12-1-1990

Developmentally Appropriate Software: Its Effect on the Language of Young Children

Janice A. Sherman

DEVELOPMENTALLY APPROPRIATE SOFTWARE: ITS EFFECT ON THE LANGUAGE OF YOUNG CHILDREN

by
Janice A. Sherman

Bachelor of Science, SUNY College at Buffalo, 1968
Master of Science, Colorado State University, 1977

A Dissertation

Submitted to the Graduate Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Doctor of Education

Grand Forks, North Dakota

December

1990

This dissertation submitted by Janice A. Sherman in partial fulfillment of the requirements for the Degree of Doctor of Education from the University of North Dakota is hereby approved by the Faculty Advisory Committee under whom the work has been done.

Mary Lou Fuller
(Chair)

Sara T. Hanhan

James R. Antes

This dissertation meets the standards for appearance and conforms to the style and format requirements of the Graduate School of the University of North Dakota, and is hereby approved.

Dean of the Graduate School

12-6-90

Permission

Title Developmentally Appropriate Software: Its Effect On The Language of Young Children

Department Center for Teaching and Learning

Degree Doctor of Education

In presenting this dissertation in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the Library of this University shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my dissertation work or, in her absence, by the Chair of the Department or the Dean of the Graduate School. It is understood that any copying for publication or other use of this dissertation or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the University of North Dakota in any scholarly use which may be made of any material in my dissertation.

Signature Janice Sherman

Date Dec. 4, 1990

TABLE OF CONTENTS

LIST OF TABLES v

ACKNOWLEDGEMENTS vi

ABSTRACT viii

CHAPTER I. INTRODUCTION 1

CHAPTER II. REVIEW OF THE LITERATURE. 12

CHAPTER III. METHODOLOGY. 35

CHAPTER IV. RESULTS AND DISCUSSION. 59

CHAPTER V. SUMMARY AND IMPLICATIONS 123

APPENDICES

APPENDIX A. DEVELOPMENTAL SOFTWARE EVALUATION FORM. 138

APPENDIX B. TOUGH'S SEVEN CATEGORIES FOR USES OF LANGUAGE AND SUPPORTING STRATEGIES. . . 140

APPENDIX C. DEVELOPMENTAL SOFTWARE EVALUATIONS FOR SOFTWARE USED IN THE STUDY. 142

APPENDIX D. PARENT CONSENT FORM 151

APPENDIX E. VIDEO TRANSCRIPTION SHEET 153

REFERENCES 155

LIST OF TABLES

1. Observation Schedule. 46

2. Self-selected Left/Right Position at the Computer . 50

3. Total Length of Time Spent Using Software Programs. 62

4. Summary of Use of Tough's Categories of Language. . 63
   for Four Software Programs

5. Turns of Talk for Software Programs During. 69
   Each Observation

6. Talkativeness Calculations for Four Software. . . . 70
   Programs

7. Total Turns of Talk for Each Observation. 76

8. Total Time for Each Observation 79

9. Children's Stated Preferences for Software. 95

10. Summary of Time Spent, Tough's Categories of
    Language Use and Turns of Talk for Each
    Software Program for Jason and Bryan. 98

11. Summary of Time Spent, Tough's Categories of
    Language Use and Turns of Talk for Each
    Software Program for Rob and Sue 104

12. Summary of Time Spent, Tough's Categories of
    Language Use and Turns of Talk for Each
    Software Program for Josh and Holly. 115

ACKNOWLEDGEMENTS

It would be impossible, in the space permitted here, to acknowledge and express my appreciation to all of those who helped and supported me throughout this endeavor. To all who may see this page and know that they were involved, I give my love and thanks.

The dedication and support of my doctoral committee members have inspired me throughout my studies at the University of North Dakota. Dr. Ivan Dahl has taught me the true meaning of education. The energy of Dr. Lynne Rocklage has inspired me. Dr. Jim Antes has exemplified what it means to be reflective and professional. I have learned new ways of thinking about childhood and early education from my mentor and friend, Dr. Sara Hanhan. My major advisor, Dr. Mary Lou Fuller, has taught me wonderful things about higher education advising and teaching through her personal example. To all of you I express my deepest gratitude and respect.

To the children who participated in the study, their parents and teachers, I give thanks for allowing me to share precious moments of childhood. I especially want to thank the director of the child-care center who must remain anonymous to protect the identity of the children involved. Your patience and help was most appreciated.

I also want to thank my many colleagues at Winona State University for their encouragement and interest in my successful completion of this project. I must especially thank Dr. Jean Billman, Dr. Wayne Erickson, Dr. Mary Rieder, and Cindy Landwehr, all of whom found ways to ease my burden so that I could bring this project to its conclusion.

The sacrifices, love and faith of Gloria and Charles Wade, my parents, have enabled me to progress successfully along life's path thus far. In my mother's memory and my father's courage, I have found the inspiration to undertake such a challenging endeavor.

To Dr. Tom Sherman, my husband and best friend, I owe much. Without his energy and constant search for a challenge in life, I would never have had the experiences that brought me in quest of a doctoral degree. And to Piper and Wade, our children, I give my love and appreciation for their patience in having a part-time Mom.

ABSTRACT

The purpose of this study was to explore the effect that the use of computer software which has been designated as more or less developmentally appropriate had on the language of young children. The guiding questions for the study were: (1) what common and varied patterns exist in children's language in response to software that has been designated by the Haugland/Shade Developmental Scale as more or less developmentally appropriate, and (2) how do individual and pairs of children respond to software that has been designated as more or less developmentally appropriate for children in their age range? Four pieces of software which varied in developmental appropriateness according to the developmental scale were selected to be used by dyads of preschool children. Eight videotaped observations were made of three dyads using all possible high/low pairings of the software. The investigator kept a log during the computer observations and also observed each participant during an activity time in the classroom. The videotaped observations were transcribed, sorted and analyzed for common and varied patterns of language for each software program and for each dyad across all four software programs. Analyzed patterns of language included use of Tough's seven categories of language, talkativeness conflict and cooperation, and language play. Tables of qualitative data were compiled to facilitate holistic analysis. Descriptions of common and varied patterns for each software program and for each dyad were written by integrating all of the data. Results of the study indicate that there was greater use of Tough's language categories of self/group maintaining, directing, and reporting than there was of reasoning, predicting, projecting and imagining. Use of the four latter categories was noted more often with the most developmentally appropriate software used in the study. Since one of the least developmentally appropriate programs produced patterns of language similar to the most developmentally appropriate program in terms of use of Tough's categories and talkativeness, questions remain concerning what factors other than developmental appropriateness may affect the language of dyads during computer use and concerning the criteria used to determine developmental appropriateness.

CHAPTER I

INTRODUCTION

The appearance of microcomputers in educational settings within the past decade has been met with some hesitancy and many questions, particularly in regard to the appropriateness and value of their use with young children in early childhood education settings. As with the introduction of any new technology or methodology, it is important to raise these questions and give thoughtful consideration to the effects of and best uses for computer technology in early childhood classrooms.

Advocates of using computers with young children have cited research which indicates some of the following advantages: increases in social interaction and cooperation; increases in independence and self-concept; increases in abilities to think, reason and solve problems; facilitation of children's abilities to construct and revise concepts; stimulation for children's play; teaching of computer skills and a positive attitude toward computers; and limiting of sex-role stereotypes associated with computers (Davidson, 1989).

Arguments against computer use with young children have centered around the possibilities of: inactivity of children during computer use; decreased oral language use and presence of adult oral language models; children in the preoperational stage of development using an abstract rather than concrete medium; dependence on teachers for quality computer experiences; and inferiority of computer graphics in comparison to other media (Davidson, 1989).

In addition to concerns regarding the use of microcomputers in early childhood education in general, there have been studies and questions regarding the most effective and beneficial types of software to use with young children. Prior studies of types of computer software designed for young children have explored the preferences of children in relation to gender as well as the types of behaviors generated by varying types of software (Clements, 1987a; Davidson, 1989). Studies examining the effects of computers and software on children's oral language have indicated that language activity was twice as high while using the computer in comparison to language activity while engaged in other classroom activities (Muhlstein & Croft, 1986) and that interaction with Logo evoked language rich in humor, imagination, emotion, play and fantasy (Genishi, McCollum & Strand, 1985; Wright & Samaras, 1986).

Guidelines for early childhood practices which are developmentally appropriate both in terms of age appropriateness and individual appropriateness have been recently developed and promoted by the National Association for the Education of Young Children (Bredekamp, 1986). Using these guidelines, Haugland and Shade (1988a & 1988b) developed ten criteria to be considered in evaluating the developmental appropriateness of microcomputer software for young children (Appendix A). The developmental criteria which they established have been used to evaluate software for young children along a continuum of developmental appropriateness. The ten criteria used in evaluating the software included: age appropriateness, clear instructions, expanding complexity, independent exploration, process orientation (as opposed to emphasis of end product), real world representation, technical features (graphics, sound, durability, etc.), trial and error opportunities, and visible transformations (objects and situations change as a result of the child's interaction with the software program).

The acquisition of language during the early childhood years has been widely recognized and articulated as a goal of primacy for most quality early childhood programs (Cazden, 1982). It is important, therefore to further consider language development in relationship to software that has been designated as more or less developmentally appropriate.

Language has been viewed by Wilkinson as "developing in response to the demands made upon the child" (cited in

Tough, 1979, p. 30). Tough (1979) has established seven categories of language that can be employed to identify the ways in which children use language to learn (Appendix B). These categories can be used as a tool "to describe what a child does with language" (p. 31) and include self-maintaining, directing, reporting, reasoning, predicting, projecting, and imagining as ways that language is used.

If microcomputers are to be used to maximize the development of the individual child, the effect of software designated as more or less developmentally appropriate on the language of young children is an important question for educators to consider.

Purpose of the Study

Although there has been some research regarding the effects of computers and software on the language of young children, these studies have not examined the relationship between the developmental appropriateness of software and its effect on language development. A fuller understanding of the software's propensity to enhance or deter children's language is needed so that teachers can better understand the effects of the technology, select software and employ strategies that enhance language development when children are interacting with microcomputers in the classroom.

The purpose of this study was to explore the relationships that exist between children's language and software designated by the Haugland/Shade rating scale as being more or less developmentally appropriate. The focus of the study, methodology employed and data analysis were primarily qualitative in nature so that the widest range of possibilities related to language behavior during computer use could be investigated. Also, recent concerns regarding the rights of young children as research subjects have suggested observational and descriptive research as a less obtrusive means for studying the development of young children, (Allen & Catron, 1990). This study was an in-depth investigation of the language of three pairs of children (a total of six children) as they interacted with four different pieces of computer software which varied in developmental appropriateness. The following questions served to guide the inquiry:

1. What common and varied patterns exist in children's language in response to software that has been designated by the Haugland/Shade Developmental Scale as more or less developmentally appropriate?

2. How do individual children and pairs of children respond to software that has been designated as more or less developmentally appropriate for children in their age range?

Methodology

The primary purpose of this study was to explore the variations of language brought about when young children interact with computer software which has been designated as more or less developmentally appropriate. The study was conducted by observing and videotaping three pairs of pre-school aged children (six children) as they interacted with the computer software. Four pieces of software previously evaluated according to the Haugland/Shade Developmental Scale were selected for use in the study. Two of the pieces of software received a low rating and two received a high rating according to the scale. Eight observations of each pair of children were conducted in order to observe all possible high/low pairings of the software included in the study. Two pieces of software, one of high rating and one of low rating, were presented to the children during each observation period. Observations were videotaped, and the researcher kept a log of each observation session.

Videotapes and logged notes were analyzed to look for patterns and variations of language that resulted from interaction with the software which varied in developmental appropriateness. Tough's (1979) seven categories of language use were utilized as one basis for comparison of the children's language. Other patterns of language use that emerged from the data were also investigated including talkativeness, conflict versus cooperation and language play.

Observations of the children took place in the computer room of the preschool in which they were enrolled. Eight children between the ages of four and five were selected on the basis of their availability during the time that the observations were scheduled, gender, the willingness of the child to participate, and consent of the parents. Observations took place every other day, or approximately two times per week for four weeks. Length of each observation period for each pair of children ranged from 11 minutes 20 seconds to 27 minutes 23 seconds.

Software for the study was selected from the 50 pieces rated according to the Haugland/Shade Developmental Scale. Basis for selection of the four software pieces included the following considerations: (1) elimination of software titles that were already owned by the preschool; (2) selection of two pieces with similar content but different in developmental appropriateness rating (i.e. The concept of opposites is presented in Juggles Rainbow rated at 3.5 and Stickybear Opposites rated at 6.5); (3) representation of software ranking at various points of the continuum designating developmental appropriateness (Alphabet Circus (1984) - 2.5, Juggles Rainbow (1982) - 3.5, Stickybear Opposites (1983) - 6.5, and Rosie, the Counting Rabbit (1987) - 9.0; (4) equalization of equipment needed to run the software effectively (i.e. Programs requiring use of computer peripherals such as joysticks, koala pad, printer, etc. were eliminated from consideration.); and (5) availability of software through local distributors.

A pilot study using one pair of children was conducted in order to determine the feasibility of the study in regard to the setting, software and mechanics of observation. As a result of the pilot study it was determined that additional observations of the children's language in their classrooms away from the computers would strengthen the data in regard to analysis of the language patterns of each child. The language of each child in the study was observed for 30 minutes during an unstructured play or activity time in the classroom to provide a basis for comparison of similarities and differences in language patterns during computer use.

The videotapes and recorded observations were analyzed both qualitatively and quantitatively. Tough's seven categories of language were used to analyze the language of each pair of children. Other categories of language also emerged from the data. The patterns and categories of language were anaylzed and described in terms of the relationships that existed between the software being used and the language observed for individual and pairs of children. Quantitative analysis included observation of the length of engagement with each piece of software during each observation period and the number of turns of talk for each piece of software during each observation.

Limitations

This study was limited to observations of three pairs of (six) children enrolled in a preschool of a small midwestern city. The generalizability of the data is limited by the small sample studied, the parameters of the physical environment for the preschool and the computer room, the limited number (four pieces) of software included in the study, and the variations in characteristics of the software. Another limitation was the elimination of one of the dyads in the analysis due to the withdrawal of one of the children from the preschool after the sixth videotaped observation.

While Tough's categories of language use were defined, it was still necessary for the investigator to make a decision in regard to the categorization due to the complexity and uniqueness of each language event. This is also reported as a limitation of the study. An inter-rater reliability procedure was employed to determine the extent to which this limitation influenced interpretation of the results of this study. The procedure is described in Chapter III.

The Haugland/Shade developmental ratings of software were revised and published in 1990 (Haugland and Shade, 1990). The developmental ratings of two of the four pieces of software used in the study changed due to these revisions. The rating for Rosie the Counting Rabbit was decreased from 9.0 to 8.5. The rating of Juggle's Rainbow was also decreased from 3.5 to 2.5. The original and revised Developmental Software Evaluations for these four pieces of software may be found in Appendix C.

Due to these limitations, the findings of this study apply only to the language of the children in the study as it related to the four specific pieces of software that were presented.

Definition of Terminology

Three terms important to the understanding of this study are developmentally appropriate, language, and turns of talk.

The term developmentally appropriate as defined by the National Association for the Education of Young Children (Bredekamp, 1987) includes the dimension of age appropriateness which refers to the predictable sequences of growth and change in human development as well as the dimension of individual appropriateness which recognizes that each child's development is unique.

Language, in this study, referred to the general ability to communicate including body language, written and oral language. Definitions of Tough's language categories may be found in Appendix B.

In transcribing the videotapes for analysis, the investigator, recorded a turn of talk as any verbal utterance by a child or the dyad which was concluded by an interruption by one of the children or by silence.

CHAPTER II

REVIEW OF THE LITERATURE

The benefits and appropriateness of microcomputer use by young children have been topics of debate and research since the early 1980's when microcomputers and software programs began to become available in some early childhood settings (Bowman, 1983; Burg, 1984; Hoot, 1983; Hungate, 1982; Partridge, 1984; Ziajka, 1983). Many of the same questions and concerns over children's exposure to other electronic and technological equipment, such as television, have been similarly raised concerning the microcomputer. The primary concern or question that has been addressed in regard to the microcomputer, as with other technologies, is "What effect will the use of this technology have on the development of young children?" For this reason literature addressing the effects of microcomputers on various aspects of young children's development is discussed in this chapter. Although the interrelatedness of all aspects of a child's development is acknowledged and emphasized (Bredekamp, 1987), for organizational purposes, the chapter gives separate consideration to the following areas of development: Computers and Language Development; Computers and Cognitive

Development; and Computers and Social/Emotional Development. A concluding section entitled Computers and Other Developmental Factors gives consideration to literature which does not fit in the three preceding categories.

Computers and Language Development

A number of studies have been conducted with the primary purpose of studying children's language during computer use. Observational studies, which had primary purposes unrelated to language, have also been able to document children's language during computer use and to draw conclusions concerning the effect of computers on the language of children. Cazden (1985) has labeled these two approaches to the study of language in the classroom as the process-product approach and the sociolinguistic approach. In the process-product approach, the observer has a predetermined set of categories which are investigated. The sociolinguistic approach enables the observer to construct categories through qualitative analysis of audio or videotapes. Some of the research regarding computers and children's language development falls into one or the other of these categories while other researchers have used a combination of these approaches (Emihovich & Miller, 1985; Shaw, Swigger, & Herndon, 1985). This review of literature will utilize two broad classifications of research (quantitative and qualitative) in discussing each area of development. Studies which focus on statistical analysis of data and predetermined categories of development will be discussed under the subheading of quantitative research. When researchers used a primarily qualitative approach to construct categories in describing the development of children, the discussion will be included under the subheading of qualitative research.

Quantitative Research

Using a Random House Criterion Reading test of basic skills for the concepts of above, below, left and right, a field test conducted by Piestrup (1981) showed an increase in children's understanding of these "basic pre-reading skills" (p. 3) after three weeks of using a computer program designed to teach those concepts.

In a study of the alphabet learning activities of preschoolers with their parents, Worden, Kee and Ingle (1985) compared the quantity and type of language interaction that occurred when parent/child dyads used alphabet books and alphabet computer software. Results of the study indicated that while there was less overall conversation during the computer activity as compared to the book activity, the length of conversations about particular topics during computer activity was longer due to the slower pace of presentation. Verbal events were categorized into ten classes. Parents exhibited a greater repertoire of verbal messages and also varied messages according to the task, using identification strategies of labeling more frequently in book reading and greater use of directives and comments (other than labeling) during the computer activity. Children predominantly used the two categories of identification and comments. Children mirrored the increase of elaborative comments by mothers in the computer task, but the same pattern did not follow for children working with their fathers, perhaps due to more inconsistency in verbal styles from task to task.

Using Flander's Interaction Analysis Scale as a means to describe the communication interaction of preschool children using computers, Klinzing (1985) reported the following frequencies of communication: silence (37.5%); giving information (21.4%); teacher initiated statements (17.8%); teacher response (7.6%); answering questions (5.4); laughing, exclamation (3.2%); giving directions (2.0); criticism (0.9%); and praise or encouragement (0.9%).

