: Codes and Definitions

The Cooperation and Conflict Resolution categories were derived from Paulson's et al. (1970) study of interpersonal strategies. These were based

TABLE 1

Definitions and Examples of Codes for Interpersonal Strategies

Cooperation Strategies: Peer dyad is jointly engaged in computer activity without conflict.

	Descriptive Definition
1. Division of Labor:	Partners share in computer activity to achieve goal (e.g. one child presses the space bar while partner presses the return key or one child prompts the partner when to go as s/he watches the red light on the disk drive.
2. Sharing Ideas:	Similar to 1 but a cognitive commodity is exchanged (e.g. "Let's try that head." or "That one matches."
3. Laughter:	Joint laughter that is task related (e.g. laughter about animal created on screen.)
4. Helping:	Assisting a partner to complete a task during partner's turn (e.g. "Here, let me help you.)
5. Taking Turns:	Peer dyads alternate use of goal-object or goal-activity (e.g. exchange places at computer keyboard.)

Conflict: Child A attempts to influence child B, child B resists, and child A persists, at that point a state of conflict exists between the peer dyad (Shantz and Shantz, 1985).

1. Cognitive Conflict:	Conflict or disagreement concerning task conceptualization or solution (e.g. Child A: "That's not the right one. Child B: Yes it is too."
2. Social Conflict:	Conflicts concerning negotiations of turntaking, control of keyboard,

or any social nature such as name calling.

Conflict Resolution Strategies: Conflict situations where one peer's overt purposeful activity interferes with the other. Conflict may be over same goal or directed toward separate goals.

1. Decision Mechanism: A game or justification is introduced especially for arriving at a mutually acceptable resolution (e.g. "You go after I do this one." or "Push return to check if that one matches.")

2. Compromise: An alternative to conflicting goals is agreeable to both partners (e.g. "You hit return and I'll do the space bar.")

3. Conning: One partner uses verbal persuasion or situational adaption to convince the other to do something that s/he initially found undesirable (e.g. "Oh, I better do this one, it looks hard," after partner refuses to give turn.)

4. Distraction: Attention is redirected from the problem situation to an agreeable or neutral one (e.g. A new game appears on the monitor.)

5. Separation: One or both partners disengaged from activity contributing to the conflict (e.g. One child gets up and leaves partner at computer when s/he doesn't get a turn.)

6. Fighting: Hostile verbalization or physical aggression as results from a clash of nearly equal wills (e.g. "I don't want to play anymore" or Peer snatches partner's hand away from keyboard or blocks partner from pressing a key.)

No Interaction

1. NoInte: No interaction between peer dyad during a 30 second time frame. Type a "1".

Codes and definitions were adapted for the purpose of this study from Paulson, F. L. (1970).

on classroom observations of 4- and 5-year-olds in an evaluation of the social goals of Sesame Street. Laughter was added to the cooperation category to identify joint humor. Lieberman (1977) found a strong relationship between aspects of playfulness and components of divergent thinking, spontaneous flexibility, ideational fluency, and originality.

A measure of computer time was computed for each software format by summing each dyads' 30-second frames for each software condition. Also, a measure of social interaction was a sum of all coded interactions between dyads for each software condition. A flexibility score was computed for each strategy type by summing the different types of cooperation or conflict resolution strategies dyads displayed during each software condition.

Dyads were the unit of analysis. Therefore, one single score was obtained across each category for both members of the dyad. A twenty minute session was segmented into 30-second time intervals yielding 40 coding frames for children who played the game for the full 20 minutes. The possible score range for frames was from 0 to 40. During each

30-second interval the occurrence of a behavior was coded only once regardless of its frequency.

Interobserver Agreement

Two graduate students, one majoring in early childhood education and the other human development, and the principal investigator independently coded data from 25% of the dyads. None of the dyads were known to the two coders nor was the purpose of the study known by the two coders. The two coders were trained to use the coding equipment and coding instrument on videotapes made during the pilot study. Both coders had 88% overall agreement with the main coder for the pilot study videotape. For the data tape, interobserver agreement was calculated using Cohen's Kappa. When disagreements occurred during training, all three coders reviewed frames in which discrepancies occurred, talked about interactions, and came to an agreement on coding a frame. Prior to coding videotapes interobserver agreement was established between three coders on 25% of the data tapes. Overall agreement with the main coder had a Kappa of .89 for the first coder and .91 for the second coder.

Treatment of the Data

Scores for each dyad in each software condition were calculated in the following manner: mean scores were computed on the cooperation and conflict resolution measures by dividing total occurrences by the total number of frames in which the dyads interacted in each software condition. To facilitate data analysis proportions were computed for each of the five types of cooperation strategies and the four types of conflict resolution strategies, after combining conning, distraction, and separation into an "other" category due to infrequent occurrences. This was done since some dyads did not stay the maximum 20 minutes for each software session; time dyads spent at the computer varied among dyads.

Total scores for cooperation and cooperation strategies, and for conflict and conflict resolution strategies were not mutually exclusive. Therefore, multivariate repeated measures analyses of variance were performed separately for cooperation and conflict resolution strategies. The multivariate *F* therefore reveals the overall effect on cooperation

or conflict resolution while univariate effects reveal the contribution of individual strategies.