Qualitative Research

Jones (1987) noted an overall trend for girls to be more verbal than boys during use of a computer drawing program and reported that girls verbalized significantly more when referring to color selection. However, since the sample in this study consisted of twenty-one girls and seven boys attending a mixed-age preschool class, class composition should be considered when interpreting the results of this qualitative study.

Two separate qualitative studies examined the language of children when using Logo software. Three types of interaction (child and child, child and computer, and child and adult) were analyzed using videotapes of six focal children, (Genishi, McCollum, & Strand, 1985). Child and child interactions comprised 95 percent of the turns of talk in this study and were highly task related. Emihovich and Miller (1986) analyzed the discourse of two dyads of five year-old children given eleven Logo lessons over a three week period. Analysis using three different coding systems, including researcher-generated categories, revealed that: elicitations defined as questions generated to create a response of both teacher and children decreased with Logo experience; teacher directives decreased as peer collaboration increased; talk of children became increasingly task-oriented; and the use of metacognitive prompts by children remained stable.

The first phase of a naturalistic study designed to examine what kinds of interactions naturally occurred when children were introduced to computers revealed the uniqueness of each of the six children's interaction, the need for teachers to monitor and pair children carefully, and the effect of teacher bias against drill and practice software, (Killian, Nelson, & Byrd, 1986). Observations and videotaping used in the second phase of this naturalistic observation led the researchers to conclude that children "taught one another, took turns in increasingly self-regulated ways, encouraged and cheered others, sang spontaneously, and delighted over what they were able to make happen" (p. 9) while using a software program designed for making drawings on the computer screen (Byrd, Killian, & Nelson, 1987).

Based on observations of children using word processing programs as a part of the primary school language curriculum, Scott and Bell (1985) wrote that as children work "a great deal of discussing, hypothesizing, arguing, debating 'storying' and 'conferencing' takes place" (p. 8).

In a study designed to examine the effectiveness of the computer as a vehicle to enhance language experiences and the development of cooperative play, counts of language events and cooperative play among preschool children were made in both computer and non-computer activities (Muhlstein & Croft, 1986). Results indicated that language activity, measured as words spoken per minute, were twice as high (about 34 words per minute) at the computer than at any of several other free choice activities. Cooperative play frequencies were reported as: fishing game (98%); computer (96%); blocks (27%); play dough (14%); and coloring pens (8%). The investigators reported that the computer was the only activity which resulted in high levels for both language and cooperative play.

Four categories of interaction (successful child-child; successful child-teacher; unsuccessful child-teacher; unsuccessful child-child) were used to analyze 146 teaching/helping events observed as children interacted at the computer, (Paris & Morris, 1985). Findings associated with successful and unsuccessful teaching and learning were identified as: (1) children can be effective teachers/helpers; (2) both verbal instruction and demonstration were used effectively by children to teach; (3) children accepted help more readily when it was requested and rejected unsolicited help; (4) quizzing and offering help before children request it were unproductive uses of teacher time; and (5) effective uses of teacher time were encouragement of children to teach/help and responding to specific requests for help.

Inconclusive results regarding the use of a computer center to encourage language development of preschool children were reported by Nieboer (1983). Observations of children at the computer center indicated that while their language was full of imagination and descriptive detail when they chose to talk to the observer or other children, language was brief due to concentration on their computer creations. It was also noted that over time children conversed less frequently as they concentrated on their work at the computer.

In another study, children's and teachers' verbalizations while at the computer were coded along three dimensions including: who initiated interaction (self, peer, or teacher); content of the statement (computer related, program related, actor related or off task); and form of statement (question, bid for attention, instruction, or evaluation) (Rosengren, Gross, Abrams, & Perlmutter, 1985). Approximately fifty percent of the children's utterances could be coded according to these dimensions. Initiations of interaction were reported as self-initiated (69%), teacher initiated (13%), peer initiated (2.4%) or off-task (15%). Content of children's statements referred more to program related issues (54%) than to turn taking issues (18%) or computer related issues (13%). In regard to the form of statement, a majority were made up of instructions (59%) and questions (21%). Less than 6% of the statements took the form of evaluations about the programs or the performance of peers.

Shaw, Swigger, and Herndon (1985) examined 322 questions generated by second grade children during computer use and classified them according to eight categories specific to computer use. Most commonly asked questions related to the following three categories:

locating and using appropriate keys; program instructions; and how the computer accepts and processes data.

Beaty and Tucker (1987) characterized observations ofconversations between partners at the computer in the following ways: giving information; giving directions; asking questions; answering questions; settling turn-taking problems; telling what she/he plans to do next; critiquing the work of the partner; making comments about the software program; making up games; and making exclamations. Use of language to humanize or personify attributes of the computer (the cursor, or lines being constructed) has been observed and reported by Wright and Samaras (cited in Clements, 1987a).

The effectiveness of microcomputers to enhance language development in children with lags in language development have been described as well (Burg, 1984). Based on observations of a kindergartener who used a software program designed by his teacher, the observer wrote "Eric speaks more often. He tells longer stories. He gains confidence. Soon he may find it less risky to talk to peers", (p. 28).

Wright (1989) reported "serendipitous" findings in regard to observations of 50 four- and five-year-old children who dictated stories which were word processed on the microcomputer for them by adults. The researcher reported that 50% of the children engaged in oral revision strategies when dictating their stories which included: adding details to setting and characterization; replacement of story elements; and clarification. In addition, it was reported that children's responses indicated a growth of the awareness of the relationship between the spoken and written word. This was substantiated by children's observations about the length or number of words on the monitor as well as by questions about the story they had dictated (Is it printing my story? Did I really say all those words?).

Computers and Cognitive Development

There has also been interest in the possibility that the use of microcomputers could increase the cognitive abilities of young children. Numerous quantitative and qualitative studies have been undertaken in order to examine this possibility.

Quantitative Research

A longitudinal study comparing the long term effects of Logo computer programming with computer assisted instruction indicated that third grade children who had received three months of Logo instruction as first graders performed better in certain cognitive tasks than did children who had been assigned to the computer assisted instruction (CAI) group as first graders (Clements, 1987b). A comparison of pretest scores with scores of tests administered eighteen months after the end of the computer training provided suggestive evidence that the group with Logo experience displayed a greater ability to decide on the nature of problems and to select solution strategies and representations. Other elevated scores produced by the Logo group in the areas of reading vocabulary, comprehension, language mechanics, and mathematics were also attributed to metacognitive skills of comprehension monitoring, experience with a computer language, and problem solving, all of which were required of children using the Logo program. The CAI group scored above the district average on subtests which measured skills drilled during CAI instruction and near the district mean on most other subtests. The Logo group's percentile rank ranged from 13 to 22 above the district mean for all subtests except the reading subtests.

Using Piagetian-based tests of conservation of length, measurement and the ability to identify Euclidean shapes as pre- and post-test measures of cognitive development, the performance of kindergarten children exposed to Logo programming through a guided discovery approach was compared with a population of children who had no access to computers, (Howell, Scott, & Diamond, 1987). Results revealed no statistically significant differences between groups. This led the researcher to conclude that six months of Logo experience did not aid children in moving from the preoperational to concrete operational stage and lent support to Piagetian theory which would attribute the rate of cognitive development to normal developmental growth. The researcher attributed positive results of using Logo as reported in teacher anecdotal data to a "halo effect" (p. 257) resulting from the novelty of the experience. Positive effects reported by teacher observations included: increased understanding and use of the terms left and right in non-computer situations; less confusion over squares and rectangles; recognition of letters out of sequence; and greater detail in artwork.

A comparison of the effects of Logo computer programming experiences and computer assisted instructional (CAI) experiences on the cognitive skills, metacognitive skills, creativity, and achievement of first- and third-grade children was made with a control group who received no special treatment (Clements, 1986). Results of posttesting revealed that the Logo programming group scored significantly higher in the following areas: operational skills of classification and seriation; four metacomponents of problem solving; comprehension monitoring; and creativity (particularly originality and elaboration). There were not significant results of the treatment reported for achievement in reading and mathematics.

Mother/child dyads with children two and three years old participated in a study to determine the effect of different types of software on mother teaching behaviors and concept formation of young children, (Shade & Watson, 1987). Results indicated that mothers using more complex, discovery-oriented (microworld) software paid closer attention to children and adjusted teaching strategies over a four-day period more than did mothers using drill and practice software with their children. Children displayed more success, regardless of software type being used, when mothers used verbal instructions. While it did not yield statistically significant results, the use of microworld software resulted in three-year-old children learning to sort better than the group of three-year-olds using drill and practice software or than either group of two-year-olds. The researchers therefore concluded that the age of introduction to the computer should be dependent upon the content of the software.

In an effort to determine cognitive and behavioral characteristics of preschool children who demonstrated high levels of microcomputer interest, Johnson (1985) made freeplay observations and administered cognitive tests to four- to five-year old children. Teachers had rated children as highly involved, moderately involved, or little involved in using microcomputers in their preschool classrooms. Frequent computer users were most often older preschoolers, were equally likely to be male or female, and exhibited higher levels of cognitive maturity than the other two groups. Cognitive tasks related to use of symbols and two of three perspective-taking measures yielded significantly higher scores for frequent users. Analysis of play behaviors indicated that frequent computer users were significantly more likely to engage in single toy play and significantly less likely to engage in concrete and unordered play. Results were interpreted to suggest that children who have obtained a certain level of representational competence and who display "a tendency to engage in single-minded, sequential and abstract play" (p. 304) may be more inclined to use the microcomputer.

The microcomputer's capability to advance preschool children's cognitive abilities to match objects, recognize letters and words, and sequence the alphabet was found to be nonsignificant after three 20 minute sessions of computer interaction, (Goodwin, Goodwin, Nansel, & Helm, 1986). In addition, the researchers reported that adult-assisted computer instruction did not yield significant differences. A rating by children of their preferences to use the computer, have a book read to them, or play with a toy showed relatively low levels of interest in the microcomputer even after relatively brief periods of using it. This finding disputes the reports of others who have written concerning children's high levels of interest and enjoyment in using the computer (Beaty, 1987; Hyson & Morris, 1986; Wright & Samaras, 1986).

Qualitative Research

After 14 weeks of Logo instruction, an increase in conflict resolution, rule determination, and self-directed work was exhibited by dyads of children in a study by Clements and Nastasi (1988). While children from both the Logo and drill and practice groups displayed an almost equivalent percentage of time working cooperatively, the necessity for cooperative interaction, collaborative decisionmaking, and shared goals when using Logo were given as explanations for the resulting differences. The benefits of social-dialogic interaction as a means of cognitive development which were advanced by Piagetian and Vygotskian theories are enhanced by collaborative Logo interaction according to the researchers. Frequent computer users were most often older, equally likely to be male or female, and exhibited higher levels of cognitive maturity.

A preliminary study by Hungate (1982) tried to assess whether computer use during the kindergarten year had enhanced children's learning to write their name and telephone number, write and recognize numerals, count blocks and distinguish shapes. At the beginning of first grade, children with computer experience in kindergarten exhibited greater ability in the following areas: counting blocks; writing telephone numbers; and filling in missing numbers in their telephone number.

Computers and Social/Emotional Development

Since social and emotional development are important goals of early childhood education, a number of studies have investigated the effect of the microcomputer in this area of development. Interesting results have been revealed through quantitative and qualitative research.

Quantitative Research

A comparison of computer free play with more traditional forms of preschool play suggested that computers may foster socialization in young children (Hoover & Austin, 1986). Using the Parten/Smilansky social/cognitive play hierarchies and the Peabody Picture Vocabulary Test in addition to four methods of assessing sociometric status within the peer group for analysis, results of this study revealed: that children of differing sociometric status tended to use computers in different ways; and that females with above average receptive language ability tended to use computers longer and in group play situations more than females with below average receptive language abilities.

Behavior categories recorded at five minute intervals and a questionnaire administered to children following the fourth week of computer use were used to determine children's capabilities and attitudes about computer interaction (Shade, Daniel, Nida, Lipinski, & Watson, 1983). Analysis of data revealed that preschool children were capable of working with computers including ability to: use the standard keyboard; change software; and work together at the computer with minimal teacher supervision.

Two studies designed to investigate the effects ofcomputers on the social behavior of preschool children revealed that use of the computer did not diminish children's social interaction, (Nida, Lipinski, Shade, & Watson, 1984). Higher rates of physical, verbal, and non-verbal aggression in study two where there were 22 children competing for use of one computer compared to 12 children to one computer in study one, led researchers to the following conclusions: that a 10 children to one computer ratio allows appropriate access to the activity; and that the role of the teacher in structuring learning, turn-taking and control of the computer activity center is important.

This two study project also provided data for analysis of the independent variables of competence, gender, and free play choice in regard to the presence of a computer in the preschool classroom (Lipinski, Nida, Shade & Watson, 1984). Results indicated that while the introduction of the computer changed the pattern of children's free play choices initially, children's choices returned to baseline levels after the computer had been in the classroom for several weeks. Children judged to have high and medium levels of competence spent equal amounts of time at the computer. While the first study found that girls spend more time at the computer, no significant sex differences were reported in the second study.

After three weeks of observing preschool children's computer use, data were analyzed to determine whether natural groupings existed among computer users (Swigger & Swigger, 1984). Results revealed that: the presence of a computer did not disrupt the predefined social groups of children; that children preferred to interact with the computer as part of a group; and that except for heavy users, children used the computer with close friends.

When given a choice between using the computer and puzzles/bristle blocks, preschool children spent significantly more time with the puzzles/bristle blocks activity (Williams & Beeson, 1985). Differences in sex or age were not found to be statistically significant. The researchers suggested caution in making generalizations about young children's interest in the computer. They concluded that the computer is similar to other preschool activities in that some children like it while others do not.

Qualitative Research

Muller and Perlmutter (1984) conducted two studies to investigate preschool children's social interactions while working on problem-solving tasks. In the first study children were observed to spend 63% of the time with a peer while working at a microcomputer. Other results of the study revealed the following: time spent at the computer increased with age of the child; instances of sharing and self-initiation of interaction at the computer increased with the age of the child; there were no differences in activities of boys and girls at the computer. In the second study, children working with jigsaw puzzles spent only seven percent of the time working with peers and displayed fewer instances of cooperative interaction. By comparing these results, the researchers suggested that working at the computer may serve as a stimulus to social interaction in problem solving of preschool children.

An observational study of preschool children's computing activity indicated that children preferred to use the computer with a peer or the teacher rather than alone, (Rosengren, et al, 1985). Observations regarding differences in computer use according to age or sex were minimal.

Computers and Other Developmental Factors

Quantitative and qualitative studies have also revealed other interesting phenomenon in regard to computer use and development of children. Factors such as sex-stereotyping of computer activity, self-esteem, and creativity have been investigated.

Quantitative Research

Concerns over sex-stereotyping of the computer as a male domain have prompted several studies regarding this issue. Beeson and Williams (1985) analyzed observational data of children's choice of the computer as a child-selected activity. Results indicating no significant differences between male and female selection of the computer as a free choice activity led the researchers to support the ideas advocated by others in regard to preschool introduction of the computer. These advocates suggest early computer involvement as a means of avoiding development of computer sex-stereotyping in elementary school, (Beaty & Tucker, 1987). While Swigger, Campbell, and Swigger (1983) reported preschool female preference for CAI programs over Logo and the reverse preference for male preschoolers, Sherman, Divine and Johnson (1985) found that both preschool males and females preferred the problem-solving type of software to the drill and practice type.

A variety of developmental factors including self-esteem, learning aptitude and creativity were examined in relation to the influence of the use of more developmentally appropriate software versus less developmentally appropriate software by preschool children, (Haugland, 1988). Results of this study indicate that children who used more developmentally appropriate software experienced a significant increase in learning aptitude while children who used less developmentally appropriate software did not. The children using the less developmentally appropriate software spent approximately three times as much time working at the computer as did the group using the more developmentally appropriate software. In addition, the group using the less developmentally appropriate software experienced a significant gain only in the areas of concentration and short-term memory and about a 50% decrease in creativity.

The effect of the placement of the computer station on the interaction time and developmental gains of preschool children was compared in a classroom with a segregated computer center and a classroom with an integrated computer center (Haugland, 1989). While no significant differences in the amount of time spent at the computer center or the developmental gains of children in the two groups were found, the researcher did report that more interaction and more social awareness occurred in the room with the integrated computer center. It was also reported that one software program, Facemaker, used in the study was popular only in the room with the integrated computer center. The researcher suggested that certain types of software programs may be more popular with availability of social interaction.

Qualitative Research

Visual thinking is prevalent during early childhood and declines with age as words and verbal skills become dominant over pictures in the school setting. The potential of the visually oriented computer programs as a means to preserving the visual type of thinking which is related to creativity has been observed and described by Beaty and Tucker (1987).

Davidson (1989) has observed that computer software can serve as a tool in the fantasy play of preschool children just as do other types of preschool materials.

There is a growing body of research on the effect of computer use on the development of preschool children. However, few studies have been conducted to investigate the effect of developmentally appropriate software as evaluated by Haugland and Shade (1988a). Studies in the area of the effect of the microcomputer on the language development of preschoolers are limited as well. An exploration of common patterns and variations of language used by children in relation to software which is more or less developmentally appropriate is needed so that teachers can make more reflective choices of software when language development, which is a primary objective of many early childhood programs, is a goal for computer use by preschool children.

Furthermore, application of Tough's (1979) categories of language use, which are recommended as a means for teachers to assess and extend a child's verbal communication skills, is not found in the literature as having been applied to children's language during computer use.

In a 1986 review of literature on the use of computers with preschool children, research recommendations included a need for descriptive research on basic unanswered questions about preschoolers and computers (Goodwin, Goodwin, & Garel, 1986). One suggestion for needed descriptive research was an investigation of the verbal and nonverbal behaviors of preschoolers when sitting in front of a computer. The present study was an attempt, in part, to help fill that need.

CHAPTER III

METHODOLOGY

Since the primary purpose of this study was to examine the diversity of children's language in relationship to more or less developmentally appropriate software, a qualitative approach to research, which included unstructured observation, was taken. An interest in an in-depth analysis of the language called for a small sample of participants who could be videotaped while interacting with the computer software. Videotaping also provided the possibility for observing factors related to oral language such as body language. Videotaping pairs of children as opposed to individual children or children paired with an adult was decided upon since previous studies have indicated that working with computers results in more social interaction among children than during other activities (Genishi, et al, 1985; Killian, et al, 1986; Muhlstein & Croft, 1986).

Selection and Description of the Research Site

The desire to analyze the influence that computer software had on the language of children necessitated that computer interaction not be a new experience in the school setting for the participants. Therefore, it was necessary to find a preschool setting which had implemented computer use with the children. A large preschool and child care center (enrollment of 250 children) in a mid-size midwestern community was willing to participate in the study. The structure of preschool was described by the director as a non-profit, state licensed child care center sponsored by a church, but operated by a separate Board of Directors. The operating handbook of the preschool outlined the philosophy and goals of the program as follows:

> The program at . . . is designed to serve the needs of the "Total Child" (sic), physically, emotionally, socially, and educationally, all of which helps the child to develop a healthy concept of himself. We draw on the theories of many psychologists and early childhood educators, but the model under which we operate is Piagetian in nature. A child is able under this, to build on logical knowledge and this becomes a vehicle for developing a healthy self-concept.

Observations took place in the preschool's "computer room" equipped with two Apple IIe computers and colored monitors. This was one of several special activity areas scheduled for daily use by groups of children attending the preschool. The small computer room also contained other activities including books and table toys which the children were able to select. The room was off to the side of the "trike" room. Therefore computer interaction was one of several activities from which children could select when their group was scheduled for this area. The computers had been a part of the preschool program for about two years at the time that this study was undertaken. In an effort to provide the preschool program with the least amount of disruption it was decided that the computers would remain in the computer room and that observations would take place during the hours when this activity area was not scheduled for use by other groups of children.

The classroom from which subjects were selected was a large area in the basement of the church. Approximately 65 four- and five-year-old children occupied this classroom under the guidance of five teachers. While children were assigned to a specific area and teacher, many activities and lessons were planned by the team of teachers. Therefore children moved quite freely among activities and were accustomed to working with a variety of children and adults.

Selection and Description of the Participants

In a previous study it was observed that children under the age of four seldom engaged in computer activity (Anselmo & Zinck, 1987). These researchers explained the increased interest in computer activity at age four based on Piaget's observations that in the middle of the preoperational stage, from 2 to 7, children begin to engage in an intuitive, prelogical form of thought. Therefore, it was determined to observe preschool children who would be entering kindergarten during the school year following the study. The participants' ages ranged from 4 years, 8 months to 5 years, 3 months. The mean age for the participants was 4 years, 11 months.

In order to eliminate language ability as an influencing variable, the participants selected all fell within the normal range for language according to the DIAL-R screening assessment used by the preschool (Mardell-Czudnowski & Goldenberg, 1983). The director of the preschool checked the children's files to verify that the scores of all participating children fell within this normal range. Other factors which influenced the selection of the participants included: the permission from parents for children to participate in the study; availability of the children during the days and hours that the study would be conducted; an equal balance of boys and girls to construct dyads of boy-boy, girl-girl, and boy-girl composition; and the willingness of subjects to participate.

To provide for the possibility that children would be unable to complete the study and to assure that the language of six children could be analyzed, four dyads of children participated in the study. The director of the center took the responsibility for obtaining signed parental consent forms which had been prepared by the investigator. A sample of the consent form can be found in Appendix D. Because it was impossible to predict which dyad or children might not complete the study, it was determined to include two boy-girl dyads and one of each single sex dyad (boy-boy and girl-girl). Formation of the dyads was based upon which pairs of children were available and willing to leave the classroom together during the first observation. Dyads remained the same throughout the study. In other words, the children had a constant computer partner throughout the study. One subject in the girl-girl dyad left the preschool before completion of the study. Therefore the analysis of the data did not include observations of the girl-girl dyad. The elimination of the girl-girl dyad was reported as a limitation of the study.

Selection and Description of Software

Four pieces of software were selected for the study from among more than 50 software programs which had been evaluated according to the Haugland/Shade Developmental Scale (Haugland & Shade, 1988b). The developmental appropriateness of software was determined by ten criteria which are related to the developmentally appropriate practice guidelines established by National Association for the Education of Young Children (Bredekamp, 1987). The ten criteria were defined by Haugland and Shade (1988a) as follows:

1. Age Appropriate. The concepts taught and their presentation must reflect realistic expectations for the children.
2. Child Control. Children are active participants, initiating and deciding the sequence of events rather than reactors, responding to pre-determined activities. The software facilitates active rather than passive involvement (Olds, 1985). The pace is set by the child not the program. Children can escape (ESC) to the main menu from any portion of the program.
3. Clear Instructions. Since the majority of preschool children are non-readers, verbal directions are essential (Fournell, 1985). If printed directions are used, they are accompanied with verbal directions. Directions are simple and precise. Graphics accompany choices to make options clear to children.
4. Expanding Complexity. Entry level is low, children can easily learn to successfully manipulate the software. The learning sequence is clear; one concept follows the next (Vartuli, Hill, Locar, & Cacamo, 1985). The software

expands as children explore, teaching children and skills they are ready to learn. Through the expanding complexity of the software, children build structures and knowledge gaining "powerful ideas or intellectual skills" (Papert, 1980b, p. 204).

5. Independent exploration. After initial exposure children are able to manipulate the software without adult supervision.

6. Process orientation. The process of using the software is so engaging for children that the product becomes secondary. Children learn through discovery rather than being drilled in specific skills. Motivation to learn is intrinsic, not the result of praise, smiling faces, or prizes. It reflects Papert's vision of a "discovery computer environment" (Papert, 1980a).

7. Real world representation. The software is a simple and reliable model of some aspect of the real world, exposing children to concrete representation of objects and their functions.

8. Technical features. The software has high technical quality that helps the young child attend (Wright & Huston, 1983). It is colorful and includes uncluttered, realistic animated

graphics. There are realistic sound effects or music that correspond to objects on the screen. The software loads from the disks and runs fast enough to maintain children's interest. Disks are able to withstand continual use by children in the classroom when given reasonable care.

9. Trial and error. The software provides children many opportunities to test alternative responses. Through resolving errors or solving "puzzlement", children build structures and knowledge (Lawler, 1982).

10. Visible transformations: Children have an impact on the software, changing objects and situations through their responses. Children are exposed to hidden processes and learn the nature of cause and effect relationships. The software is a "process highlighter," allowing children to view processes and their effects that are more difficult to observe in daily living (Chaille & Littman, 1985). (p. 39)

If the software being evaluated by Haugland and Shade met all of the developmental characteristics for any one criterion, it received 1 point. At least half of the characteristics had to be met in order for the software to receive a score of .5 for any criterion. A score of zero indicated that less than half of the characteristics were met for that particular criterion. Therefore the software evaluated by Haugland and Shade received a score along a continuum from 0 to 10 when all criteria were considered. Software receiving a low score is less developmentally appropriate than software receiving a high score. According to Haugland and Shade (1990), software receiving a score of 7.0 or above is considered to be developmentally appropriate. Haugland (1988) referred to software with a score with a score of 7.0 or more as developmental software. Software with a score of below 7.0 was considered to be nondevelopmental. A sample of the software evaluation form used by Haugland and Shade can be found in Appendix A.

In an effort to prevent the influence of variation in children's selection or use of software, the study did not include any programs which were contained in the preschool's software collection. While there was no attempt to determine if children had exposure to the selected pieces of software outside of the school, none of the children indicated that they were familiar with any of the software introduced. Other factors considered in the software selection included: selection of software at various points along the developmentally appropriate continuum (2.5, 3.5, 6.5, 9.0); consideration of peripherals needed to run the software (since the children were only accustomed to keyboard use and there was not a printer available, certain pieces of software were eliminated); selection of software with similar content but at different points on the developmentally appropriate continuum (Juggles' Rainbow and Stickybear Opposites both deal with opposite concepts but have scores of 3.5 and 6.5 respectively); and availability of software from distributors. Haugland and Shade's (1988b) Developmental Software Evaluation Form can be found in Appendix C for each of the four pieces of software used in the study. The abbreviations indicated in parenthesis have been used throughout the study in referring to the four pieces of software. A brief description of each of the four software programs used follows:

Alphabet Circus (AC) provides six different activities to help children learn about the alphabet. These include letter recognition, alphabetical order, keyboarding, text creation and problem solving. (Developmentally appropriate score = 2.5).

Juggles' Rainbow (JR) presents the concepts of above, below, left and right. Three games which increase in level of difficulty allow children to work through a series of exercises in practicing these concepts and lead to creation of a rainbow, butterfly, or windmill at the end of the exercise. (Developmentally appropriate score = 3.5).

Stickybear Opposites (SBO) provides animated opposite concepts which are randomly presented to the children. Opposite concepts include slow/fast, night/day, up/down, stop/go, full/empty, etc. (Developmentally appropriate score = 6.5).

Rosie the Counting Rabbit (RCR) presents a story of a rabbit who finds many things in her environment to count. Children are able to animate the story as well as to write, edit, label, and illustrate the story as they like. A companion storybook is provided with the software. (Developmentally appropriate score = 9.0).

Observation Schedule

In an effort to assure that children were provided with equal opportunities to respond to each computer software program included in the study, several variables were taken into consideration in the observation schedule. One-half of the observations were scheduled during the morning hours and one-half were scheduled for the afternoon hours so that the energy level of the children would minimally influence the amount of language offered by them. Children were presented with two software programs during each observation in an effort to control variation in talkativeness from day to day. The schedule also was planned so that the order of presentation (i.e. first or second) was not a variable influencing the amount of language observed. Each computer software program was scheduled to be presented in the first and second order an equal number of times. In order to present all four computer software programs in all possible pairings of first and second order, eight observations were scheduled. For observations 2 and 4, the order of presentation of the software is simply a reversal of observations 1 and 3. This was planned in an effort to provide the children with the opportunity to become more familiar with each piece of software within a short time span. Throughout the study the letters A and B were used to indicate whether the software was presented first or second during each observation. Therefore each observation was labeled 1A, 1B, 2A, 2B, etc. Table I illustrates the schedule followed in presenting the software for each of the eight observations.

TABLE 1

Observation Schedule

OBSERVATION #	1	2	3	4	5	6	7	8
PRESENTED FIRST (A)	SBO	JR	RCR	AC	SBO	JR	AC	RCR
PRESENTED SECOND (B)	JR	SBO	AC	RCR	AC	RCR	SBO	JR
TIME OF DAY	PM	AM	PM	AM	PM	AM	PM	AM

The dyads of children determined the length of time that they interacted with each piece of software. The first computer software program scheduled for each observation was booted up before the children came to the computer room. When the children were ready for the second program scheduled for the day, they requested it from the observer. In other words, children were not forced to interact with each program for an equal number of minutes. When children showed visible signs of disinterest or fatigue, the investigator reminded them of the availability of another piece of software or to "let me know when you want to go back to your room". The need for these reminders became less frequent with each subsequent observation.

In addition, each child was observed in the classroom setting by the investigator during either the morning or afternoon self-selection time. The procedure for these observations will be described later in this chapter.

The Pilot Study

A pair of children was selected to participate in a pilot study before the actual study began. The purposes of this pilot study were: (a) to provide extensive experience for the observer with the selected software and video equipment to be used in the study; and (b) to place the observer in the preschool setting so that she would become a familiar figure to the children at the preschool. Four videotaped computer observations (rather than eight) and two classroom activity observations were conducted in order to fulfill these purposes.

Videotaped Computer Observations

As previously explained, the preschool's existing "computer room" was used as the setting for the videotaped observations of computer use. Prior to bringing children to the computer room, the observer would set up the video camera, microphone, and "boot up" the first piece of computer software scheduled for use that day. Dyads of children went to the computer room based on their availability and willingness to leave the classroom activities. In other words, no effort was made to have the dyads participate in the observations in any type of sequential or rotating fashion.

Upon entering the computer room for the first time, the presence of the videocamera and microphone were explained to the children as vehicles to enable me "to hear and remember what you say and do". Several of the children expressed familiarity or previous experiences with a video camera. Throughout the study, the video camera provided little distraction to the children although a few of them on occasion approached the camera and looked or made faces into the lens. The limited distraction may have been due also, in part, to the placement of the video camera on a counter to the left rear side of the children and the computer. The microphone, on the otherhand, was placed closer to the children on the counter to the left of the computer and stimulated more curiosity. Children would occasionally touch or speak into the microphone as a means of experiencing and understanding how it worked. In these instances, the observer would simply state "Pretend the microphone isn't there", and the child would resume interaction with the computer and her/his partner.

Directions for using each piece of software were given during the observation in which it was initially used. Thereafter, the observer gave additional instructions when the children requested them (How do we do this?, What do we push?, etc.) or when it seemed apparent that the children needed a reminder of how to use the software. The role of the observer for the remainder of the videotaped observations was to sit out of the camera's range, to be available for questions and assistance, and to keep a brief log of the observation, noting general information and impressions to keep in mind during analysis of the videotapes at a later date.

Upon entering the computer room, children moved toward the chairs facing the computer and selected one placed on the left or right. The observer made no attempt to control the left/right seating position. It was interesting to note however, that the children seemed to "self-assign" themselves a seat. Once they selected a seat for the first observation, most were prone to take that same seat during subsequent observations. Table 2 reflects the left/right

TABLE 2

Self-selected Left/Right Position at the Computer

	Dyad 1		Dyad 2		Dyad 3	
Observation 1	L	R	L	R	L	R
	B	Ja	R	S	H	Jo
Observation 2	L	R	L	R	L	R
	B	Ja	R	S	H	Jo
Observation 3	L	R	L	R	L	R
	B	Ja	R	S	H	Jo
Observation 4	L	R	L	R	L	R
	B	Ja	R	S	*Jo	H
Observation 5	L	R	L	R	L	R
	B	Ja	R	S	*Jo	H
Observation 6	L	R	L	R	L	R
	B	Ja	*S	R	*Jo	H
Observation 7	L	R	L	R	L	R
	B	Ja	R	S	H	Jo
Observation 8	L	R	L	R	L	R
	*Ja	B	R	S	*Jo	H

Key:
L = Left
R = Right
Initials (Ja, B, R, S, Jo, H) represent children's pseudonyms which are introduced in Chapter 4.
* Indicates seat change which varies from Observation 1

seat selection by each dyad of children for the eight observations.

It was also interesting to note that children did not choose to change seats during any of the eight observations. With the exception of the one of the children in the pilot study, none of the children exhibited interest in or distraction by the other materials or toys in the computer room during any of the observations.

At the conclusion of the eighth videotaped observation, the investigator privately asked each of the six children to indicate first, second, third, and fourth preference for the four pieces of software. This was conducted in the following manner:

> The illustrated covers for all four pieces were laid out on the counter. The investigator then said to the child, "Show me the one you liked the best". After the child indicated her/his first choice, that cover was removed from the counter. The investigator then said, "Now show me which of these you liked best". The second selection was then removed and the statement "Now show me which of these you liked best" was repeated to determine the third and fourth preference. The placement of the software covers on the counter (left to right) was held constant for all six children.

After all eight videotaped observations had been conducted, they were viewed, timed and transcribed manually by the investigator. A sample of the form used for transcribing can be found in Appendix E. The size of the actual transcription sheet was 8 1/2 x 14. Information recorded at the top of the transcription sheet included the names of the children in the dyad, their position at the computer (left or right), the observation identification number (1A, 1B, 2A, 2B, etc.), the title of the software being used, and the duration of software use (length of time). Columns were used to record the initial of the child speaking, verbal language, nonverbal actions, and observer language. The coding column on the left was used by the investigator to categorize and classify patterns of language later.

Approximately 234 pages of transcriptions were examined from a variety of perspectives. These included: (1) counting the number or <u>turns of talk</u> by each child and by the dyad as a total; (2) using colored highlighter to classify language according to <u>Tough's (1979) seven categories of language use</u> and then looking for the categories most commonly used in relation to each of the four pieces of software; and (3) examining the transcriptions for <u>other common and varied patterns cf language</u> by individual and dyads of children in relation to the software being used. Each of these analyses has been more fully described in the paragraphs below.

A turn of talk was counted as any verbal utterance by a child which was concluded by an interruption by the other child or by silence. It could vary from a one word utterance or incident of laughter to a 2-3 sentence expression of thought. This method was similar to a previous study which counted statements of children at the computer as a separate utterance when it was separated from other speech by a pause or if a shift in content occurred (Rosengren, et al., 1985). Instances where both children in the dyad verbalized simultaneously with laughter, the alphabet song, or another identical utterance were counted as one turn of talk. The turns of talk were analyzed in relation to the amount of time that the dyad spent using each piece of software during a particular observation.

Tough (1979) described her seven categories of language use as a "commonsense view of the use of language" and suggested that "its purpose is to help teachers identify ways of using language that contribute to children's learning" (p. 31). The classification system includes: (a) self-maintaining language which enables an individual to satisfy physical and psychological needs by "supporting or asserting self in relation to others" (p. 32); (b) directing language which is used to direct, guide, or control our own actions or to instruct, demonstrate or demand a particular course of action by other people; (c) reporting language which allows expression of present and past experiences based on what the individual sees or recalls; (d) _reasoning_ language which is used to express causal and dependent relationships; (e) _predicting_ language which allows anticipation and preview of future events; (f) _projecting_ language which enables the individual to cast her/himself into situations that have not actually been experienced; and (f) the _imagining_ use of language which is reserved to designate talk which is wholly the product of the imagination. A table delineating Tough's seven categories for uses of language and supporting strategies can be found in Appendix B.

The investigator used seven colors of highlighter to code examples of language which could be classified according to Tough's (1979) categories of language use. It should be noted that not every turn of talk was classified since Tough's system does not claim to be all inclusive for every instance that language is used.

> We do not claim that everything that a child says will fit into one or another of the categories which make up the classification. We claim only that it helps us to differentiate a number of characteristics of children's use of language and gives us a means of talking about language in a way that has some practical value for our work in the classroom. (p. 31)

Therefore, if a turn of talk fit into one of Tough's seven categories, it was color coded. If it did not fall into any of the seven categories, it was left uncoded. The directing category was also labeled S or O to indicate language which was self-directing or directing of others respectively. The transcription sheets were then sorted according to the four titles of the software used and examined to determine if a prevalence of any of Tough's seven categories of language use existed for individuals and dyads when using a particular piece of software.

In order to provide reliability for this procedure, another rater, who was familiar with Tough's language categories, used photocopied transcripts to categorize samples from the second, fourth and eighth observations. The color coding did not show up on the photocopied transcripts providing the other rater with an unbiased means of categorizing the samples. An inter-rater reliability index of .84 for use of Tough's language categories was calculated by this procedure.

In analyzing the transcription sheets for other common and varied patterns of language two separate procedures were used. The transcription sheets were first sorted according to software titles and examined for common and varied patterns of language among all the dyads. A list of words describing common and varied patterns of language as well as examples of language illustrating these patterns was compiled for each piece of software. The transcription sheets were then regrouped and sorted for each dyad. They were examined with a focus on common and varied patterns of language across all eight observations for the dyad and each child. Similarly, a list of words describing the common and varied patterns of language and examples of language illustrating these patterns was compiled for the dyad and for each child in order to write a narrative description of language during use of all four software programs. The logged notes for each observation of each dyad, which had been word-processed onto two or three pages for each dyad, were also referred to in creating these descriptions. After subdividing the transcription sheets for each dyad according to software title, this same procedure was followed in order to describe the common patterns and variations in language in relation to the software that the dyad was using.

Classroom Observations

In order to augment the videotaped observations and to provide a comparison of each child's language in another setting, the investigator spent 30 to 45 minutes observing each of the participants during an unstructured indoor classroom period. During this time, children were free to choose among a variety of activities available in the classroom. Some of these activities were planned by teachers, and others were self-selected, child-initiated play activities. Because there was a large number of children in this classroom and because the children moved freely and frequently among activities in the classroom, the investigator did not attempt to tape record any language or conversations of the children in the classroom setting. Rather, the investigator positioned herself near the child's activity and wrote a narrative observation of the child's activity and language during the observation. When the child moved to a different part of the room to another activity, the investigator would finish writing a description of the activity and language observed and then move closer in proximity to the child's new activity. Since the investigator had become quite familiar to the subjects, none of them seemed to be inhibited by her presence during the classroom observation periods. Comments by the investigator were minimal responses to something that the subjects asked of or wanted to show her.