Design and Statistical Analyses

The design for the study was a 2(age) x 2(software condition) multivariate repeated measures analysis of variance (MANOVA) using Wilks' Lambda. Age was the between subject factor and software condition was the within subject factor. Main effects and age x software interaction were assessed for independent variables, age and software conditions, on the dependent measures, cooperation strategies, conflict resolution strategies, and flexibility. A MANOVA with repeated measures was also used to assess the separate effects of software formats on social interaction and computer time. A repeated measures design was used since each dyad's behavior was observed at each level of the software condition. This design reduces overall variability and at the same time removes subject differences from the error term across software condition (Winer, 1971).

Results

Preliminary analysis of variance revealed no significant order effect for the two software

conditions $F(1,22)=.003$, $p=.956$. The descriptive statistics on the various dependent measures for age and software formats are presented in Tables 2 and 3. The results are discussed to address the five research hypotheses.

Computer Time

To investigate the hypothesis that dyads would spend more time at the computer during the divergent condition than during the convergent condition, a multivariate repeated measures analysis of variance (MANOVA) was performed on the measure of computer time (mean number of 30-s frames dyads spent on the computer, maximum = 40 frames). This analysis revealed no significant main effect for software $F(1,22)=.001$, $p=.971$ (see Table 2). On the average, dyads spent approximately 78% (15.5/20 minutes) of the maximum 20-minute- session at the computer. Total number of frames for the divergent format ($M=31.13$) ranged from 8 to 40, and the convergent format ($M=31.04$) ranged from 6 to 40 frames. The main effect for age and the age by software interaction were also not significant.

Time Spent in Social Interaction

The hypothesis that dyads would spend more time in social interaction during the divergent condition, rather than the convergent condition was not supported. The social interaction score was the sum of all coded dyadic interactions that occurred. These scores were analyzed using a multivariate repeated measures analysis of variance. This analysis revealed that dyadic interaction which occurred in the divergent condition a mean of 1.23 times per 30-s frame (M=1.23, SD=.33) did not differ significantly from the dyadic interaction in the convergent condition which occurred a mean of 1.28 times per 30-s frame (M=1.28, SD=.39), $F(1,23)$=.39, p=.537 (see Table 2). No interactions among dyads were much less frequent per frame for software formats (M=.17 and M=.16 for divergent and convergent formats respectively). Neither age nor the age by software interaction were significant.

Insert Table 2 about here: Means and Standard Deviations for Computer Time and Social Interaction

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TABLE 2

Means and Standard Deviations for Measures of Computer Time and Social Interaction with F-ratios and P-values

	Divergent		Convergent		F [a]	p
	M	(SD)	M	(SD)		
Time on Computer	31.13	(10.42)	31.04	(10.84)	.001	.971
Social Interaction	1.23	(.33)	1.28	(.37)	.393	.537

a df=(1,22)

Differences in Cooperation and Conflict Resolution Strategies for Age and Software

The hypothesis that there would be significant differences in cooperation and conflict resolution strategies due to age and software and their interaction was partially supported. Observational data for cooperation and conflict resolution strategies were analyzed separately using a 2 X 2 (age x software formats) MANOVA with repeated measures across software formats. The MANOVA analysis was used to examine age and software effects and their interaction, using Wilks' Lambda. Preliminary tests for symmetry conditions, homogeneity of variance and sphericity revealed no violation of these assumptions.

Tables 3 & 4 present the means, standard deviations, *F*-ratios, and *p*-values from the multivariate repeated measures analysis of variance for each type of cooperation strategy. Wilks' multivariate *F*, $F(5,18)=4.55$, $p=.007$ indicated a significant difference between software formats. The univariate *F*s revealed a significant difference favoring the divergent format for laughter, $F(1,22)=8.19$, $p=.009$, and a marginal effect for

division of labor favoring the convergent group, $F(1,22)=3.17$, $p=.09$ (see Table 3).

Insert Table 3 about here: Means, Standard Deviations, Univariate F, and p for Cooperation and Conflict Resolution Strategies by Software

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A significant multivariate interaction, $F(5,18)=3.38$, $p=.03$, was also found for cooperation strategies. The univariate F revealed a significant age by software interaction for Helping $F(1,22)=11.92$, $p=.002$, (see Table 4) with more helping by the older children in the convergent condition ($M=.22$ vs $M=.07$ for older and younger dyads respectively, $p=.007$). In the divergent condition differences were reversed ($M=.14$ vs $M=.09$, for younger and older children respectively, $p=.20$.) with younger children helping more than older children.

A similar 2 x 2 (age x software) MANOVA (repeated measures) performed on the conflict resolution measure revealed nonsignificant results (see Table 4).

TABLE 3

Means, Standard Deviations, and Univariate F and p for Cooperation and Conflict Resolution Strategies by Software

	Divergent M (SD)	Convergent M (SD)	F[a]	p
Cooperation Strategies				
Div Lab	.10 (.14)	.17 (.22)	3.17	.089
Share Ideas	.62 (.29)	.68 (.20)	.77	.391
Laughter	.21 (.20)	.09 (.12)	8.19	.009
Helping	.12 (.10)	.14 (.14)	.90	.353
Take Turns	.09 (.07)	.13 (.09)	1.67	.209
Conflict Resolution Strategies				
Dec Mec	.01 (.03)	.01 (.03)	.06	.809
Compromise	.01 (.03)	.01 (.04)	.09	.768
"Other"	.01 (.02)	.02 (.07)	.43	.517
Fighting	.05 (.11)	.02 (.05)	1.86	.187

Note:

Div Lab=Division of Labor

Dec Mec= Decision Mechanism

"Other"= Conning, Distraction, Separation

[a] df=1,22

Insert Tables 4 about here: MANOVAS Social Problem-Solving Strategies

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Flexibility in Cooperation and Conflict Resolution Strategies for Two Software Formats

The descriptive statistics for flexibility in cooperation and conflict resolution strategies are presented in Table 5. To examine differences in cooperation flexibility for the two software formats, a 2 x 2 (age x software) MANOVA with repeated measures analysis was performed. This analysis revealed a significant multivariate age by software interaction $F(2,21)=5.75$, $p=.01$. Univariate Fs revealed a significant interaction for cooperation flexibility, $F(1,22)=.11.06$, $p=.003$. Older dyads displayed more flexible cooperation strategies in the convergent condition ($M=4.33$, $sd=.65$) than did younger dyads ($M=3.58$, $sd=1.38$). The difference was reversed for the divergent condition. Younger dyads used more flexible cooperation strategies ($M=4.67$, $sd=.65$) than did older dyads ($M=3.83$, sd .94) (see Table 5).