The narrative description of each child's classroom observation was later word processed and used as a basis of comparison for the descriptions of language that each child used during the videotaped computer observation. These comparisons are included as a part of the description of each child's language in Chapter IV.

Integration of the Data

The data obtained from analysis of the videotaped computer observations, the notes logged during the computer observations, and the narrative descriptions of each child's activities and language during the classroom observation were grouped and described using a largely qualitative approach. Certain quantitative factors, such as length of time spent with each software program and turns of talk, were also considered and included in the descriptions in order to provide a more wholistic picture of language during the computer observations. Descriptions of the pairs of children and their responses to the software were also written. For each dyad a description of their language during computer use was made under the following headings: use of Tough's categories; and common and varied patterns of language including talkativeness, competition and collaboration, and play with language in relation to software programs. Descriptions of characteristics of language by each child in the dyad were also written and concluded with a comparison to the language observed during the classroom observation.

As a result of data analysis and integration, descriptions of common and varied patterns of language related to use of four software programs as well as common and varied patterns of language unique to each dyad and child were the outcomes of this study. These descriptions follow in Chapter IV.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter includes presentation and discussion of the results found in regard to the two questions which guided this study. The two questions were:

1. What common and varied patterns exist in children's language in response to software that has been designated by the Haugland/Shade Developmental Scale as more or less developmentally appropriate?

2. How do individual children and pairs of children respond to software that has been designated as more or less developmentally appropriate for children in their age range?

Using videotaped observations which were transcribed, grouped and analyzed from several perspectives, notes logged during the computer observations and narrative descriptions of each participant's language and activities during the classroom observation, two types of descriptions were written. The first set of descriptions focuses on patterns of language in relation to the software while the second set of descriptions focuses on patterns of language for each dyad and the individual children. The first descriptions were written to answer the guiding question in regard to common and varied patterns of language in response to each of four software programs which varied in developmental appropriateness as designated by the Haugland/Shade Developmental Scale. The descriptions in the second part of the chapter focus on the common and varied responses of the participants when using all four software programs.

Common And Varied Patterns of Language In Response To Four Software Programs

The guiding question which provided the focus for the discussion of results in the first part of this chapter was:

> What common and varied patterns exist in children's language in response to software that has been designated as more or less developmentally appropriate by the Haugland/Shade Developmental Scale?

In discussing these results the software programs are presented in the order of their developmental appropriateness score, from less developmentally appropriate to more developmentally appropriate. Each software program is discussed in regard to: 1) the length of time spent with the program; 2) patterns of Tough's categories of language use; and 3) other common and varied patterns including turns of talk/talkativeness, conflict and cooperation, and language play. This section of the chapter concludes with a discussion of common and varied patterns of response to all four software programs.

Alphabet Circus (AC), which is ranked as 2.5 by the Haugland/Shade Developmental Scale for all games on the software program except Marquee Maker, was used a total of 148 minutes and 46 seconds by the three dyads of children. This was the greatest amount of time spent with any of the four software programs. This result is consistent with the findings of Haugland (1988) who reported that children who only had access to less developmentally appropriate software used the computer approximately three times longer each week than did those children who only had access to more developmentally appropriate software. Table 3 reports the total length of time spent using each software program by all dyads for each of the four observations it was used. With the exception of observation 4A, the length of time spent using AC increased with each subsequent observation.

In this study children were free to change back and forth between all games on a software program. In the case of AC, no attempt was made to separate the data for use of the game Marquee Maker. Since the Marquee Maker game was ranked as 6.5 on the Haugland/Shade Developmental Scale, a true ranking of 2.5 for developmental appropriateness of AC could not be applied to the results of this study. While Marquee Maker was used by the participants, it was not used extensively except by one dyad.

Analysis of turns of talk using Tough's categories of language use indicated that all seven categories were used at least once by the participants in this study during the use of AC. The use of <u>reporting</u> language was the most

TABLE 3

Total Length of Time Spent Using Software Programs

Software	AC	JR	SBO	KCR
Observations				
1A			26m 18s	
1B		41m 12s		
2A		27m 24s		
2B			32m 42s	
3A				30m 48s
3B	34m 20s			
4A	26m 3s			
4B				36m 3s
5A			13m 22s	
5B	42m 46s			
6A		12m 15s		
6B				41m 45s
7A	45m 37s			
7B			11m 54s	
8A				33m 42s
8B		19m 45s		
Total	148m 46s	100m 36s	84m 16s	142m 18s

(m = minutes, s = seconds)

frequently used strategy for AC. When compared with the other three software programs, reporting occurred more frequently during use of AC than during use of any other software program as indicated by the asterisk in Table 4. This table summarizes the occurrence of Tough's seven categories of language use for all four software programs. Totals for the number of turns of talk observed and the number of turns of talk categorized for each software program are also given in this table.

The frequent use of reporting in AC was characterized by naming letters and naming or describing the circus characters associated with the letters. These types of reporting episodes were found in all four observations and were used by all 3 dyads as exemplified below:

Observation 3B

Dyad 1 (Ja & B): (B) You pushed A. (Ja) A was for this.
(Ja points to picture of acrobat on letter sheet).

Dyad 3 (Jo & H): (Jo) E! (H) Elephant (Jo) Elephant (H)
That's what I like, don't you! (Jo) HOOO!
That's a juggling fire man. (Jo) O; (H) O (Jo) Ostrich.

TABLE 4

Summary of Use of Tough's Categories of Language Use for Four Software Programs

Software	AC	JR	SBO	RCR
Tough's Categories:				
Self/Group Maintaining	233	92	100	349*
Directing (Total)	395	118	109	565*
Self-directing	(146)	(32)	(14)	(220)*
Directing others	(197)	(68)	(64)	(267)*
Collaborating	(52)	(18)	(31)	(78)*
Reporting	468*	114	77	203
Reasoning	76	28	13	144*
Predicting	6	2	2	13*
Projecting	1	0	0	11*
Imagining	5	0	3	30*
Total Turns Of Talk Categorized	1184	354	304	1315*
Total Turns of Talk Observed	1449	491	498	1736*

* = greatest frequency for that category

Observation 5B

Dyad 1 (Ja & B): (Ja) E, E (B) That wasn't E. Now what one? Yeah, the giraffe.

Dyad 3 (R & S): (R) All right, go. Now push tiger. (S) It's not a tiger. It's a lion.; (R) And the lion.

Observation 7A

Dyad 2 (R & S): (R) That giraffe looks kind of funny doesn't he?

Dyad 3 (Jo & H): (Jo) He's a tall man.

The familiarity of and interest in circus characters and the alphabet are probable explanations for the high level of reporting associated with this software program. The circus had been a recent curricular theme at the preschool.

Directing was the second most common category of language used in conjunction with AC. The pattern that was evident in all three subcategories of directing (self-directing, directing others, or collaborating) was also related to circus characters and letters as participants directed what letter or circus character to select next. This strategy was commonly used by all 3 dyads in all four observations. A sample conversation of one of the dyads illustrates the typical directing language used in conjunction with AC:

Observation 5B

Dyad 1 (Ja &B): (Ja) Now what one? (B) N (Ja) N (Ja) Now what one? (B) The monkey! Yeah, the monkey! (Ja) Where's the monkey? (B) Right there. (Points to screen). (Ja) Where's the monkey on there? (Referring to letter sheet). (B) Let's do P - P for man. (Ja) now what one?

Expressing desires in regard to which character, letter or game to choose, turn-taking and likes and dislikes were common patterns of <u>self/ group-maintaining</u> language during use of AC. Samples from each of the dyads illustrate these patterns as follows:

Observation 5B

Dyad 2 (R & S): (S) You want yo-yo man. (Laughing); (R - later in the same observation) I want to press it this time.

Observation 7A

Dyad 1 (Ja & B): (Ja) O.K. Now I want to do L. I can find L. (Ja) Now I want to do... (B interrupts). Now it's my turn to do the letters (Hands paper to Ja). (Ja) Nah-uh! (Hands paper back to B). (B) No, no! It's my turn. (Ja) Let's just not look at the paper. Let's... My side is right here and your side is right here. Here's yours. (Pointing to left and right side of keyboard).

Dyad 3 (Jo & H): (Jo) Yeah, I'm so good at this, aren't I? (H) Yeah, we like this one don't we? (Jo) No, we hate that one.

Turn-taking also appeared as a pattern of language for the reasoning category as demonstrated by this example for dyad 3 during observation 5B:

(Jo & H): (H) Now you get to do two times. (Jo) We'll both do two times.

The use of reasoning to explain the score of the game or the mechanics of a game emerged as a common pattern, particularly during later observations such as the following:

Observation 7A

Dyad 2 (R & S): (S) We got 2. (R) No, 1, 2, 3. We got three of them. (S) 1, 2, 3 (R) Now it has to start over. We want the one where all of them hit the floor, don't we? (S) That's the next one. (S - Later in the observation) It's right. The only thing is if he goes like that (Shaking her head yes like the ringmaster in the corner of the screen) with his hand up, you're right. (R) Now it's gonna tell you how many we got.

While there were relatively few instances of predicting, projecting or imagining language during use of AC, only one software program surpassed AC in use of these categories as reported in Table 4. Familiarity of the circus theme sparked one child's ability to imagine he was the circus ringmaster as he announced into the microphone that "The cir cus is a bout to begin" (separating syllables for emphasis).

In analyzing turns of talk and talkativeness for AC, Tables 5 and 6 were helpful. Table 5 summarizes the total turns of talk for each software program during each observation. Analysis of the turns of talk for each observation shows that the number was fairly consistent during the first and third observation of AC. The decrease in the total turns of talk (146 turns of talk Table 5) and the amount of time spent with AC (26 minutes 3 seconds Table 3) during the second observation (4A) might be explained by the fact that the children were aware of which software program they would be using during the second half of the observation. Their eagerness to use the second program probably influenced the amount of time spent with AC as well as the turns of talk observed. The greatest number of turns of talk observed for AC occurred during the last observation when 596 turns of talk were recorded. This is a notable increase over the other three observations.

By dividing the total turns of talk for AC during all four observations (Table 5, 1449) by the total amount of time the program was used (Table 3, 148m 46s), it was possible to get a sense of the amount of talk, or talkativeness, that the program produced. This figure was calculated to be 9.7 turns of talk per minute when

TABLE 5

Turns of Talk for Software Programs During Each Observation

Software	AC	JR	SBO	RCR
Observations				
1A			85	
1B		91		
2A		90		
2B			166	
3A				245
3B	352			
4A	146			
4B				405
5A			122	
5B	355			
6A		99		
6B				550
7A	596			
7B			125	
8A				536
8B		211		
Total	1449	491	498	1736

TABLE 6

Talkativeness Calculations For Four Software Programs

	Total turns of talk observed	Total time used	Turns of talk per minute
Software			
AC	1449	148m 46s	9.7
JR	491	100m 36s	4.9
SBO	498	84m 16s	5.9
RCR	1736	142m 18s	12.2

m = minutes, s = seconds

calculated to the nearest half minute. A summary of this talkativeness calculation is provided in Table 6.

According to the figures presented in Table 6, the talkativeness during use of AC was surpassed by only one of the other three software programs. Again, the interest in and familiarity with circus characters and letters probably were contributing factors to this relatively high level of talk during use of a software program that ranks low in developmental appropriateness.

A low level of conflict and high level of cooperation also emerged as a pattern of language and interaction during use of AC. The program's organization in terms of reinforcing correct responses as a clear indication of the end of a turn served to facilitate the cooperative nature of interactions. In other words, it was easy for children to determine the end to a turn due to the stimulus/response nature of the software which served to stimulate cooperation and turn-taking. This sample of language from Dyad 2 during Observation 7A illustrates this pattern of cooperation:

Dyad 3 (Jo & H): (H) H A Y L (Jo & H) E E E (Jo) Y (H) That's my name. Now it's your turn. There now you do it.

The software's accompanying letter sheet, which was illustrated with the circus characters, also contributed to the ability of children to cooperate during use of AC. One child in the dyad typically used the paper to direct the keyboard actions of her/his partner.

Language play characterized by singing, making up rhymes, or noisemaking was also a common pattern during use of AC. All of the dyads participated at one time or another in singing the familiar alphabet song which introduced the program and was used within certain games. At other times children made up a song or tune in response to the letters or characters as exemplified by Jo from dyad 3 during observation 7A as he sang "K Q P dan q da pie" (sing song while pointing to each letter). Rhyming was noted in the language of two of the three dyads with examples such as "I - my big fat thigh" (Ja, observation 4A) or "Holy Cowly"

(Jo, observation 7A). Noisemaking was common to all three dyads and included a diversity of noises such as booing, hooting, and panting like a dog.

In summary, the common and varied patterns of language in response to AC included: use of all seven of Tough's categories of language with reporting occurring most commonly for this program and at the greatest frequency of all four software programs; use of letters and circus characters as a theme for language during reporting, directing, self/group-maintaining; use of reasoning to explain the score or mechanics of a game, particularly during later observations of the study; and use of predicting, projecting or imagining at a level which was low compared to the other four categories but notable when compared to their occurrence across all four software programs used in the study. AC was used by children for the longest period of time, and a large number of turns of talk was recorded. Calculations using these factors revealed a relatively high level of talkativeness during use of AC which was surpassed by only one other software program used in the study. High levels of cooperation and frequent language play were noted to be common to all dyads during use of AC.

A developmentally appropriate score of 2.5 was assigned to _Juggle's Rainbow_ (JR) according to the Haugland/Shade Developmental Scale (1990). At the time the software was selected for the study it had been ranked as 3.5 in developmental appropriateness (Haugland & Shade, 1988b). This software program was used a total of 100 minutes and 36 seconds by the three dyads during the four observations of use. A pattern of decreasing time spent using JR was noted (see Table 3). The time spent using JR ranged from a high of 41 minutes and 12 seconds total for all three dyads during the first observation (1B) to a low of 12 minutes 15 seconds during the third observation (6A). This led the observer to conclude that there was a declining interest in using JR since children made the decisions in regard to choosing the time for changing programs or returning to their room. (Refer to Table 3 for the total length of time spent using JR for all four observations).

Five of seven categories of language use identified by Tough were employed by the dyads while using JR. There were no instances of projecting or imagining during any of the four observations for JR. The directing category was the most frequently used category for JR (Table 4, 118 turns of talk). All three directing subcategories (self-directing, directing others and collaborating) were largely characterized by directing which of three games to play or directions regarding turn-taking. Underlined parts of the following example illustrate these patterns of directing:

Observation 8B

Dyad 1 (Ja & B): (Ja) B, which one should we do?

(B) I want the rainbow. (Ja) I'm trying to get the rainbow. (B) Well, I made it to the rainbow, and don't push that. (Ja) I push my side and you push your side.

Reporting was the second most frequently used language strategy by dyads during use of JR (Table 4, 114 turns of talk). Identifying the butterfly, rainbow, or colors and describing the bars used for teaching the concepts above, below left and right as the letters E or F were common patterns for reporting. Underlining in the following samples indicates these patterns of reporting:

Observation 1B

Dyad 3 (Jo and H): (Jo) You made an F too. (H) Yep. I made an F. (Jo) You made an E. (H) Yeah. I made those lines there. (Jo) No. You made an E cause that line's here and that one's there and that one's there. Except that line's a little bigger. (Jo, later during observation) What color did you press? (H) Orange. (Jo, still later during observation) We got to the butterfly.

Observation 2A

Dyad 1 (Ja & B): (J) That makes a rainbow. Green, red, blue, yellow and orange.

Self/group maintaining was the third most frequently used category of language for JR. Patterns which were common in this category of language were 1) expressing a desire to get to the activity at the end of the game (making a rainbow, butterfly or windmill) and 2) expressing a desire to use a different software program or to return to the classroom. These patterns are underlined in the following samples:

Observation 2A

Dyad 2 (R & S): (S) I want to do the butterfly again.

Dyad 1 (Ja & B): (Ja) I guess I'd rather play Sticky Bear. Okay? (Looks at B for approval). (Ja) Sticky Bear. (B) Sticky Bear. (Observer) Are you ready for Sticky Bear? (Ja & B) Yeah!

Observation 8B

Dyad 2 (R & S): (R) That was a cute butterfly wasn't it? (S) We are all done. We want to go back to our room.

References to color also emerged as a common pattern for reasoning as exemplified by dyad 3 during observation 8B:

(J & H): (J) How do you make the purple? (H later in the observation) Don't push the dots or you'll make different colors.

The total turns of talk for each observation were fairly consistent for the first three observations of JR. The turns of talk during the fourth observation (211), however, were more than double any of the three preceding observations (see Table 5). There seemed to be no unusual factor which would explain this increase although it should be noted that it was also one of the highest level of turns of talk for the other software program used that day as well (Table 5, 536 RCR) which might serve to indicate that the participants were especially talkative during the last observation. Examination of the total turns of talk across all eight observations revealed that quantity of talk (regardless of software used) generally showed an increasing trend. Table 7 summarizes the total turns of talk for observations 1-8.

TABLE 7

Total Turns of Talk for Each Observation

Observation	A	Software	B	Software	Total
1	85	SBO	91	JR	176
2	90	JR	166	SBO	256
3	245	RCR	352	AC	597
4	146	AC	405	RCR	551
5	122	SBO	355	AC	477
6	99	JR	550	RCR	649
7	596	AC	125	SBO	721
8	536	RCR	211	JR	747

Analysis of the total number of turns of talk for JR (491) and the total time the program was used (100 minutes and 36 seconds) indicated that the dyads averaged 4.89 turns of talk per minute when calculated to the nearest half minute (see Table 5). This was the lowest level of talkativeness for all four software programs. The limited variety of games (three) and illustrations (a rainbow, a butterfly and a windmill) in this software program may be probable explanations for the low level of talk associated with JR.

Just as with AC, there was a relatively low level of conflict for two of the three dyads observed during use of JR. In fact, children in several instances volunteered to allow the other child to have all the turns. An example of this occurred in observation 1B when one of the children in dyad 3 (Jo) said to his partner (H), "You can do most of it".

Although there were no observations of rhyming, language play consisting of singing and noisemaking was observed numerous times (39 occurrences) during use of JR. During observation 1B, Jo, from dyad 3, moved his arms, danced in place, and sang "We made a rainbow with rain falling down" in tune to the computer's playing of "Rain, rain go away".

Common and varied patterns of children's language while using JR can be summarized as: use of five of the seven categories of language identified by Tough with no occurrences of projecting or imagining; use of directing most often and as a means to direct which game to play or how to take turns; use of reporting to identify colors and the three illustrations (rainbow, butterfly, windmill); use of self/group maintaining to get to the illustration at the end of the game, to change to a different software program, or to return to the classroom; and references to color during reasoning. There was a low level of talkativeness as well as a low level of conflict while using JR. Language play consisted of singing and noisemaking, but no rhyming.

StickyBear Opposites (SBO), ranked as 6.5 for developmental appropriateness by the Haugland/Shade Developmental Scale, was used a total of 84 minutes and 16 seconds by all three dyads during the four observations it was used. This was the least total time that was spent using any of the software programs in this study. The time spent using SBO notably decreased from a high of 32 minutes 42 seconds during its second use (observation 2B) to a low of 11 minutes and 54 seconds during its last use (observation 7B). The figures on Table 3 indicate a declining interest in the use of SBO. While the total amount of time spent using the pair of software programs during any given observation showed a tendency to decrease from the high of 67 minutes and 30 seconds spent during observation 1 to a low of 53 minutes and 27 seconds for

TABLE 8

Total Time for Each Observation

Observation	A	B	Total
1	26m 18s	41m 12s	67m 30s
2	27m 24s	32m 42s	60m 6s
3	30m 48s	34m 20s	65m 8s
4	26m 3s	36m 3s	62m 6s
5	13m 22s	42m 46s	56m 8s
6	12m 15s	41m 45s	54m
7	45m 37s	11m 54s	57m 31s
8	33m 42s	19m 45s	53m 27s

observation 8, it was not as notable as the decrease in time spent for SBO alone. Table 8 provides the total time for each observation.

All of Tough's categories of language except projecting were employed during use of SBO. Directing was the most frequently used category (109 turns of talk) and was largely characterized by directing which SBO picture to select. Patterns of looking for favorite pictures seemed to emerge in at least two of the three dyads. Much time was spent in hitting the spacebar as the partners looked for the duck or pictures that had opposite motions of fast and slow. Underlining in the following examples indicates this pattern of directing.

Observation 2B

Dyad 1 (Ja &B): (B) Let's do the duck. (J) Yeah, they never come on! (J) Tell me what one we should do.

Observation 5A

Dyad 3 (Jo & H): (J) Get that car one. (J) Let's do that car one. (H) Why? (J) Cause. (J) Now we're looking for the car one.

Self/group maintaining of two of the three dyads reflected this same pattern of wanting or desiring particular fast and slow SBO pictures as illustrated by the underlining in the following examples:

Observation 5A

Dyad 1 (Ja & B): (J) Aww. We wanted that machine. Didn't we? Let's do that machine. (B) What machine? (J) No! No! No! No! No! (Responding to each changed picture that appears with the press of the spacebar). I want to do that machine.

Observation 7B

Dyad 3 (J & H): (J) We want that flying one that's a duck. (Later in the same observation) (J) We like the plant one. (H) We want the bird. (Later in the same observation) (J) We want that fast and slow one don't we?

Use of adjectives to describe various attributes of the pictures was a pattern of <u>reporting</u> that was observed during use of SBO. Reporting was the third most frequently used category for this software program. It was interesting to note, however, that the attributes noted and the adjectives used by the children were most often not the opposite words which were intended to be taught by the software. For example, in the picture of the duck which was used to teach the opposite concepts of fast and slow, children often verbalized looking for the black or dark sky. In another picture, a bear using stairs to teach the concepts of <u>up</u> and <u>down</u> was often described as "dancing". Occasional prompts from the observer in regard to the opposite concepts that were being presented resulted in little use of those terms by the children. Because the opposite concepts being presented in SBO rarely appeared in the language of the children as they were using the software, it is possible that the children were not learning those concepts. This indicates that there might be need for more teacher intervention with this program if the goal is for the children to be able to verbalize the opposite concepts being presented in SBO.

Since <u>reasoning</u> was only observed 13 times during use of SBO, it was difficult to find distinct patterns for this category of language. Most of the instances of reasoning language during use of SBO were either questions regarding the program (Do we push K or P?) or unrelated to the program

(We don't have to take a nap cause we're doing this). Patterns were not found for the few instances of predicting (two) and imagining (three) that occurred during use of SBO.

SBO produced 498 total turns of talk for all four observations (Table 4) and resulted in a talkativeness calculation of 5.9 turns of talk per minute when computed to the nearest half minute (Table 6). This program ranked third out of the four software programs in terms of the amount of talk that was stimulated by its use.

There was a moderate level of conflict observed during use of SBO. The use of the spacebar to change the SBO picture was a tool frequently used by children to control the actions of their partners. These observer notes from observation 2B typify this pattern of conflict during use of SBO.

> Dyad 1 (Ja & B): Ja pushes away B's hand as he attempts to push a key. Ja makes a "mad" face at B who pressed spacebar to change picture. Later (during the same observation) B tries to change the picture but Ja pushes his hand away. Ja is pointing to and counting slats on a fence that the ball is bouncing behind. B points to screen and counts. Ja softly counts along. B attempts to change screen but pushes keys incorrectly. This distracts Ja who then resolves to change screen. Ja makes a "smart-alec" or fake "mad" face at B.

Language play during use of SBO commonly consisted of exclamations of "AWWW!" or "Phooey!" as unwanted pictures came on the screen during search for the favored or sought after pictures. Patterns of singing and rhyming were common in the observations of only one of the dyads, but were not unique to them during SBO. This pattern will be discussed in the second part of this chapter when the common and varied patterns for each dyad and individual children are discussed.

In summary, common and varied patterns of language during use of SBO included: use of six of seven categories of language by Tough with directing occurring most frequently, followed closely by self/group-maintaining both of which often related to the search for a favorite picture; use of adjectives to describe attributes unrelated to the opposite concepts intended to be taught as a pattern of reporting language; low levels of reasoning, predicting and imagining which resulted in limited samples to distinguish patterns; a low level of turns of talk and talkativeness; a moderate level of conflict often involving use of the spacebar to change the picture and control the actions of a partner; limited observations of language play except for exclamations related to the search for a favorite picture.

Rosie the Counting Rabbit was second in the total length of time spent using the four software programs included in this study. The developmental appropriateness rating for RCR was originally reported as 9.0 (1988b) but was later adjusted to 8.5 (1990) by Haugland and Shade. The total length of time spent using RCR remained fairly consistent across the four observations ranging from a low of 30 minutes and 48 seconds during the first observation to a high of [illegible] minutes and 45 seconds during the third observation (Table 3).

The highest levels for six of seven of Tough's categories of language use were observed during use of RCR. Reporting, which was more frequently used during AC, was the only category that did not have the highest frequency when RCR was compared with the other three software programs used in this study.

<u>Directing</u> was the most frequently used category for RCR (Table 4, 565 turns of talk). While directing often involved verbalizing which way to move the cursor (up, down, over), a more descriptive and elaborative pattern of directing was also observed. The following underlined examples illustrate this descriptive and elaborative pattern:

Observation 4B:

> Dyad 1 (Ja & B): B, <u>you crack some eggs and I will too.</u> <u>You crack one.</u> <u>I'll crack one.</u> <u>I'll crack one.</u> <u>You crack one.</u>
>
> Dyad 2 (R & S): (R) <u>First, we have to go over then down.</u> I want to do that apple (points to

left side of tree). (S) And down. (R) Now start with that one (points to right side of tree).

Dyad 3 (Jo & H): (H) I'm gonna put it on the bird. (Jo) Click on the bird. The bird. (Jo) O.K. Click on it. Now you can move wherever you want. (Jo) Move it on to the rabbit's head. (Repeats) Move it on to the rabbit's head. (H) O.K. (Jo) Over that way. Now down.

Self/group-maintaining was the second most frequently used language category during use of RCR. This category of language also was characterized by more descriptive and elaborate language than observed with the other software as dyads negotiated for turns. The underlined examples from observation 6B serve to illustrate this pattern:

Dyad 1 (Ja & B): Ja tries to press keys again. B resists. (Ja) Me want to move. How come I don't get a turn? (Deliberate baby talk.) (B) I will let you get a turn. First I have to do my chance. (Ja) I want to do the cloud too.

Dyad 2 (R & S): (R) We're gonna do all of these wrong. I'm gonna do both of these flowers and make it go... (S) No, let me, R. (R) You can do this one and I'll do this one. (R) No. I'll do this one. You can do that one (points to apples on the tree).

This pattern of more elaborate and descriptive language was also evident in the reporting and reasoning language used by the participants as they interacted with RCR. Reporting and reasoning were respectively the third and fourth most frequent strategies used in association with RCR. This pattern for both reporting and reasoning can be found in the following examples:

Observation 6B

Dyad 1 (Ja & B): (B) Look at his wings are gone. (Ja) Lookit, they're two of 'em! (B) Two of 'em now. We put two of 'em on. (Ja) He came off of that one. (Points to Rosie the Rabbit on the computer screen.) (Observer) Hm? I wonder how we did that? (B) Yeah! See I pushed the spacebar and that's what happened. (B) Now it stays there. (Ja) Brent! (B) Oh, another one! I made another one. (Ja) Do that again. (B) O.K. (Ja) Lookit! (B) Oh you made the other one hop away. (In this example Ja and B have discovered that by pressing the space bar on a figure in the illustration, it can be duplicated over and over again.)

Observation 8B

Dyad 2 (R & S): Thun der! Thun derous, Thunderous, Thunderous Thunder. (R) Thunder right there, see? It's raining out. (Points to cloud on computer screen.) (R) It's thundering out. (S) Now we've gotta put Rosie out. (R) So he doesn't get sick cause you never should go outside when it's thunder. (S) Right!

Imagining, which was the fifth most frequently used language category used during RCR was observed 30 times (see Table 4). An elaborate and descriptive pattern was typical in the imaginative language of two of the three dyads as exemplified by the following examples.

Observation 4B

Dyad 3 (Jo & H): (J) Help! I'm gonna splash in the water! (On computer screen Jo is moving duck egg across the water). (Jo) Oooh! Oooh! I hope I don't touch the water. Oooh! Oooh! Click on me quick. (H) Squeal! He's almost in the water!

Observation 8B

Dyad 2 (R & S): (S) That is really not real water. (Points to pond on screen.) (R) But on the screen it's real water. But inside of the screen it's real water. (S) Huh-uh! (R) Uh-huh! Cause one time I went behind the screen and went in the door and I walked in the water - it was real. (S is looking at R with interest or disbelief). (R) Oooh! (S) No it wasn't. (R) Let's turn the page.

Thirteen occurrences of predicting were observed during use of RCR (Table 4). Many of these occurred during the later observations of RCR and were also typically more descriptive or elaborate. Examples of predicting associated with RCR included the following:

Observation 6B

Dyad 3 (Jo & H): (J) What is this one? (H) The flower one. (Observer) O.K. Those are the caterpillars. I think what you are supposed to do is move the caterpillars up to the flowers and see what happens. (Jo) We build a cocoon.

Observation 8A

Dyad 2 (R & S): (R) What if the leaves fall down? All of the leaves. Then we'd just have branches on our tree, right? (Referring to tree on computer screen.)

Another example by dyad 3 during observation 8B was a good example of the projecting language which occurred 11 times in association with RCR (Table 4). Projecting often involved language which described what Rosie or one of the other story characters was doing or how they were behaving. The following example was observed:

Dyad 3 (R & S): (R) Your apple got aten didn't it? (S) Um hmm. (R) The birdie ate it didn't it? (S) Rosie ate it. (R) Yeah. Rosie ate it.

The greatest number of total turns of talk (Table 4, 1736 total turns of talk) and the highest level of talkativeness (Table 6, 12.18 turns of talk per minute) were observed during use of RCR. The increase in the amount and elaborateness of language was evident from the first observation during which RCR was used. RCR and AC were both introduced during the third observation. Table 7 shows the turns of talk for each observation. During the third observation there was a dramatic increase in the turns of talk observed (Table 7, 245 for RCR and 352 for AC). This result was partly attributed to the fact that the children had become more accustomed to the observation setting. However, by comparing the figures on Table 7 for turns of talk during all observations, it can be noted that the high levels of turns of talk remained fairly consistent for both RCR (245, 405, 550, and 536) and AC (352, 146, 355, 596) while turns of talk remained comparatively low for JR (91, 90, 99, 211) and SBO (85, 166, 122, 125).

Conflict was common during use of RCR. Because of the open-ended nature of this software program and the lack of a response/reward for a correct answer, participants had a difficult time in establishing when one turn should end and another should begin. Another feature of the program which contributed to conflict was the ability of one child to change what another child had done to the picture that was being created. The following conversations illustrate these patterns of conflict while during use of RCR:

Observation 6B

Dyad 2 (R & S): (R) I'm gonna move the apple.

(S) It's my turn. (R) I'm gonna move it down (S shakes head no) RUh huh! I never got a turn. First I'm gonna move the apple. (S) Uh-huh! He got to move the ' .> (S turns to observer and repeats). He g. : to move the bee. (Observer) All right. Le him move one more thing. (R) Click. (S reacnes over to grab keys but R pushes her hand away). (R) Hey! (S) Laughing (S succeeded in taking his turn to change the apple from whole to eaten). (R) Oh, S! (With annoyance.) (S) Laughing. (R) It's not funny. Now I get to move the other apple. (S) Huh-uh! (R) Because you clicked the other one. (S) But R has had three turns now (turns to observer with this statement). Later in the same observation (R) He's on the grass isn't he? (Reference to duckling that he moved into the grass). (R) Hey, S clicked it back (S clicked duckling back into the pond). (S) Yes, because that's not where it's supposed to be, R. (S) There! (R) But I want it on the grass! (They are screaming at each other.)

Observation 8A

Dyad 1 (Ja & B): (Ja) You're not supposed to push that, B. (Ja) Click. (B) Click. (B) Oh, Oh! (Ja) Yeah, let's do this one. (B) Yeah.

It's my turn to do it isn't it? (Ja) Put the arrow in the apple. (Ja) Yeah, and in this one. (B) Ja, don't push (Ja keeps trying to push keys as B is having his turn). (Ja) This is mine (pointing to keys).

Language play in the form of noisemaking, singing or rhyming were observed with all dyads during use of RCR. The following samples from observation 4B illustrate the types of language play observed:

Dyad 2 (R & S): (R) Over, over, over, down. (R) Over, down. (S) Up, up, up, up (sing song style). (R) Up (intonation of word goes up). (S) Over. (R) Over - whooa - down. Later during the same observation (R) A little baby look (putting mouth up to computer and speaking in a humorous voice). (S) What? A little baby look? (laughs). (R) A little baby look. (S) A little bitty fook. (R) A little bitty book.

Dyad 3 (Jo & H): (H) Duck a duck a rooni a duck a duck a rooni. Later in the observation (H) Do dah de dah duh (making up a song). (Jo) Click. Quack, quack, a quack. (H) Click clock click clock. Now I get the last one (referring to last duck egg). Still later in the observation (H) 3-5 lizards (singing Burl Ives tune). (Jo & H)

Doing what they otter (singing together). (H)
Doing what they otter.

A summary of language patterns observed during use of RCR includes: the highest frequency of all seven of Tough's language categories except for reporting; more elaborate and descriptive language for all seven categories as compared to language use during the other three software programs; the greatest number of turns of talk and highest level of talkativeness compared to the other three software programs in the study; a common pattern of conflict due to the open-ended and changeable nature of the program which made it difficult for children to determine turn-taking; the use of language play by all dyads who participated in noisemaking, singing, or rhyming.

In concluding this portion of the discussion of the results, it is important to note some of the common and varied patterns of language observed in regard to all four software programs. The greatest amount of language and the greatest use of six of Tough's seven categories of language were associated with RCR, the software rated as most developmentally appropriate by Haugland and Shade (1988b, 1990). One of the two least developmentally appropriate software programs, AC, was observed to rank second in the amount of talk and use of Tough's categories and included a higher level of reporting than was observed during use of RCR. A language pattern which was more elaborate and descriptive was associated with RCR, while the pattern observed during use of AC consisted primarily of naming letters and circus characters. Comparatively smaller amounts of language were observed during use of JR and SBO both of which stimulated little or no use of reasoning, predicting, projecting or imagining. The use of Tough's categories of self/group maintaining, directing, and reporting was greater with all four software programs than was the use of reasoning, predicting, projecting or imagining. Patterns of language associated with JR and SBO raise a question concerning the ability of these software programs to teach the concepts which they present (concepts of above, below, left, right and opposite concepts respectively).

More conflict was observed during the use of SBO and RCR than was observed during use of AC and JR. The ability of participants to determine the end of a turn in AC and a lower level of interest in JR are probable reasons for the lower levels of conflict associated with these programs. The more open-ended nature of SBO and RCR, as well as program features which enabled control or change of the actions of partners were thought to result in more conflict during use of these programs. Language play was observed during use of all four software programs but seemed to occur more often and with more variety during use of AC and RCR, particularly for two of the three dyads.

The length of time that children spent using each software program generally indicated a decreasing trend for JR and SBO. The total amount of time spent using each program from most to least was: AC (148 minutes, 46 seconds); RCR (142 minutes, 18 seconds); JR (100 minutes, 36 seconds); and SBO (84 minutes, 16 seconds).

When asked at the end of the eighth observation to identify their preferences for the software programs, children responded according to the results recorded in Table 9.

By adding the numbers indicating the first, second, third and fourth choices for each software program it was possible to determine a total score which suggests the overall preference by the six participants as a whole.

Comparison of the participants' preferences with other results in this study reveal interesting patterns. Five of the six participants selected AC as their first or second choice to indicate preference for the four software programs. This preference is supported by the fact that AC was used for the greatest amount of time (Table 3, 148m 46s). However, it is interesting to observe that JR tied with RCR in the total score to indicate overall preference and yet was used notably less by participants (Table 3, JR = 100m 36s; RCR 142m 18s). Despite the greater amounts of time and language associated with RCR during this study, participants were unable or unwilling to identify RCR as

TABLE 9

Children's Stated Preferences for Software

Dyads	Ja & B		R & S		Jo & H		Total Score
Software							
AC	2	4	1	2	1	1	(11)*
JR	4	3	2	3	2	2	(16)**
SBO	1	1	4	4	4	3	(17)***
RCR	3	2	3	1	3	4	(16)**

Numbers 1, 2, 3, 4 indicate the order in which participants selected software to indicate preference.

* most preferred

** tied for second ranking for preference

*** least preferred

preferable to JR. The total score of 17 which indicates that SBO was the least preferred software program by the participants in this study is consistent with the observations of lesser amounts of time and language associated with SBO.

<u>The Children and Their Patterns of Response to the Software</u>

The second question which guided this study was:

> How do individual and pairs of children respond to software that has been designated as more or less developmentally appropriate for children in their age range?

In analyzing the transcription sheets for each dyad, common and varied patterns of language and interaction emerged. Common and varied patterns of language are described for each dyad in regard to 1) length of time spent with the programs; 2) use of Tough's categories of language; and 3) other common and varied patterns of language including turns of talk (talkativeness), conflict vs. cooperation, and engagement in language play. Language patterns which are unique to the individual and/or the dyad will be described as well. Finally, the patterns of language and interaction during computer observations are compared with the classroom observation of each child. It should be noted that the names given to the children who participated in this study are pseudonyms used to protect their identity.

Dyad 1: Jason and Bryan

Jason and Bryan were observed for a total of 143 minutes and 29 seconds of computer use with all four software programs (see Table 10). This was more than 20 minutes less than either of the other two dyads. The greatest amount of time was spent using AC which Jason picked as his second preference of programs and Bryan picked as his fourth preference. They spent the least amount of time, 31 minutes and 38 seconds, using RCR which was selected as the second preference by Bryan and the third preference by Jason (Table 9).