TABLE 4
MANOVAS SOCIAL PROBLEM-SOLVING STRATEGIES

Source	DF	Wilks' Lambda	F	p
Cooperation Strategies				
Between Subjects				
Age	5,18	.83	.77	.593
Within Subjects				
Software	5,18	.44	4.55	.007
Age x Software	5,18	.52	3.38	.025
Conflict Resolution Strategies				
Between Subjects				
Age	4,19	.92	.41	.796
Within Subjects				
Software	4,19	.82	1.02	.420
Age x Software	4,19	.80	1.16	.360

Insert Table 5 about here: Means, Standard Deviations, and Univariate *F* and *p* for Flexibility in Strategies Use

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No significant main effect for software format was found for the flexibility of conflict resolution. Significant main effects or interaction also failed to appear for the flexibility of conflict resolution measure. Main effects for age failed to appear on any measure. The multivariate *F* did not indicate a significant age effect for cooperation strategies $F(5,18)=.77$, $p=.60$ or for conflict resolution strategies $F(4,19)=.41$, $p=.80$. There were no significant age differences in flexibility, $F(2,21)=.01$, $p=.99$, for dyads use of cooperation strategies, $F(1,22)=.02$, $p=.89$, nor conflict resolution strategies, $F(1,22)=.00$, $p=1.00$ (see Table 6).

Insert Table 6 about here: Flexibility in Strategies Use

TABLE 5

Means, Standard Deviations, and Univariate F and p for Flexibility in Strategies Use

	Divergent		Convergent		F [a]	p
	M	(SD)	M	(SD)		
Cooperation Flexibility	4.25	(.90)	3.96	(1.12)	11.06	.003
Conflict Resolution Flexibility	.83	(1.34)	.83	(1.16)	.35	.557

Note:

[a] df=1,22

TABLE 6

MANOVAS

FLEXIBILITY IN STRATEGIES USE

SOURCE	DF	WILKS' CRIT.	F	p
Flexibility in Cooperation Strategies				
Between Subjects				
Age	2,21	.99	.01	.991
Within Subjects				
Software	2,21	.94	.73	.495
Age x Software	2,21	.65	5.75	.010
Flexibility in Conflict Resolution Strategies				
Between Subjects				
Age	1,22	.99	.00	1.000
Within Subjects				
Software	1,22	.93	.00	1.000
Age x Software	1,22	.65	.35	.557

Summary and Discussion

The present study examined the effects of two computer software formats--divergent and convergent--on older and younger peer dyads' strategies for cooperation, conflict resolution, and the flexibility of their strategy use. Dyads' interpersonal cooperative strategies significantly differed across the convergent and divergent software formats.

The hypothesis that a significant difference would be found in cooperation strategies for the divergent format was supported. The multivariate *F* was significant, driven, perhaps by the strong univariate effect for laughter. This format allowed dyads more freedom to choose animal parts, and to create animals with different combinations of parts, a situation that provided a basis for shared humor. Social laughter may have served as a strategy to include the partner in the computer game (Hawkins, 1984). In the convergent condition, however, the effort to replicate an animal displayed in the corner of the computer screen elicited relatively little social laughter. The divergent software format thus provided children greater opportunities

to display positive affective behavior in their social interactions.

However, different social interactions might be encouraged by different formats. The marginally significant effect for division of labor favoring the convergent group suggests that dyads in this condition were more willing to divide-up the task. This was particularly true whenever dyads had difficulty correctly matching animal parts. One partner pressed the return key after the other partner pressed the space bar, in a trial-and-error manner until the correct animal part was found. In the divergent format, this approach was less common since any combination of animal parts was acceptable.

Children may have interpreted the goal of the divergent problem to make silly animals. Laughter therefore, might have provided social confirmation of the dyads' success. In contrast, success in the convergent format was determined by the software. Dyads needed to make a correct match to advance to another level of the program. Therefore, dyads' joint effort through division of labor may have

proven to be a more useful strategy for attaining success under these externally determined criteria.

Even in children as young as 4-years-old, cooperative strategies are adapted to the problem at hand. Social interactive behavior is differentiated and used selectively for the situation a dyad is facing. One set of strategies is used in divergent situations while another set is used in convergent situations. A concept of differentiated strategies for optimal performance may be especially true for dyads using divergent vs convergent computer formats. In the divergent condition the cooperative strategies required to optimize performance may be laughter and sharing ideas, whereas the convergent format may require more division of labor, helping, and taking turns.

The significant age by software interaction for helping behavior indicated that situations favoring social behavior may differ according to the age of the child. Four-year-olds were more helpful in the divergent condition, whereas five-year-olds were more helpful in the convergent condition. Younger dyads in the divergent condition were offering help voluntarily, such as pressing a key for a partner.