Bryan and Jason displayed use of all of Tough's categories of language. The frequencies for Tough's categories of language used by Bryan and Jason from most to least were: directing (467); self/group maintaining (263); reporting (191); reasoning (33); predicting (7); imagining (3); and projecting (1).

Nearly half of the observed language which could be categorized according to Tough's classification fell into the directing category. This amounted to 467 instances of directing out of a total of 965 categorized and a total of 1283 turns of talk for all observations for Bryan and Jason. Directing the action of others was the most common subcategory for directing with a total of 266 instances out of the 467. This strategy was most commonly used by Jason

TABLE 10

Summary of Time Spent, Tough's Categories of Language Use and Turns of Talk for Each Software Program for Jason and Bryan

Software Programs	AC	JR	SBO	RCR	Total
<u>Tough's Categories</u>					
Self/group maintaining	78	40	39	106	263
Directing (total)	183	55	68	161	467
Self-directing	(56)	(14)	(5)	(50)	(125)
Directing others	(106)	(33)	(38)	(89)	(266)
Collaborating	(21)	(8)	(25)	(22)	(76)
Reporting	87	35	25	44	191
Reasoning	4	10	6	13	33
Predicting	2	0	2	3	7
Projecting	0	0	0	1	1
Imagining	3	0	0	0	3
Total turns of talk categorized	357	140	140	328	965
Total turns of talk observed	438	174	243	428	1283
Length of time (minutes)	41	35	34	31	143
observed (seconds)	48	37	26	38	29
Average turns of talk per minute to nearest half-minute	10.4	4.9	7.0	13.5	8.9

and Bryan in association with AC (106 instances) and RCR (89 instances).

An interesting pattern of directing was observed for this dyad. Jason clearly preferred to be in charge of the keyboard. For seven of eight observations, he sat on the right side of the computer where most of the keys which controlled the programs for JR, SBO, and RCR were located (see Table 2). He often directed Bryan concerning which half of the keyboard they each were in charge of. Jason also devised various strategies to get Bryan to do the directing, especially while using AC, so that he could be in charge of the keyboard. The following examples illustrate this pattern:

Observation 4A

Jason: How about I do the computer and you talk on that? (Pointing to microphone on the counter.

Bryan: The cir cus is a bout to begin. (separates syllables as he speaks into the microphone).

Jason: How about we work here and you're the talker?

Bryan: (Sits looking at microphone and slides it around).

Jason: Talk on that.

Bryan: No.

Observation 7A

Jason: Let's say you're my boss. You tell me what to do. O.K.?

Bryan: Lever 4. 4. Right there. Right there. Yeah!

Bryan: Now lever 4 - lever... lever..

Jason: Lever? Letter!

Bryan: Letter...Z.

(Later in the observation)

Jason: You're the boss remember? It's upside down.

(Referring to the alphabet paper).

Bryan: K! K...for ...Kangaroo!

Jason: O.K. I can find K for kangaroo.

Jason: I found K!

Jason: Remember you're the boss? (Responding to Bryan's attempt to have a turn with the keyboard).

Bryan: Yeah!

Jason: Remember you're the boss of me. (Again responding to Bryan's attempt for a turn at the keyboard).

The self/group maintaining category of language was the second most frequently used category employed by Jason and Bryan (263 turns of talk) and was used most often (106 turns of talk) during use of RCR. Reporting occurred a total of 191 times and was most frequently used in association with AC (87 turns of talk), as was the use of reasoning (13 instances). Projecting language was found to be used only once by Jason and Bryan and in association with RCR, while imagining was observed only three times always during use of AC.

Jason and Bryan were most talkative while using RCR. When using this software, they averaged 13.5 turns of talk per minute. They were least talkative when using JR averaging only 4.9 turns of talk per minute. The stated preferences for JR (fourth by Jason and third by Bryan) were congruent with the low level of talk stimulated by this software. It is interesting to note that while both Jason and Bryan selected SBO as their first preference for the software, it resulted in the second lowest amount of talk (7.0 turns of talk per minute) and the second lowest amount of time being used by them.

For Jason and Bryan conflict seemed to center around the issue of who was in charge of the keyboard. There seemed to be a higher level of conflict in association with the software RCR and AC. More instances of self/group-maintaining language for these programs (106 turns of talk for RCR and 78 turns of talk for AC) are indicative of this higher level of conflict. Since Bryan was characteristically a rather compliant child, he usually gave in to Jason's demands and strategies to be in control of the keyboard. In later observations, however, Bryan began to become more vocal about Jason monopolizing the keyboard. In observation 8A, for example, Bryan stated, "It's not always your turn to push the buttons".

Language play by Jason and Bryan was not prevalent during computer use. When it was observed, it usually took the form of rhyming or noisemaking on the part of Jason. A typical example of this occurred during observation 3A when Jason stated "Smoke me, smoke me, a big fat poke me".

The classroom observations for Jason and Bryan validated the observations of language and other behaviors during computer use. Jason's use of language to display power and to "be in charge" were visible in the classroom observation as well as during the computer observations. In the classroom, when clean-up from play time was announced by the teacher, Jason went around announcing clean-up time to all areas of the large classroom. When he finally did join in the clean-up activity, he lifted the tub of Lincoln Logs over his head and stated to the observer, "Jan, look it. I'm carrying it with one hand". Bryan's tendency to be compliant and desire to cooperate with others was also observable during both the computer and classroom observations. During the snack period, Bryan carried on a conversation with the teacher about the first time that he had come to the classroom. Bryan said, "When I first came down, I liked it. Did I like it?". This conversation was stimulated by the fact that a child new to the large classroom was displaying his unhappiness. Also during the snack period, Bryan patted the back of the girl next to him and made a statement regarding what good partners they were. These observations in the classroom as well as the computer observations, suggests that Bryan is very cooperative and compliant and has a desire to be recognized for these qualities.

The language patterns of Bryan and Jason appeared to be consistent during both the computer and classroom observation. They did display the greatest amount of language during use of RCR which was the most developmentally appropriate software used in the study. In summary, for Jason and Bryan the computer seemed to be just another activity that extended their typical patterns of language and interactions.

Dyad 2: Rob and Sue

Observations of Rob and Sue during computer use totaled 165 minutes and 48 seconds. They spent the greatest amount of time using RCR for a total of 63 minutes and 30 seconds and the least amount of time, 19 minutes and 25 seconds, using SBC. Rob and Sue respectively chose RCR as their third and first preference for the software. SBO was chosen as the fourth preference by both Rob and Sue (see Table 9). Table 11 provides a summary of Rob and Sue's use of each software program as well as the categories, and turns of talk observed in association with each program.

TABLE 11

Summary of Time Spent, Tough's Categories of Language Use and Turns of Talk for Each Software Program for Rob and Sue.

Software Programs		AC	JR	SBO	RCR	Total
Tough's Categories						
Self/group-maintaining		87	16	15	165	283
Directing (total)		95	26	8	255	384
Self-directing		(35)	(13)	(1)	(110)	(159)
Directing others		(44)	(8)	(6)	(105)	(163)
Collaborating		(16)	(5)	(1)	(40)	(62)
Reporting		110	20	3	84	217
Reasoning		26	6	0	74	106
Predicting		1	0	0	9	10
Projecting		0	0	0	5	5
Imagining		0	0	0	19	19
Total turns of talk categorized		319	68	26	611	1024
Total turns of talk observed		392	112	35	806	1345
Length of time observed	(minutes)	49	33	19	63	165
	(seconds)	43	10	25	30	48
Average turns of talk per minute to nearest half minute		7.9	3.4	1.8	12.7	8.1

All seven of Tough's categories of language were utilized by Rob and Sue during the computer observations. The frequencies for Tough's categories of language used by Rob and Sue from most to least were: directing (384); self/group-maintaining (283); reporting (217); reasoning (106); imagining (19); predicting (10); and projecting (5) (Table 11). It should be noted that all instances of projecting and imagining were observed during use of RCR. Directing, which was the category most frequently used by Rob and Sue (384 turns of talk), occurred most often during interaction with RCR (255 turns of talk).

Self/group-maintaining was the second most frequently used strategy occurring 283 times with more than one half of those instances (165 turns of talk) observed during use of RCR. Reporting was the third most frequently employed language strategy used by this dyad with 110 instances during interaction with AC and 84 instances during interaction with RCR. Rob displayed much richer and more descriptive language for reporting as well as for other categories during interaction with RCR and somewhat with AC than during use of JR or SBO. The following examples illustrate this pattern of richer, more descriptive language by Rob:

Observation 4B (RCR)

Rob: You missed the basket.

(Later)

Rob: (Laughing) The apple's in the sky.

(Later)

Rob: The bunny can't move. Oopsie.

Rob and Sue: Laughter.

Rob: His paws move.

(Later)

Rob: There's a ducky. His foot is in the water.

Sue: Uh-huh (Chuckling).

Observation 7A (AC)

Sue: And now it's G. We did that one.

Rob: That giraffe looks kind of funny doesn't he?

(Later)

Sue: Where's the T?

Rob: There he is! (Referring to tall man).

Rob: He's on stilts, isn't he? He's got stilts inside of him, doesn't he?

Observation 8A (RCR)

Rob: Now it's under the ground. (Referring to Rosie on the screen).

Rob: Silly.

Rob: And even Rosie is under the ground, right? But the bird isn't.

Rob: The tree is.

Rob: The tree - part of the tree is under the ground.

Sue: There. (Indicating the end of her turn).

Rob: O.K. Up.

Rob: Your apple got aten didn't it?

Sue: Um-hmm. (Nodding in agreement).

Rob: The birdie ate it didn't it?

Sue: Rosie ate it.

Rob: Yeah, Rosie ate it.

It was also Rob who displayed the most frequent and interesting examples of imaginative language of all the children who participated in the study. Rob was the child who told the story, previously reported on page 88, concerning going in the back of the computer to walk in the water. Use of reasoning also occurred most often during use of RCR and was more typically used by Rob than by Sue. The following example from observation 8A is a typical example:

Rob: My apple's aten right?

Rob: See what's that green? (Looking near basket on the screen). Oh, that's where the grass is, isn't it?

Sue: That's the inside of the apple.

Rob: I know.

Sue: Now down.

Rob: Now, there's no apples in the tree, is there? (Referring to fact that they have moved both apples from tree on the computer screen).

Rob and Sue were most talkative during use of RCR, averaging 12.7 turns of talk per minute as compared to 1.8 for SBO, 3.4 for JR and 7.9 for AC (Table 11). They averaged 8.1 turns of talk per minute for all observations. More than one-half of the language observed for Rob and Sue occurred during use of RCR. This amounted to 806 turns of talk for RCR out of 1345 total turns of talk for all observations. The least amount of language was observed during use of SBO with only 35 total turns of talk recorded for Rob and Sue during use of this software.

The greatest amount of conflict and least amount of cooperation for all of the dyads was observed between Rob and Sue. The conflict, to a great extent, centered around Sue's desire to be in control of everything. Sue dominated the keyboard, the AC alphabet sheet, and even Rob's placement of characters on the screen during use of RCR. Except during observation 6, Sue sat on the right side of the computer where she could be in charge of the keys which controlled most of the program for JR, SBO, and RCR (see Table 2). During the first observations, Rob seemed to be content to allow Sue to have her way and be in charge. However, after RCR and AC were introduced during observation 3, the conflict began and continued to grow until it evolved into a sort of game between the two of them. The following dialogues typify the conflict between Rob and Sue during use of AC and RCR:

Observation 5B (AC)

Rob: We got 1, 2... (Rob stands and is counting the number correct for AC game).

Rob and Sue: 3, 4, 5.

Sue: No, 1, 2, 3, 4, 5. (Points and recounts then holds alphabet sheet up to the screen. Rob tries to get sheet from Sue and they are struggling over it.)

Sue: Don't! You're going to rip it.

Rob: I know, but you are too!

Observation 6B (RCR)

Rob: Sue, it's my turn. (Rob keeps trying to push Sue's hand away from the keys.)

Rob: Don't, Sue!

Sue: Laughing.

Rob: Don't! (Rob again tries pushing her hands out of the way.)

Sue: Don't push on me! (Sue continues to try to control keys.)

Rob: Hey!!! (Loudly.) Sue!!

Sue: My turn!

Rob: Huh-uh! You already had a turn to move the cloud.

(Later in the observation.)

Rob: Click, then it's my turn.

Sue: No! Now it's. . .

Rob: Hey! You get to do all of the duckies.

Sue: Nah-uh.

Rob: Uh-huh! You just get to do that one, then it's my turn.

Sue: There! Now it's your turn.

Rob: My turn! My turn, my turn, my turn.

Sue: Mine!

Rob: Mine! (They alternate yelling this back and forth in a mock argument for a total of eight times each.)

(Later in the observation)

Rob: Now it's my turn.

Sue: Now it's your turn.

Rob: My turn!

Sue: Your turn! (This conversation is carried on in an argumentative fashion on the part of both Rob and Sue.)

It is important to note that the pattern of conflict was greatest during use of RCR and AC. For example, during observation 7B Rob did not take advantage of taking a turn at SBO when Sue was carrying on a conversation with the observer and uninvolved with the computer.

Rob and Sue both engaged in language play in the form of singing. This included both singing songs that they previously knew as well as making up songs or sing-song rhymes related to the computer software that they were using. Both typically joined the partner in singing which was initiated by the other. These instances were among those limited examples of cooperation observed between Rob and Sue. The eighth observation provides examples of the pattern of singing for this dyad:

Observation 8A (RCR)

Sue: There! Our little duckies, our little duckies, our little duckies are walking all away. (Sue says this in sing-song fashion.)

Rob: My ducky's already up to here. (Rob stands and points to screen.) He walked, walked, walking. Now he's walking there. (Points to corner of screen.)

Observation 8B (JR)

Rob: Right. (Points to right side of screen.)

Sue: Kay (meaning okay) - Left. (Points to left side of screen.)

Rob: Up.

Sue: Down.

Rob: OOOO!! Left- right- up- down (begins singing).

Rob and Sue: I don't know which way to go-o. (Sue joins Rob in singing.)

Rob and Sue: Left - right - up - down. (Singing together.)

Rob: I don't know which way to go. (Rob finishes singing by himself.)

Rob also engaged in language play through noisemaking and exclamations. His tendency to be more vocal was reflected in a greater amount of language play as compared to Sue. It was Rob who played with the word thunder in the example from observation 8A previously reported on page 87.

The classroom observations of Rob and Sue confirmed the patterns of language and interaction during the computer observations. Rob's language during free play was rich in imagination. As Rob played with blocks and trucks, he was the leader in creating the imaginary setting and fantasy making statements such as: "Do you want to ride in back? Right here. Do it sideways then. My motor's going around. Hey bud! Lift my trunk". This pattern of describing an imaginary setting was observed later during play with lock blocks as he made statements such as: "How about the lion makes one for his wife? Let's put it like this so they can shoot them out. The lion and a helper has him in a net. The red is for your brain... These aren't really lite brites are they?".

Sue's need to be in control during the computer observations was also apparent in the classroom observation, as she engaged in doll and cradle play with Amy. Sue had a small pillow for the doll. When Amy found a larger one, Sue forced a trade. There was conflict over this with Amy going to the teacher to report the incident. Later as they were sitting on chairs holding and rocking the dolls Amy says, "My baby is going to fall asleep". "So is mine", replies Sue. "We're sharing the blankets anyway", states Sue as if trying to find something they are able to agree about. "Shall we put them in?", Sue asks Amy in reference to putting the dolls in the cradle. After both girls place their dolls in the cradle, Sue rearranges Amy's doll in the cradle as if needing to have final control over the situation. This play scene parallels many of the computer observations during which Sue tried to control every aspect of the situation. Just as she had to move Rob's ducks from where he had placed them in the RCR software program, she was compelled to put the final touches on the placement of Amy's baby in the cradle.

Language and interaction patterns observed during the classroom observations of Rob and Sue were similar to those observed during the use of software programs AC and RCR. The most developmentally appropriate software, RCR, served as a stimulus for language, including imaginative language for Rob. More than one half of the language during computer observations was associated with RCR. A higher level of conflict between Rob and Sue was also observed during use of RCR and AC.

Dyad 3: Josh and Holly

Computer observations of Josh and Holly totaled 166 minutes and 39 seconds, which was the greatest amount of time for all three dyads. They spent the most time using AC (57 minutes and 15 seconds) and the least amount of time with SBO (30 minutes and 25 seconds). Table 12 provides a summary of Josh and Holly's time spent, use of Tough's categories and turns of talk observed for each software program. Both Josh and Holly selected AC as their most preferred software program which is consistent with the fact that they spent the greatest amount of time using it (see Table 9). It is also interesting to note, however, that they both selected JR for their second preference yet spent only about half as much time (31 minutes and 49 seconds) using that program as they did using AC.

Josh and Holly used all seven of Tough's categories of language sometime during the computer observations. The frequencies of the categories for Josh and Holly from most to least were: reporting (442); directing (336); self/group-maintaining (228); reasoning (122); imagining (16); and predicting and projecting (6 occurrences each). It should be noted that this pattern of frequencies is somewhat different than it was for the other two dyads. Reporting, which ranked third in frequency for dyads 1 and 2, was the language category used most frequently for dyad 3. Both dyads 1 and 2 used directing most frequently, followed by self/group-maintaining which were respectively the second and third most frequently used categories by Josh and Holly

TABLE 12

Summary of Time Spent, Tough's Categories of Language Use and Turns of Talk for Each Software Program for Josh and Holly

Software Programs	AC	JR	SBO	RCR	Total
Tough's Categories					
Self/group-maintaining	68	36	46	78	228
Directing (total)	117	37	33	149	336
Self-directing	(55)	(5)	(8)	(60)	(128)
Directing others	(47)	(27)	(20)	(73)	(167)
Collaborating	(15)	(5)	(5)	(16)	(41)
Reporting	259	59	49	75	442
Reasoning	46	12	7	57	122
Predicting	3	2	0	1	6
Projecting	1	0	0	5	6
Imagining	2	0	3	11	16
Total turns of talk categorized	496	146	138	376	1156
Total turns of talk observed	619	205	220	502	1546
Length of time observed (minutes)	57	31	30	47	166
(seconds)	15	49	25	10	39
Average turns of talk per minute to nearest half minute	10.8	6.4	7.2	10.8	9.2

(dyad 3). (This varied pattern is related to the observations of Josh and Holly's language in regard to conflict and cooperation which will be discussed later.) More than half of the reporting observed for Josh and Holly occurred during use of AC (259 instances out of 442 total). All other categories of language occurred most frequently during RCR.

Josh and Holly were equally talkative during use of AC and RCR with an average of 10.8 turns of talk per minute for both programs. Since RCR was ranked as the most developmentally appropriate software and AC was ranked as the least developmentally appropriate software, it appears that factors other than developmental appropriateness affect the amount of language which is associated with a software program. This is supported by the fact that AC produced the second highest level of talkativeness for both of the other dyads while JR and SBO consistently stimulated lesser amounts of language for all three dyads (see Tables 10 and 11).