This strategy might have served mostly for a partner to join in on the fun of making funny animals. The partner's approach was generally, "Here, let me help you make a real funny one." Dyads' cooperative helping strategy in the divergent format came more often as an offer to help, rather than as a request for help from the partner. To some extent, this may explain the elevated level of fighting in the divergent condition for younger dyads. When younger dyads tried to help without being asked, this generally resulted in conflict and fighting. However, these differences were not pronounced enough to yield a significant effect. Paris and Morris (1985) found that younger children were most likely to reject help offered and accept help requested.

Older dyads' helping in the convergent condition differed from that of the younger dyads' in that the older dyads were more likely to request help. For older dyads help was solicited in order to be successful in accomplishing the goal of matching animals. For younger children, the expressed desire to help may have reflected the egocentric motive of gaining access to the computer

keyboard. Depending on the software format, helping may serve different purposes. If helping behavior is desired in preschool, and if teachers wish to encourage it, they may need to be aware that it will be facilitated by different types of problems at different age level.

An age by software interaction also appeared for cooperation flexibility. Older dyads demonstrated more flexible cooperation strategies than younger dyads, but only for the convergent format. The reverse occurred in the divergent condition for younger dyads who demonstrated more variety in their cooperation strategies than did older dyads in this condition. Perhaps, due to the nature of the divergent software which poses no external problem, younger dyads were provided more opportunities to use diverse cooperation strategies. A combination of strategies may have proven to be more socially rewarding for the younger age group, whereas for older children a combination of strategies appeared to have been more socially rewarding in the convergent condition. Here the partner's joint efforts were needed to successfully complete the task.

A major limitation of the present study is that only one computer game was used. Other types of divergent problems are possible. For example, "Colorasauras" produced by The Learning Company is another computer software designed for young children with both convergent and divergent features. For the divergent task, this software requires children to color a dinosaur using chunks of various colors. Children may make a dinosaur using one color or a combination of colors. The problem of which pattern to use requires negotiations among partners. In the convergent task, a dinosaur of a particular color is matched to another dinosaur in one of four boxes. When an incorrect match is made, the incorrect dinosaur drops to the bottom of the screen and children must try again by choosing a dinosaur of a different color. The program continues with increasing levels of difficulty. These variations might affect children's social responses under convergent and divergent conditions. The divergent condition might require more affiliative responses to color the one large dinosaur. In the convergent condition children in a dyadic situation are more encouraged to pursue

separate goals. They may use less cooperative strategies in pursuing these goals.

In addition, the convergent/divergent dimension might have been inadequately represented by the dependent measures of the present study. Dyad's competitive behavior was not differeniated from their cooperation strategies. Competitiveness among older dyads in the divergent condition may have hampered their use of cooperative strategies and contributed to failure to find significant results for the divergent software condition. Adam, 1985 found that the experimental condition of competition impeded ninth-graders performance on a spontaneous flexibility test. In other school situations where older 6-to-9-year-olds are socialized to schools that emphasize evaluation and competition, divergent thinking might be inhibited rather than facilitated. Also, in an experimental situation where younger children 4-to-5-years-old are exposed to an experimenter's confederate who refuse to cooperate, the findings may not support children's use of laughter as a predominant strategy. If cooperative interacting occurred, it might be limited to turn taking alone. On the other

hand, more conflict with conflict resolution strategies might also be used in this constrived situation.

The failure to find significant age effects or more software effects for individual dependent measures may also be due in part to the small sample size. The narrow age range may have limited the impact of age on social interaction strategies. With a broader age range sharing ideas and turn taking strategies may have revealed significant age effects, especially if younger children had been included in the study.

Implications of the Study

The increasing use of microcomputers by young children are increasing the demands for appealing, yet developmentally appropriate computer software. The impact of computer software on young children's social skills and development demands urgent attention, since computers are here to stay. Researchers have just recently begun to focus on the influences of software used with this new technology. The results of the present study indicate a significant software effect; one that

might depend on age for certain types of dyadic interaction.

The study showed that children had more fun in the divergent condition and tended in the convergent condition to use a strategy that would optimize each of the partner's contribution to the solution of the problem. Also, for the two age groups a combination of cooperative strategies was more useful under different software conditions. Well chosen convergent software need not reduce or undermine constructive peer interaction.

The results of this study did not reveal significant differences in the time dyads spent on the computer or social interactions they ecountered. The dyads may have been so sociable that software did not make much of a difference on these measures. A stronger effect for software and age differences might have occurred if the children were less sociable or less familar with one another. The limited nature of the present study does not permit such questions to be addressed. However, findings of this study suggest that software formats may affect different aspects of children's interpersonal strategies. Continued research is

needed to address additional questions dealing with this issue. Additional questions may focus on which software format is more appropriate for what types of social interactions and for whom. Future research with more diverse populations and more diverse software packages will provide a better understanding of the effects of computer software formats on peer interaction.

APPENDICES

APPENDIX A

LITERATURE REVIEW: PEER INTERACTION WITH PLAY OBJECTS

LITERATURE REVIEW: PEER INTERACTION WITH PLAY OBJECTS

Peer interaction has been acknowledged by some psychologists and educators as a medium through which young children develop social competence (Weinstein, 1969; O'Malley, 1977; Hartup, 1979; Urbain & Kendall, 1980) and social skills (Ladd & Asher, 1985). Young children's social encounters with age-mates provide them with opportunities to cooperate, compete, negotiate, and resolve conflicts (Hartup, 1979, 1983). However, for young children, social interactions with same-age peers do not occur in a vaccum. Most peer contacts center around play objects, which may serve as a mediator of both positive and negative peer interchange (Fein, 1981; Hartup, 1970, Maudry and Nekula, 1939). The extent to which young peers interact and the various ways they interact around play objects have raised questions and concern among those who provide means for children's social development.

Studies of play objects have basically focused on two areas of concern: 1) whether play objects will alter the frequency of children's play behavior, and 2) how the quality of children's play

is affected by these objects. Play objects may modify the frequency of children's social interaction, bringing children physically closer and thereby creating an opportunity for interactions to occur (Shure, 1969; Quilitch and Risley, 1973; Smith and Connolly, 1980). Play objects may also modify the quality of children's social interaction because different play objects may "pull for" different kinds of behavior by posing different kinds of social problems (e.g., see-saw vs jungle gyms vs slides). This paper reviews theoretical and empirical studies of the impact of specific play objects and general dimensions of play objects on the frequency and quality of children's play behavior.

Lewinian Theory--Play Objects and Play Behavior

First, theory based research offers support for the notion that environmental factors such as different types of play objects or activity centers affect social behavior. These studies have been based on Lewin's (1931) Field Theory Model which provides a theoretical base for conceptualizing the contribution of play objects to peer interaction. Lewin (1931) proposed that, "objects are not neutral

to the child but have an immediate psychological effect on its behavior" (Lewin, 1931, p.6). This theory claims that a state of tension driven by the child's need to accomplish a desired goal, motivates the child's movement towards that goal. The Lewinian Model (1931) related to this theoretical view is stated mathematically as 'B=f(P E)'. The behavior(B) of a person may be seen as a function(f) of the person(P) and environmental factors(E).

Darvill (1982) proposed a modification of Lewin's model to construct a model of play behavior. According to this proposal on play behaviors (Bp), the playing child (Pc), and the play setting (Ep) would account for the effects of personal variables and environmental variables on play behavior. This transformed model is Bp=f(Pc Ep), which implies that, "...a child's play behavior is a function of the relation between the playing child and the play environment" (Darvill, 1982, p.147). This practical empirical theory stresses the interaction of the child and the environment based on here-and-now forces, rather than past experiences (Deutsch, 1968).

Some studies of the influence of play objects on children's play behavior have either incorporated or can be viewed according to the three components of Darvill's (1982) proposed model (Pelligrini, 1983; Pulaski, 1973; Chafel, 1987). Pelligrini (1983) using all three components of the model experimentally examined the effects of personal variables (age and gender) and environmental variables (blocks and dramatic play centers) on social-cognitive aspects of children's play behavior. Other studies have examined the impact of environmental factors on the frequency of children's play behavior when using specific play objects in a freeplay setting (Pulaski, 1973; Rubin, 1977b, 1986; Johnson and Ershler, 1981; Hendrickson, Strain, Tremblay, and Shores, 1981). Still other studies have manipulated environmental factors by examining the effects of dimensions of play objects on children of different age groups or in different settings. These studies suggest that the play behavior of a child is motivated by the goal a child hopes to accomplish. Environmental and personal variables influence that outcome.

SPECIFIC OBJECTS AND PLAY BEHAVIOR

Frequency and Quality of Peer Interaction

Researchers have attempted to document differences in frequency of peers' interaction with specific play objects such as dolls, blocks, clay, water, sand, art materials, playdoh, paints, dress-up materials, vehicles, puzzles, and more recently microcomputers (Rubin, 1977; Shure, 1963; Hendrickson, Strain, Tremblay, and Shure, 1981). These studies have used observational and experimental paradigms to investigate influences of play objects on children's play behavior.

Findings have been consistent in showing that the frequency of children's play behavior differed with different play objects. For instance, social play most often occurred with blocks, climbing apparatus, toy vehicles, water and sand, musical instruments, dramatic materials, and toy housekeeping objects, while nonsocial play most often occurred with puzzles, fine motor toys, library, and art materials. Rubin (1977) found that most social interactions occurred in housekeeping (54%), with vehicles play (50%), and, surprisingly

with books (63%). They explained that the high occurrence of social behavior with books was a result of teachers reading to children. While the studies are fairly consistent in showing percentages of social and nonsocial play occurring with different play objects, some studies yield data that are different. For example, Stoneman, et. al. (1983) reported that 57% of children's play with sand and water involved cooperative interactions and 39% of children's play was solitary. However, Rubin and Seibel's (1979) finding was reversed for sand and water play, with 96% being solitary, and only 4% being cooperative (see Table A for percentages).

Insert TABLE A about here: Studies Reporting Percentages

TABLE A

Studies Reporting Percentages of Play Behavior With Different Play Objects

	Study							
	1		2		3		4	
Play Object	S	C	S	C	S	C	S	C
Books	24	76		63			77	14
Clay	20	70	64		80	19		
Housekeeping	31	61		54	54	46	40	51
Blocks	34	55			72	28	24	60
Toy Vehicles	22	37		50	47	53	51	28
Leggo Toys	44	34			87	13		
Sand & Water	04	27	79		96	04	39	57
Puzzles	84	08	80		61	39		
Art Materials	13	04	83		100		49	36

Notes:
1 = Hendrickson, et al., 1981
2 = Rubin, 1977
3 = Rubin and Seibel, 1979
4 = Stoneman, et. al 1980
S = Solitary
C = Cooperative

Measures of the frequency of object-centered peer interactions in these studies consist of percentage or duration of time children spent in play based on Parten's (1932) social play categories. Most studies of specific objects yield only lists of particular objects and their effects. They do not specify what it is about these play objects that affect social behavior and therefore do not provide general guidelines for choosing or designing play objects for preschool classrooms. In addition, they do not specify the nature of solitary or cooperative play associated with particular play objects. Asher, Markell, and Hymel (1981) point out that an assessment of the frequency of a child's rate-of-social interactions is not sufficient to identify children at risk in peer relations or for measuring treatment outcomes. Additional assessment of the quality of a child's behavior would be more useful.