Of the three dyads participating in this study, Josh and Holly displayed the least amount of conflict and the greatest amount of cooperation. This is reflected in the lower levels of directing and self/group-maintaining categories of language for Josh and Holly as compared to the other two dyads as was previously mentioned. There were few instances of conflict in this dyad. Use of the pronoun "we" was striking in the transcripts of language for Josh and Holly. It is also important to note that Josh and Holly had equal placement on the left and right side of the computer with Josh sitting on the right during the first, second, third, and seventh observations and Holly sitting on the right during the fourth, fifth, sixth, and eighth observations (see Table 2). Both the cooperative spirit and use of the collective pronoun "we" were observed in the first through eighth observations of Josh and Holly and are illustrated by the following examples:

Observation 2A:

Holly: Your turn.

Josh: You do it. You do it.

Josh: Yeah! Oh!

Josh: We got 4-5...1, 2, 3, 4, 5.

Josh: Oooh!

Josh: Yeah!

Holly: Yes, we got the rainbow!

Josh: Yes! We got it back to our own place.

Josh: Do we get to make another rainbow?

Observation 7A

Holly: You got my chair and I got your chair.

Josh: Yeah!

Holly: You can have it cause you know what letters to do.

Josh: Yeah, I'm so good at this aren't I?

Holly: Yeah, we like this one don't we?

Josh: No, we hate that one. (Holly turns to observer for comment, but observer makes none.)

Later in the observation

Josh: I'll do this one.

Holly: You get two turns - that's no fair (Holly deliberately uses baby talk and puts a mock pout expression on her face.)

Josh: No fair again. You get one turn (also using baby talk).

Josh: E for "Elly".

Holly: There's that guy (Holly points to ringmaster in corner of screen).

Josh: Whoa! Snake the pake the very make.

Josh: N

Josh: Clarinet

Holly: Clarinet

Josh: Whoa good thing I had 'em (points to alphabet paper).

Holly: You got to have two turns. Now I get to have two turns.

Josh: Yeah, and then I get to have two turns.

Holly: Yeah.

The use of language play by this dyad was also very striking from the very first observation. Josh was very stimulated by the music of the software programs and responded with dancing, rhyming, sing-song talking and singing nonsense syllables. Holly also participated extensively in language play. The following excerpts from the transcripts are typical of the language play observed with this dyad:

Observation 1A

Holly: (Clicking tongue to match sound of bear walking on stairs.)

Josh: Up, up.

Josh: Going on the top of the stairs (sing-song).

Josh: He's doing a little dance. De de dee dee du du du du (making up a tune and "dancing" in his chair).

Holly: He's tap-dancing, tap-dancing.

Holly: He's still tap dancing isn't he?

Observation 8A

Holly: Up a dooey. Up a doody. Up a cookie. Up a tooty.

Josh: Up a tooty. I said up a tooty.

Josh: Hey, look on another page.

Holly: Now down.

Holly: Oh, I dinta push the right thing (using animated voice).

Josh: Oh, I dinta push the right thing (he is leafing through RCR book).

Josh: Oh, I dinta push the righta thinga.

Josh: Oh, I dinta push the righta thing. (This statement was spoken with rhythm each time.)

The classroom observations of Josh and Holly verified the language patterns of cooperation and language play which had been observed during the computer observations. While playing with plastic nuts and bolts as well as with a Fisher Price garage and cars, Josh played cooperatively with others and engaged in extensive language play and noisemaking. Statements such as "This is where my guy lives. My guy gots 'buds'. Yeah, let's have a kitty cat" were examples of the cooperative nature of Josh's play. When clean-up time was announced, Josh wrecked the play setting with extensive noisemaking of buildings and cars crashing, but then cooperated with the others in the clean-up activity.

The preference for friendships and cooperative relationships was also apparent in the classroom observation of Holly. Brett's invitation to Holly's birthday party was later rescinded when he sided with Kelly during a conflict between Holly and Kelly over a glue bottle. Holly later became Kelly's ally when John put glue in Kelly's hair. Holly reported John's behavior to the teacher. Later during the observation Holly had a conversation with Sue from dyad 2. "Why don't you like me?", Holly asked Sue. Sue replied, "I do like you, but you don't like it when I try to play with you". This conversation verified Holly's preference for cooperative relationships as well as Sue's recognition that Holly would not be pleased to be in situations of conflict which were certain to arise as a result of Sue's desire to control.

The patterns of language during computer and classroom observations for Josh and Sue varied from the other dyads in this study in regard to more cooperation and more language play. A higher level of cooperation resulted in a greater frequency of reporting and less frequency of directing and self/group-maintaining language strategies for Josh and Holly than for the other two dyads. An equal amount of talk by Josh and Holly was observed during use of the most developmentally appropriate software, RCR, and the least developmentally appropriate software, AC. This is consistent with the pattern of more language for RCR and AC respectively during the computer observations of the other two dyads.

In summary, these findings suggest that factors other than developmental appropriateness of computer software for young children may affect the amount and type of language observed in dyads during computer use. Those factors may include the interest and familiarity of the children with the subject of the software, the diversity of activities and illustrations within the software, and the uniqueness of each dyadic relationship.

In addition, the present study raises questions concerning the validity of the instrument used to determine developmental appropriateness of software. Since one of the least developmentally appropriate programs (AC) produced results similar to the most developmentally appropriate program (RCR), certain questions need to be addressed concerning the criteria which have been identified to determine the developmental appropriateness of software (Haugland and Shade, 1990). In regard to the influence that software has on the development of children, including language development, it could be that the ten criteria used to determine developmental appropriateness should not be equally weighted. In other words, perhaps certain criteria such as independence and age appropriateness have more influence on particular areas of development of children, particularly language development, than do other criteria such as technical features or transformations. It is important to note that Haugland and Shade (1990) stated, "Indeed, software is like people--every program is unique" (p. 21). It is equally important to note that the response of children to software is also unique as is the influence that each program has on their language and other areas of development.

CHAPTER 5

SUMMARY AND IMPLICATIONS

The recent availability of microcomputers and development of software for young children has necessitated investigations into the effect of this technology on the various aspects of development of young children. Since one of the goals of many early childhood programs is to provide young children with experiences which will enhance their language development, one developmental question which requires careful and specific consideration is how computers affect the language development of young children. The interrelationship of language development to all other areas of development including social, emotional and cognitive development makes these types of investigations of paramount importance. Since the mid 1980's greater concern over developmental appropriateness of various educational practices has been voiced by early childhood educators. These factors require thoughtful and careful consideration in relation to the developmental appropriateness of computer use in early childhood education settings.

Summary

The purpose of this study was to investigate the effect that use of computer software that has been designated as more or less developmentally appropriate has on the language of young children. The questions which guided this inquiry were (1) What common and varied patterns exist in children's language in response to software that has been designated as more or less developmentally appropriate by the Haugland/Shade Developmental Scale and (2) How do individual children and pairs of children respond to software that has been designated as more or less developmentally appropriate for children in their age range? It was not expected that answers to these questions would be fully conclusive as a result of this study. Rather it was expected that some results would provide suggestions for educational practice and further research.

To enable careful analysis of children's language during computer use, eight videotaped observations of three dyads of children were made. During each observation participants used two of four computer software programs which had been designated as more or less developmentally appropriate by the Haugland/Shade Developmental Scale. The observer also kept a log of notes pertaining to each computer observation. At the conclusion of these observations, which took place in the room that had been designated by the preschool for computer use, children were individually asked to designate their first through fourth preferences for the software. A classroom observation of each child was made in order to provide a base for comparison of the language patterns observed during the computer observations. Videotaped computer observations were later timed and transcribed to permit careful analysis and comparison.

Transcripts were analyzed by counting the turns of talk for individuals and dyads, by coding turns of talk to indicate use of Tough's categories of language, and by looking for other common and varied patterns of language. The transcriptions were then sorted and analyzed according to each software title and later according to each dyad in order to provide a focus for responding to each of the two guiding questions of the study. Tables of quantitative data for each software title and each dyad were compiled in order to provide more holistic descriptions. Descriptions of common and varied patterns of language relating to each software title were written in relation to length of time spent with the program, use of Tough's seven categories of language, and evidence of other common and varied patterns of language including talkativeness, conflict and cooperation and language play. The descriptions of the common and varied patterns of language observed for each dyad and individual children included those same categories as well as patterns of language unique to the dyad or individual and a comparison with the classroom observation of each child.

Patterns of language for each software program were described proceeding from the least developmentally appropriate software to the most developmentally appropriate software. Patterns noted for AC included:

-use of all seven of Tough's language categories with reporting occurring most frequently for this program as well as for all four programs;

-use of letters and circus characters as a theme for language;

-use of reasoning to explain the score or mechanics of a game;

-use of predicting, projecting, or imagining at a low but notable level in comparison with all programs used in the study;

-the greatest length of time used of all four software programs;

-the second highest level of talkativeness;

-a high level of cooperative interaction;

-a high level of language play.

Patterns of language and use noted for JR were:

-use of five of Tough's seven categories of language;

-use of directing most often and in a way to indicate which game to play or how to take turns;

-use of reporting to identify colors and the three illustrations;

-use of self/group-maintaining to get to the illustration, change to a different game or change to a different software program;

-references to color during reasoning language;

-the lowest level of talkativeness;

-a low level of conflict;

-language play consisting of singing and noisemaking, but no rhyming.

Patterns identified for SBO were:

-use of six of Tough's seven categories;

-use of directing and self/group-maintaining language most often and related to searching for favorite pictures;

-use of adjectives describing attributes unrelated to the opposite concepts intended to be taught by the software;

-limited use of reasoning, predicting, and imagining;

-a low level of talkativeness;

-a moderate level of conflict often involving use of the spacebar to change the picture;

-limited observations of language play.

The most developmentally appropriate software used in the study, RCR, revealed the following patterns:

-the highest frequency for all of Tough's categories except reporting;

-more elaborate and descriptive patterns of language for all categories;

-the highest level of talkativeness;

-a high level of conflict;

-use of various forms of language play by all dyads.

Language analyses and comparisons of use of all four software programs revealed the following patterns: 1) The length of time spent using the software was not necessarily related to its developmental appropriateness since one of two less developmentally appropriate software programs used in the study was used the longest amount of time while the most developmentally appropriate software was used the second longest amount of time (Table 3). This finding supports that of Haugland (1988) who reported that children with access to less developmentally appropriate software spent more time using the computer than did children who had access to more developmentally appropriate software; 2) The use of Tough's categories was somewhat related to the developmental appropriateness of the software since all categories were observed during use of the most developmentally appropriate software with six of the seven categories occurring most frequently in association during its use. The developmentally more challenging categories of language including reasoning, predicting, projecting and imagining occurred with the greatest frequency during use of the most developmentally appropriate software. One category (reporting) occurred more frequently during observations of one of the less developmentally appropriate software programs and all other categories ranked second in frequency during its use (Table 4); 3) The use of three categories (self/group-maintaining, directing, and reporting) occurred with greater frequency across use of all four software programs, while the use of the other four categories (reasoning, predicting, projecting, and imagining) was comparatively infrequent across all four software programs (Table 4); 4) The most developmentally appropriate software program produced the greatest number of turns of talk while one of the two less developmentally appropriate programs produced the second greatest number of turns of talk (Table 5); 5) The total turns of talk observed during use of each software program divided by the length of time spent using that program resulted in a talkativeness calculation for each program. Results of these calculations revealed that while talkativeness was greatest for the most developmentally appropriate software program, again, one of the less developmentally appropriate programs ranked second in the talkativeness calculation (Table 6); and 6) The quantity of talk showed an increasing trend across all eight observations regardless of software used (Table 7).

Analysis of transcripts for each dyad and for individual children revealed common and varied patterns of language and interaction which were surprisingly consistent with the patterns of language and interaction during observations of each child in the classroom. These findings suggest that factors other than developmental appropriateness may influence the amount and type of language observed during computer use by dyads. These findings also raise concerns regarding the criteria used to determine developmental appropriateness of software, particularly as related to language development (Haugland & Shade, 1988a, 1988b, 1990).

Implications for Education

The use of computers in early childhood education settings has been met with both enthusiasm and apprehension. Somewhere between those extremes, thoughtful pedagogy regarding use of the computer with young children can be found. Research regarding the effect of the computer on various aspects of a child's development is still in its infancy, but has revealed implications for educators who are concerned about how best to integrate use of the computer and software programs into the curriculum. The present study suggests several considerations that early childhood educators should make when planning to utilize computers with young children.

One consideration to be made is in regard to the selection of software which has been designated developmentally appropriate. Haugland and Shade (1990) suggest that software receiving a rating seven or above on their developmental scale is developmentally appropriate. Other factors such as the children's interest and the teacher's ability to integrate the software into other aspects of the curriculum can enhance the effectiveness of software which has a rating of less than 7. In this study the software program AC with a developmental rating of 2.5 ranked second in its ability to stimulate language. The children's natural interest in the subject of the circus and alphabet letters coupled with the fact that the circus had been a recent curricular theme probably enhanced the effectiveness of this software.

Another consideration that early childhood educators should take into account relates to the preponderance of certain categories of language which were observed during the present study. Tough's categories of directing, reporting, and self/group-maintaining occurred with much greater frequency than did the categories of reasoning, predicting, projecting, and imagining (Table 4). The category of imagining occurred in only 38 turns of talk out of the thousands recorded in this study.

Previous studies (Genishi et al, 1985; Wright et al, 1986) reported that interaction with Logo prompted language which was rich in humor, imagination, emotion, play and fantasy. These studies did not indicate the specific frequencies with which these categories of language occurred. However, the low ratio of imaginative language which was observed in the present study raises the question as to whether it is the amount of this type of language which is observed or whether these instances are so striking in contrast to the other language being observed during computer use that they stand out in the memories of observers. What observer would not take note of Rob's imaginative story about going in the back of the computer and walking in the water he saw on the screen while using the RCR software? The investigator of the present study observed many instances of imagination during the brief classroom observations of the individual children as they engaged in play and other self-selection activities. These instances of imaginative language during classroom observations perhaps are not as striking or as memorable because they were not related to technolo y and were viewed only once as compared to repeated viewings of the videotaped computer observations. The related implications and considerations for educators, therefore, are "What types or categories of language do I want to encourage?" and "Is the use of the computer the best way to encourage the type of language I want to foster for the children in my classroom?". Teachers of young children should consider ways of interacting with children during computer use in order to encourage reasoning, predicting, projecting in the language of young children.

The nature of the dyadic relationships and the positive or negative effects of conflict are other implications for educators to consider as a result of this study. A democratic relationship between partners in a dyad assures that both children will have a beneficial experience with the computer. While conflict is often viewed negatively, it can also have positive effects if children are learning to negotiate turns, solving problems, or engaging in cognitively challenging conversations. Similarly, completely cooperative dyadic relationships may not always be advantageous to the development of children. Teachers need to carefully observe the language and interaction of children during computer use in order to determine if the dyadic relationship is a positive developmental force in terms of conflict or cooperation.

The present study's finding that the turns of talk increased over time with subsequent uses of software has another interesting implication for educators. Perhaps rather than investing in many different software programs, it would be more beneficial to invest in fewer software programs that have potential for extended use by children. Programs such as RCR with the capability for expanding complexity would be a more prudent and beneficial investment of school resources than purchasing programs of less complexity would be. During the present study, children were only able to begin to explore the complexity of RCR.

The last implication for educators relates to what children think or say they like and what is truly best or more developmentally appropriate for them. While RCR was most successful both in terms of the amount and variety of language that it was able to evoke, only one of six participants identified this software as the one most preferred. Four out of six of the participants identified RCR as the third or fourth preference. Perhaps Haugland (1988) used a good analogy when she stated that although children like candy very much, adults know that too much is not good for them. Therefore, adults have the responsibilities of being informed regarding the effects that computer use has on the development of children and of monitoring the use of computers and software by children.

Implications for Research

The results of the present study and how they relate to the results of previous studies reveal the need for ongoing discussion and research concerning the questions that surround the appropriateness and benefits of young children using computers. Since the present study was limited by sample size, the number of software programs utilized, and the location of the computers outside of the classroom, there is further need to investigate the relationship between the developmental appropriateness rating of software and its effect on the language of young children. While perhaps it would be more difficult to observe and record language in the classroom where many other activities are occurring simultaneously, conducting research in the ecological setting where language development and computer use are most likely to take place can have different results.

A study designed to explore the commonalities between AC and RCR would also be beneficial. Such a study would help to reveal why two pieces of software which differed greatly in the rating given by the Haugland/Shade Developmental Scale (1990) resulted in similar patterns of language in terms of talkativeness and Tough's seven categories.

Another implication for research relates to the issue of conflict versus cooperation. A previous research study, which compared the effectiveness of the computer to enhance the development of language and cooperative play to other free choice activities, reported that the computer was the only activity which resulted in high levels for both language and cooperative play (Muhlstein & Croft, 1986). In the previous study no mention was made of the frequency of conflict during computer use as compared to other free choice activities. Since a notable pattern of conflict was observed in the present study, further research is needed to investigate the relationship between conflict and computer use as compared to other classroom activities.

The low proportions of reasoning, predicting, projecting, and imagining language categories as compared to the other three language categories observed in the present study points out the need for further research. Investigations should be conducted to compare the use of Tough's language categories during computer involvement and during other activities in the preschool classroom. The present study made no attempt to record or classify the language of children when they were observed in their classroom.

The results of this study indicate that teachers should carefully observe the language and interactions of children when making decisions regarding the developmental appropriateness of software. While the Haugland/Shade Developmental Scale (1990) can serve as a guide in software selection, the present study raises questions concerning the effectiveness of the ten criteria to determine developmental appropriateness for children, particularly in the area of language development. The present study and previous studies are just a beginning look at the effect that computers have on the development and education of young children.

APPENDICES

APPENDIX A

DEVELOPMENTAL SOFTWARE EVALUATION FORM

Developmental Software Evaluation Form

Title:
Publisher:

Criteria	1	.5	0	Characteristics
Age Appropriate				Realistic presentation of concepts
Child Control				Actors not reactors; active not passive; child sets pace, can escape
Clear Instructions				Verbal instructions; picture choices; simple and precise directions
Expanding Complexity				Low entry, high ceiling; learning sequence is clear; teaches powerful ideas
Independent Exploration				Adult supervision not needed after initial exposure
Process Orientation				Process engages child, product secondary; discovery learning, not skill drilling; intrinsic motivation
Real-World Representation				Simple, reliable model; concrete representations of objects and functions
Technical Features				Colorful; uncluttered realistic graphics; animation; loads and runs quickly; corresponding sound effects or music; sturdy disks
Trial and Error				Children test alternative responses
Visible Transformations				Objects and situations change; process highlighter

Total Score

1: Software Reflects Developmental Characteristic
.5: Software Reflects At Least Half The Items Within Characteristic
0: Software Does Not Reflect Characteristic

From Haugland and Shade, 1988b (p. 2).

APPENDIX B

TOUGH'S SEVEN CATEGORIES FOR USES OF LANGUAGE AND SUPPORTING STRATEGIES

USES OF LANGUAGE AND SUPPORTING STRATEGIES

1 Self-maintaining and group maintaining

Strategies
1 Referring to physical and psychological needs and wants of the self or the group.
2 Protecting the self or group and self or group interests.
3 Justifying behaviour or claims of self or group.
4 Criticizing others.
5 Threatening others.
6 Asserting superiority of self or group.