Another methodological concern pointed out by Krasnor and Pepler in Rubin, 1980 (ed.) is that in a naturalistic situation, preference for a play object may bring certain children together. Thus, the effect of the play object is confounded by

individual differences (i.e., factors producing proximity). It is suggested that in an experimental situation, proximity is to some extent controlled. Then, one can come to stronger conclusions regarding the effects of play objects on quality of social interaction.

Social-Cognitive Play Behavior

Several studies used Parten's (1933) social participation categories crossed with Piaget-Smilansky's (1968) cognitive play categories to describe social-cognitive play associated with children's use of specific play objects (Pulaski, 1973; Rubin and colleagues, 1976, 1978; Johnson and Ershler, 1981; Pellegrini, 1983). These findings revealed differences in levels of social participation and cognitive play forms as a result of children's play with different objects. Children were observed during free play periods for occurrences of Smilansky's (1933) five levels of cognitive play (functional, constructive, dramatic, socio-dramatic, and games with rules), as well as Parten's (1968) levels of social participation

(solitary, parallel, associative, or cooperative play).

Using Parten's (1933) social participation categories crossed with Smilansky's cognitive play categories, it was found that paints, crayons, and scissors elicited or pulled for solitary and constructive play, and playdoh, clay, water, and sand pulled for solitary or parallel and constructive play. In contrast, vehicles, dolls, and dress-up materials pulled for cooperative play behavior (Rubin and Seibel, 1979).

In addition, variations in social-cognitive play have also been reported. Studies have found settings and activities variations to contribute to differences in social-cognitive play (Barnes, 1971; Pelligrini, 1982; Parten, 1933; Quilitch and Risley, 1973). In a study of the effects of settings and personal characteristics on social-cognitive play forms, Pelligrini (1982) used an experimental design to observe eighty 4- and- 5 year-old same-age, same-gender dyads playing in a dramatic center and a block center on two different occasions. Dyadic play was significantly affected by the center in which play occurred. For instance, the blocks

context (low structure objects) elicited significantly more solitary-constructive and parallel-constructive play than did the dramatic context. Also, the dramatic context (high structure objects) elicited significantly more solitary-functional, parallel-functional, and interactive-dramatic play forms.

Age differences showed older children's play as more socially and cognitively sophisticated than younger children's play. Gender differences in the dramatic center depended on the child's age. While four-year-old boys engaged in more interactive and dramatic play and less parallel play than did four-year-old girls. The opposite trend was found for five-year-olds. This study suggests that in the dramatic play context children came together in closer proximity. Therefore, a pull for more interactive-dramatic play occurred in this context, than in the blocks context. These differences were greater for older than younger children.

Social Play Behavior

An observational study conducted by Rogers, 1985, employed Parten's levels of social

participation, as well as a social behavior category to examine kindergarten children's social play behavior with large hollow blocks and small, solid, unit blocks. This researcher found that while kindergarten children engaged in group, parallel, and solitary play with both types of blocks they came together in close proximity for group play more often with large hollow blocks than with unit blocks. Unit blocks produced more parallel and solitary play than did hollow blocks. There were no sex differences for any of the social behaviors (Verbal Behavior; Action Behavior; Facial Expressions and Vocalizations). Roger (1985) did not examine age differences and the cognitive qualities of children's play.

Quilitch and Risley (1973) reported an experimental study showing differences in the frequency of social play of 7-year-old children. He measured the amount of time children played together socially and nonsocially with "social" and "isolate" play objects. Play objects were pre-categorized as "isolate" toys (toys generally used by children alone) such as, crayons, tinker toys, jigsaw puzzles, talking books, Farmer Says and Play Doh or

"social" toys (toys generally used with one or more other persons) which were competitive games (Don't Break the Ice, Don't Cook Your Goose, Dont's Spill the Beans, Pick Up Stix, playing cards and checkers). These researchers reported that, "... social play occurred only 16% of the time when the children were provided with "isolate" toys, whereas social play occurred 78% of the time when children were provided with "social" toys." The presence of "social" or "isolate" toys had a great impact upon the frequency of children's social play behavior.

Other studies using similar measures have compared play objects such as blocks and clay (Updegraff and Herbst, 1933); Village and Burger King props (Getz, 1977); jigsaw puzzles and a microcomputer (Muller and Purlmutter, 1984); and Logo and Computer-Assisted Instructions programs (Clements and Nastasi, 1985). The previous studies were consistent in finding differences in children's social play behavior elicited by different play objects.

Cooperative Behavior

In contrast to more recent studies, Updegraff and Herbst (1933) found 2-and-3-year-olds to be more social and engage in a higher frequency of cooperative sharing behavior with clay than with blocks. When children played with clay, they tended to watch and imitate each other more, and to engage in converstations unrelated to clay. While children's conversations were more task related when they played with blocks, more conflicts occurred. It was found that the quality of children's play differed, depending on whether they played with blocks or clay. Children's play with clay elicited more cooperative sharing behavior, while blocks elicited more conflict behavior, especially for 2-and 3-year-olds. Rubin (1977a) found that cooperative behavior most often occurred when children played with dress-up materials, toy vehicles, and dolls, then when they played with manipulative toys and art materials. The nature of some play objects appears to attract children in group play more than others.

More recently, microcomputers have been used as a play object in studing children's cooperative

behavior. Muller and Purlmutter (1984) compared young children's social behavior while either working on problem-solving tasks at a microcomputer or with noncomputers (jigsaw puzzles). In this study, differences were found in the forms of cooperative interaction observed: sharing (turntaking), doing (performing the action for another), showing (demonstrating the action), and explaining (describing the action) according to whether children used jigsaw puzzles or the microcomputer. They found that 63% percent of the time, children chose to work at the computer with a peer, in contrast to only 7% of the time spent with a peer working with jigsaw puzzles. Fewer occurrences of cooperative interactions were observed when children used jigsaw puzzles then when they used a microcomputer.

Summary

Generally, the above studies have shown that play objects such as jigsaw puzzles, pegboards, play doh, stacking toys, unit blocks, crayons, computer-assisted instructional software all pull for solitary or parallel play behaviors. In contrast, hollow blocks, dramatic play props,

competitive games, and Logo were found to be more social. However, conflict more often occurred with social play objects. Children have more opportunities to engage in conflict when they come into closer proximity with one another. The frequency of nonsocial or social play behavior may be influenced differently by different play objects.

Studies of the qualitative aspects of children's play behavior provide a more concise assessment of the impact of play objects on social behavior. Although studies of specific play objects have been useful in providing information about social behavior that occurred more with one type of play object than another, studies of the quality of young children's object-centered social interactions provides more useful information.

COMPLEXITY OF PLAY OBJECTS

While the studies examined in the previous section, provide some evidence of relations between specific play objects and the frequency and quality of young peers' interactions, more recently, researchers studying peer play have examined the impact of a more general features of play objects on

peer interaction. One of Berlyne's (1970) four collative variables--complexity, has been used to examine similarities and differences related to this property of play object. Complexity was defined as "...the amount of variety or diversity in a stimulus..." (p. 38). Berlyne (1970) proposed that children's preference for simple objects should decline faster after repeated exposure than their preference for complex objects.

Findings from these studies are relevant to a the study of microcomputers, a new technology for preschoolers, as well as traditional play objects. Complexity, may be defined in at least two ways: a) the number of parts an object consist of (Bishop, 1972; Scholtz & Ellis, 1975; Bloch, 1984); and, b) the activity potential of the object, that is, the number of things the object can do. These general features of play objects will be examined in the extant literature in relation to peer interaction.

Number Of Parts

A complexity component that is relevant to the study of play objects is the number of an object's manipulatable parts. Scholtz and Ellis (1975)

examined peers interactions during repeated exposure to play trestles varying in complexity. As 4-and-5-year-olds became more familiar with the trestles and with each other, peer interaction increased and play with the trestles decreased. While the rate of interaction with peers increased as a result of repeated exposure, interaction with play objects decreased. The rate of decrease was influenced by the complexity of the play object.

Bloch (1984) studied Senegalese children's involvement with complex objects. Children preferred more complex or open-ended objects to objects with one or two parts when they were engaged in dramatic play. Complex objects elicited longer attention span and more creativity. These findings are consistent with Bishop's (1972) study of preschool children. Preschool children preferred and played longer on more complex outdoor play equipment. These studies suggest that complexity, defined as the number of parts, produces differences in the frequency and quality of peer interactions.

Activity Potential

Another important deminsion of complexity more relevant to a study of peer interaction and microcomputer software is complexity of activity potential or the number of actions an object can perform. This feature has been studied by Pepler (1979) and Pepler and Ross (1980) in their examination of distinctons between convergent and divergent play objects on children's problem solving behavior. According to their definition, convergent and divergent play objects may be defined as follows:

> **Convergent materials, such as puzzles, are those that elicit convergent processes to solve the problem posed by the materials to which there is only one answer. Divergent materials, such as blocks, on the other hand, pose no specific problem to be solved but elicit divergent processes by which the child may generate a wide variety of responses to the materials (Pepler, 1979, p.34).**

In both studies, effects of convergent and divergent play objects on children's puzzle-solving behavior were examined. Children ages three and four years old were permitted to play with five sets of nine piece puzzles with formboards (convergent materials) and the same nine puzzle pieces without formboards (divergent materials). Differences were found

between the two groups in the number of actions performed with the same play object, with and without a formboard. With the divergent play object, the children showed more flexible manipulation strategies. With the convergent play object, children used two-thirds of their time filling the formboards and engaged in significantly less investigative behaviors. Differences were greater among the three-year-olds than four-year-olds. A greater frequency of flexible manipulation strategies occurred in the three-year-old divergent play group than in the convergent play group. The three-year-olds manipulation behavior was greater than that of the four-year-olds during play with divergent objects. When tested subsequently on their ability to solve convergent and divergent problems, the divergent play group performed better on divergent tasks.

Convergent/Divergent Microcomputer Software

Previous research on microcomputer software characteristics, although scanty, can be classified according to the convergent/divergent distinction. In Borgh and Dickson's (1986) study of peer interaction in a microcomputer setting, preschool

children used two types of software. "Counting Bee" (Eduware), a task-oriented program in which a smiling or frowning face identified a child's right or wrong response may be categorized as convergent. In contrast, "Hodgepodge" (Dynacomp) displays graphics with each key press to promote keyboard exploration and letter recognition and does not present problems with right or wrong answer may be categorized as divergent software.

Borgh and Dickson (1986) found that children's pattern of interaction and verbal statements were influenced differently by these two types of software. The convergent software elicited verbal interactions about right and wrong responses and facilitated more peer teaching. The divergent software, on the other hand, elicited more hypothesizing and wondering about how the computer worked. The researchers stated that, "Software characteristics exert considerable influence on children's verbal interactions"(Borgh & Dickson, 1986, p.41).

Conclusions and Implications

This review has summarized research that relates play objects to play behavior and peer interactions. Theory based and empirical studies showed that specific play objects have different potential for social and nonsocial forms of social behavior. Different individual objects might share psychologically relevant characteristics that affect the frequency and quality of peer interactions. Also, the dimensional property of play objects accounts for some of the variability in the frequency and quality of peer interactions. Two dimensions, complexity and divergence appear to exert an influence on children's social behavior.The more complex a play object is, the more potential there is for peer interaction. The divergence dimension of play objects facilitates the manipulatability of the object and influence the quality of play behavior emitted. By manipulating dimensional aspects of play objects in experimental studies, researchers have provided evidence that play objects affect young children's social interactions.

Early childhood eduactors may be encouraged to look for differences in the type of play behavior children display when they use different play objects. The frequency of children social interactions may increase, as well as conflicts. Children's maximum involvement with play objects and with each other may depend not only on different individual play objects, but also on the dimensional property of the play object.

APPENDIX B

INSTRUCTIONS FOR CODING VIDEOTAPES

APPENDIX B

INSTRUCTIONS FOR CODING SAMPLE VIDEOTAPE

This 1-1/2 hour sample videotape was developed for the purpose of obtaining interobserver agreement. It will take approximately 2-1/2 hours to code. The videotape is operated through "**HANDY**" commands. The "**HANDY**" program presents for coding 30-second intervals of taped interaction.

In the **CODE2** display unit appearing on the computer screen there are 14 abbreviated subcategories within 4 broad categories. The coders should have become very familiar with these categories and definitions during training (see definition and examples for each code attached).

After viewing each 30-second interval, type in ID for peer dyad (see listing) then code social interactions by typing a "1" for each interaction occurred or "1" in the last category for no interactions within a 30-second time frame. Coding for the first three broad categories--**Cooperation; Conflict; and Conflict Resolution Strategies** is not mutually exclusive. More than one type of interaction may be coded within a 30-second interval. The Conflict Resolution Strategies category is not coded unless a conflict occurs first. If the same type of interaction occurs more than once

within a 30-second time frame, it is coded only once. The fourth broad category--**No Interaction** is coded with a "1" only if there is no interaction of any type within a 30-second time frame.

Codes may be edited by typing in a zero over the "1" code. Then use the up or down arrow key to move to the desired code and type "1". To review a frame, before entering dyad's initials, press the "F1" key, this will rewind the tape to the beginning of the frame just watched. Code the frame and then press the "ESC" key to continue to the next 30-sec. frame. The code column is programmed to revert to zeroes before coding the next frame. Two indications that coding for a dyad is completed, may be when the examiner announces to a dyad that it's time to go back to the classroom or when a dyad gets up to leave.

When all frames for a dyad have been coded be sure to **SAVE** data onto the data disk provided. This is accomplished by pressing "ESC" before entering initials for the next dyad. The data display unit will appear on the screen as well as on the command display which will read [Place data disk in default drive.]. Put data disk into disk drive A. [Type the name of the data file]. At this point type in file name which will be TAPXXxxD. The first two Xs represent the tape number

01 through 11 and the second two xx respresent the first two initials of the coder and the last code "D" stands for the number of each dyad on each tape (1 through 4 for most tapes, but, in two instances five dyads are on one tape). [Then press any key.] At this point the data will be saved onto the data disk. Now, in the command display unit that appears on the screen type "Hid data". Press "Enter". Type "Run" before hitting ENTER again hit "F1" to hide command display and press "Enter". Remember to press "F1" to repeat a frame. It is good practice to have a frame repeated when starting to code a new set of dyads.

To continue coding next dyad on tape, remove data disk and replace with program disk. Type in **FRAME VCR.** A frame number will appear on screen, for example 31886. Write down this number. Next, type **VCR** then press **ENTER.** Type **RUN**, press **ENTER.** At the prompt **ENTER THE NEW START FRAME OR JUST ENTER TO DEFAULT** Type in the frame number for the frame beginning the next dyad, for example, 31886. The frame beginning the next dyad will play for 30-seconds. Previous steps are then repeated.

GOOD LUCK!

APPENDIX C

DESCRIPTION OF "FANTASTIC ANIMALS" FORMATS

Description of "Fantastic Animals"-- Divergent and Convergent Formats

The divergent game (Mixed-Up Animals) of "Fantastic Animals" is one which allows the children to create their own animals choosing from body parts of 20 different animals--head, body, legs, tail, and an animal tune to suit their fancy. Children will use the space bar on the computer keyboard to cycle through animal parts and the return key to lock on their selection. The dyads will be permitted to make as many mixed-up animals as they wish within the twenty-minute session.

The convergent game format of "Fantastic Animals" (Animal Arcade) is one in which children choose animal parts to match a small pictured representation of the animal in the lower left corner of the computer screen. Children use the space bar on the computer keyboard to cycle through animal parts for 20 different animals and the return key to lock on correct animal part. If an animal part does not match a beep signals the child that an incorrect match has been made. Once an animal has been correctly matched, a different animal appears on screen. The dyads will continue for a maximum 20-minute session.

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