2 Directing

Strategies
1 Monitoring own actions.
2 Directing the actions of the self.
3 Directing the actions of others.
4 Collaborating in action with others.

3 Reporting on present and past experiences

Strategies
1 Labelling the components of the scene.
2 Referring to detail (e.g. size, colour and other attributes).
3 Referring to incidents.
4 Referring to the sequence of events.
5 Making comparisons.
6 Recognizing related aspects.
7 Making an analysis using several of the features above.
8 Extracting or recognizing the central meaning.
9 Reflecting on the meaning of experiences, including own feelings.

4 Reasoning

Strategies
1 Explaining a process.

4 Reasoning continued ...

2 Recognizing casual and dependent relationships.
3 Recognizing problems and their solutions.
4 Justifying judgments and actions.
5 Reflecting on events and drawing conclusions.
6 Recognizing principles.

5 Predicting

Strategies
1 Anticipating and forecasting events.
2 Anticipating the detail of events.
3 Anticipating a sequence of events.
4 Anticipating problems and possible solutions.
5 Anticipating and recognizing alternative courses of action.
6 Predicting the consequences of actions or events.

6 Projecting*

Strategies
1 Projecting into the experiences of others.
2 Projecting into the feelings of others.
3 Projecting into the reactions of others.
4 Projecting into situations never experienced.

7 Imagining*

Strategies
1 Developing an imaginary situation based on real life.
2 Developing an imaginary situation based on fantasy.
3 Developing an original story.

* Strategies which serve directing, reporting and reasoning may serve these uses also.

From Tough, 1979 (p.36).

APPENDIX C

DEVELOPMENTAL SOFTWARE EVALUATIONS FOR SOFTWARE USED IN THE STUDY

Developmental Software Evaluation Form

Title: ALPHABET CIRCUS
Publisher: DLM Teaching Resources, 1984

Criteria	1	.5	0	Characteristics
Age Appropriate	X			Realistic presentation of concepts
Child Control			X	Actors not reactors; active not passive; child sets pace, can escape
Clear Instructions			X	Verbal instructions; picture choices; simple and precise directions
Expanding Complexity			X	Low entry, high ceiling; learning sequence is clear; teaches powerful ideas
Independent Exploration	X			Adult supervision not needed after initial exposure
Process Orientation			X	Process engages child, pr duct secondary; discovery lear ing, not skill drilling; intrinsic motivation
Real-World Representation			X	Simple, reliable model; concrete representations of objects and functions
Technical Features		X		Colorful; uncluttered realistic graphics; animation; loads and runs quickly; corresponding sound effects or music; sturdy disks
Trial and Error			X	Children test alternative responses
Visible Transformations			X	Objects and situations change; process highlighter
Total Score		2.5		

1: Software Reflects Developmental Characteristic
.5: Software Reflects At Least Half The Items Within Characteristic
0: Software Does Not Reflect Characteristic

From Haugland and Shade, 1988b (p. 45).

Reprinted with permission of the authors.

ALPHABET CIRCUS (NOT MARQUEE MAKER)

Total Score:	2.5
Publisher:	DLM Teaching Resources
Description:	Five games focusing on letter recognition and alphabetical order. Instructions and sound turn off and on.
Comment:	There are many more effective ways to present letter concepts to children than this skill-drilling software.

Criteria	**Rating**	**Characteristics**
Age Appropriate	0	Realistic presentation of concepts
Child Control	.5	Actors not reactors; children set pace; can escape
Clear Instructions	0	Verbal instructions; simple and precise directions; picture choices
Expanding Complexity	0	Low entry, high ceiling; learning sequence is clear; teaches powerful ideas
Independence	1	Adult supervision not needed after initial exposure
Process Orientation	0	Process engages, product secondary; discovery learning, not skill drilling; intrinsic motivation
Real-World Model	0	Simple, reliable model; concrete representations; objects function
Technical Features	1	Colorful; uncluttered realistic graphics; animation; loads and runs quickly; corresponding sound effects or music; sturdy disks
Trial and Error	0	Children test alternative responses
Transformations	0	Objects and situations change; process highlighter

From Haugland and Shade, 1990 (p. 25).

Developmental Software Evaluation Form

Title: EXPLORE-A-STORY: ROSIE, THE COUNTING RABBIT
Publisher: D. C. Heath and Company/Collamore Ed. Publishing, 1987

Criteria	1	.5	0	Characteristics
Age Appropriate	X			Realistic presentation of concepts
Child Control	X			Actors not reactors; active not passive; child sets pace, can escape
Clear Instructions			X	Verbal instructions; picture choices; simple and precise directions
Expanding Complexity	X			Low entry, high ceiling; learning sequence is clear; teaches powerful ideas
Independent Exploration	X			Adult supervision not needed after initial exposure
Process Orientation	X			Process engages child, product secondary; discovery learning, not skill drilling; intrinsic motivation
Real-World Representation	X			Simple, reliable model; concrete representations of objects and functions
Technical Features	X			Colorful; uncluttered realistic graphics; animation; loads and runs quickly; corresponding sound effects or music; sturdy disks
Trial and Error	X			Children test alternative responses
Visible Transformations	X			Objects and situations change; process highlighter
Total Score		9.0		

1: Software Reflects Developmental Characteristic
.5: Software Reflects At Least Half The Items Within Characteristic
0: Software Does Not Reflect Characteristic

From Haugland and Shade, 1988b (p. 58).

Reprinted with permission from the authors.

EXPLORE-A-STORY: ROSIE, THE COUNTING RABBIT

Total Score:	8.5
Publisher:	D. C. Heath and Company
Description:	Children follow storybook or build a story by manipulating backgrounds, animating characters, arranging scenery, and composing text. Icon menus, color printing, multiple input devices. Part of a series.
Comment:	Children never tire of these open-ended, child-in-control programs.

Criteria	Rating	Characteristics
Age Appropriate	1	Realistic presentation of concepts
Child Control	1	Actors not reactors; children set pace; can escape
Clear Instructions	0	Verbal instructions; simple and precise directions; picture choices
Expanding Complexity	1	Low entry, high ceiling; high learning sequence is clear; teaches powerful ideas
Independence	1	Adult supervision not needed after initial exposure
Process Orientation	1	Process engages, product secondary; discovery learning; not skill drilling; intrinsic motivation
Real-World Model	1	Simple, reliable model; concrete representations; objects function
Technical Features	.5	Colorful; uncluttered realistic graphics; animation; loads and runs quickly; corresponding sound effects or music; sturdy disks
Trial and Error	1	Children test alternative responses
Transformations	1	Objects and situations change; process highlighter

From Haugland and Shade, 1990 (p. 55).
Reprinted with permission from the authors.

Developmental Software Evaluation Form

Title: JUGGLES' RAINBOW
Publisher: The Learning Company, 1982

Criteria	1	.5	0	Characteristics
Age Appropriate	X			Realistic presentation of concepts
Child Control		X		Actors not reactors; active not passive; child sets pace, can escape
Clear Instructions		X		Verbal instructions; picture choices; simple and precise directions
Expanding Complexity			X	Low entry, high ceiling; learning sequence is clear; teaches powerful ideas
Independent Exploration			X	Adult supervision not needed after initial exposure
Process Orientation			X	Process engages child, product secondary; discovery learning, not skill drilling; intrinsic motivation
Real-World Representation			X	Simple, reliable model; concrete representations of objects and functions
Technical Features		X		Colorful; uncluttered realistic graphics; animation; loads and runs quickly; corresponding sound effects or music; sturdy disks
Trial and Error	X			Children test alternative responses
Visible Transformations			X	Objects and situations change; process highlighter
Total Score		3.5		

1: Software Reflects Developmental Characteristic
.5: Software Reflects At Least Half The Items Within Characteristic
0: Software Does Not Reflect Characteristic

From Haugland and Shade, 1988b (p. 64).

JUGGLES' RAINBOW

Total Score:	2.5
Publisher:	The Learning Company
Description:	Three games drill children in up/down and right/left orientations. Colorful, animated graphics and music accompany the keyboard activity.
Comment:	Too abstract and removed from children's actual experiences to teach anything about directionality.

Criteria	Rating	Characteristics
Age Appropriate	0	Realistic presentation of concepts
Child Control	.5	Actors not reactors; children set pace; can escape
Clear Instructions	.5	Verbal instructions; simple and precise directions; picture choices
Expanding Complexity	0	Low entry, high ceiling; learning sequence is clear; teacher powerful ideas
Independence	0	Adult supervision not needed after initial exposure
Process Orientation	0	Process engages, product secondary; discovery learning, not skill drilling; intrinsic motivation
Real-World Model	0	Simple, reliable model; concrete representations; objects function
Technical Features	.5	Colorful; uncluttered realistic graphics; animation; loads and runs quickly; corresponding sound effects or music; sturdy disks
Trial and Error	1	Children test alternative responses
Transformations change;	0	Objects and situations process highlighter

From Haugland and Shade, 1990 (p. 71).
Reprinted with permission from the authors.

Developmental Software Evaluation Form

Title: STICKYBEAR OPPOSITES
Publisher: Weekly Reader Software

Criteria	1	.5	0	Characteristics
Age Appropriate	X			Realistic presentation of concepts
Child Control		X		Actors not reactors; active not passive; child sets pace, can escape
Clear Instructions			X	Verbal instructions; picture choices; simple and precise directions
Expanding Complexity			X	Low entry, high ceiling; learning sequence is clear; teaches powerful ideas
Independent Exploration	X			Adult supervision not needed after initial exposure
Process Orientation		X		Process engages child, product secondary; discovery learning, not skill drilling; intrinsic motivation
Real-World Representation	X			Simple, reliable model; concrete representations of objects and functions
Technical Features	X			Colorful; uncluttered realistic graphics; animation; loads and runs quickly; corresponding sound effects or music; sturdy disks
Trial and Error	X			Children test alternative responses
Visible Transformations		X		Objects and situations change; process highlighter
Total Score		6.5		

1: Software Reflects Developmental Characteristic
.5: Software Reflects At Least Half The Items Within Characteristic
0: Software Does Not Reflect Characteristic

From Haugland and Shade, 1988b (p. 40).

Reprinted with permission from the authors.

STICKYBEAR OPPOSITES

Total Score:	6.5
Publisher:	Weekly Reader Software
Description:	Children use the arrow keys to change objects or events to their opposite. Comment: Simple to operate with colorful graphics, but children quickly lose interest. Children need more control to discover the process by which objects change.

Criteria	**Rating**	**Characteristics**
Age Appropriate	1	Realistic presentation of concepts
Child Control	0	Actors not reactors; children set pace; can escape
Clear Instructions	0	Verbal instructions; simple and precise directions; picture choices
Expanding Complexity	0	Low entry, high ceiling; learning sequence is clear; teaches powerful ideas
Independence	1	Adult supervision not needed after initial exposure
Process Orientation	1	Process engages, product secondary; discovery learning, not skill drilling; intrinsic motivation
Real-World Model	1	Simple, reliable model; concrete representations; objects function
Technical Features	1	Colorful; uncluttered realistic graphics; animation; loads and runs quickly; corresponding sound effects or music; sturdy disks
Trial and Error	1	Children test alternative responses
Transformations	.5	Objects and situations change; process highlighter

From Haugland and Shade, 1990 (p. 117).
Reprinted with permission from the authors.

APPENDIX D

PARENT CONSENT FORM

Dear Parents,

As a doctoral student in teacher education at UND, I am required to complete a dissertation based upon a research project. The subject of my dissertation is an examination of children's language when they are using a computer. The purpose of the study is to determine whether the quality of computer software has an effect on children's language. Children will be videotaped as they are working at the computer with a partner. This will take place at ____________ two times per week for approximately four weeks (a total of eight videotaped observations). Children will be leaving their classroom for approximately 20-30 minutes between 8:00-9:45 a.m. or 1:00-3:00 p.m. to go to the computer room. They will be introduced to four new computer software programs through this project. Children will not be identified in the research report or any articles published as a result of the research.

____________ has been selected as the site for the research because of the children's previous experience with computers. ____________, Director of ____________, is randomly selecting 4 and 5 year old children who are enrolled full time to facilitate completion of the research in a timely manner. It should be noted that the desires of the children in regard to declining to participate or in stopping the activity at any given time will be respected.

If you have any questions concerning this project, please feel free to call me at 777-3155. Please leave a message if I am not in the office and I will return your call.

Sincerely,

Janice Sherman

# # # #

I give permission for my child, _________________, to participate in the computer/language research project and to be videotaped.

________________________ ______________
Signature Date

(I also give permission for my child's photo to be used in any publication that may result from this research and understand that my child's identity will not be revealed. Yes _____ No______

PLEASE SIGN A DUPLICATE OF THIS FORM TO KEEP FOR FUTURE REFERENCE.

APPENDIX E

VIDEOTAPE TRANSCRIPTION SHEET

Videotape Transcription Sheet

Dyad ____________________ Left________ Right______

Observation # ____________ Software________________________

Duration __________________________

Coding	I	Verbal	Nonverbal	Observer

REFERENCES

REFERENCES

Allen, J. & Catron, C. (1990). Researchers at the early childhood center: Guidelines for Cooperation. Young Children, 45(4), 60-65.

Alphabet Circus [Computer program]. (1984). Allen, TX: DLM.

Anselmo, S. & Zinck, R. A. (1987). Computers for young children? Perhaps. Young Children, 42(3), 22-27.

Beaty, J, J., & Tucker, W. H. (1987). The computer as a paintbrush. Columbus, OH: Merrill Publishing Company.

Beeson, B. S. & Williams, R. A. (1985). The "holding power" of the computer: A study of young children's computer time. (ERIC Document Reproduction Service No. ED 262 914)

Bowman, B. T. (1983). Do computers have a place in preschools. Alburquerque, NM. (ERIC Document Reproduction Service No. ED 231 504)

Bredekamp, S. (Ed.). (1987). Developmentally appropriate practice in early childhood programs serving children from birth through age 8. Washington, DC: NAEYC.

Burg, K. (1984). The microcomputer in the kindergarten: A magical, useful, expensive toy. Young Children, 39(3), 28-33.

Byrd, D., Killian, J. E., & Nelson, J. N. (1987). Is there a role for computers in early childhood programs: A naturalistic study. (ERIC Document Reproduction Service No. ED 288 621)

Cazden, C. (1982). Language in early childhood education. Washington, DC: NAEYC.

Cazden, C. (1985). Classroom discourse, In M. C. Wittrock (Ed.), Handbook of research on teaching. 3rd edition. New York: Macmillan.

Clements, D. H. (1986). Effects of Logo and CAI environments on cognition and creativity. Journal of Educational Psychology, 78(4), 309-318.

Clements, D. H. (1987a). Computers and young children: A review of research. Young Children, 43 (1), 34-44.

Clements, D. H. (1987b). Longitudinal study of the effects of logo programming on cognitive abilities and achievement. Educational Computing Research, 3(1), 73-95.

Clements, D. H. & Nastasi, B. K. (1988). Social and cognitive interactions in educational computer environments. American Educational Research Journal, 25(1), 87-107.

Davidson, J. I. (1989). Children and computers together in the early childhood classroom. Newark, NJ: Delmar Publishers, Inc.

Emihovich, C., & Miller, G. E. (1986). Talking to the turtle: A discourse analysis of logo instruction. San Francisco, CA: American Educational Research Association. (ERIC Document Reproduction Service No. ED 276 532)

Genishi, C., McCollum, P. & Strand, E. (1985). Research currents: The interactional richness of children's computer use. Language Arts, 62, 526-532.

Goodwin, L. D., Goodwin, W. L., & Garel, M. B. (1986). Use of microcomputers with preschoolers: A review of the literature. Early Childhood Research Quarterly, 1, (3), 269-286.

Goodwin, L. D., Goodwin, W. L., Nansel, A. & Helm, C. P. (1986). Cognitive and affective effects of various types of microcomputer use by preschoolers. American Educational Research Journal, 23(3), 348-356.

Haugland, S. W. (1988, November). Computer interaction: How does it affect the development of preschool children? Paper presented at the annual meeting of the National Association for the education of Young Children, Anaheim, CA.

Haugland, S. W. (1989). The effect of computer placement on interaction time and children's developmental gains. Paper presented at the annual meeting of the National Association for the Education of Young Children, Atlanta, GA.

Haugland, S. W., & Shade, D. D. (1988a). Developmentally appropriate software for young children. Young Children, 43,(4), 37-43.

Haugland, S. W., & Shade, D. D. (1988b). Software evaluations based upon the Haugland/Shade developmental scale. Presented at the annual meeting of the National Association for the Education of Young Children, Anaheim, CA.

Haugland, S. W., & Shade, D. D. (1990). Developmental evaluations of software for young children. Newark, DE: Delmar Publishers, Inc.

Hoot, J. L. (1983). Computers and very young children: Educational promise and problems. (ERIC Document Reproduction Service No. ED 235 897)

Hoot, J. L. (1986). Computers in early childhood education. Englewood Cliffs, NJ: Prentice-Hall.

Hoover, J. M., & Austin, A. M. (1986). A comparison of traditional preschool and computer play from a social/cognitive perspective. San Francisco, CA: American Educational Research Association. (ERIC Document Reproduction Service No. ED 270 220)

Howell, R. D., Scott, P. B. & Diamond, J. (1987). The effects of "instant" logo computing language on the cognitive development of very young children. Educational Computing Research, 3(2), 249-261.

Hungate, H. (1982). Computers in the kindergarten. The Computing Teacher. 9(5), 15-18.

Hyson, M. & Morris, S. (1986). Computers? I love them: Young children's concepts and attitudes about computers. Early Childhood Development and Care, 23, 17-29.

Johnson, J. E. (1985). Characteristics of preschoolers interested in microcomputers. Journal of Educational Research, 78(5), 299-305.

Jones, E. E. (1987). Sex differences in preschooler's use of the computer? Medford, MA: Tufts University. (ERIC Document Reproduction Service No. ED 282 635)

Juggles' Rainbow [Computer program]. (1982). Menlo Park, CA: The Learning Company.

Killian, J., Nelson, J., & Byrd, D. (1986). Child's Play: Computers in early childhood programs. The Computing Teacher. 14(1), 13-16.

Klinzing, D. G. (1985). A study of the behavior of children in a preschool equipped with computers. Chicago, IL: American Educational Research Association. (ERIC Document Reproduction Service No. ED 255 320)

Lipinski, J. M., Nida, R. E., Shade, D. D., & Watson, J. A. (1984). Competence, gender and preschooler's free play choices when a microcomputer is present in the classroom. Greensboro, NC: University of North Carolina. (ERIC Document Reproduction Service No. ED 243 609)

Mardell-Czudnowski, C. & Goldenberg, D. (1983). Developmental Indicators for the Assessment of Learning (DIAL-R). Edison, NJ: Childcraft Education Corporation

Muhlstein, E. A., & Croft, D. J. (1986). Using the microcomputer to enhance language experiences and the development of cooperative play among preschool children. Cupertino, CA: De Anze College. (ERIC Document Reproduction Service No. ED 269 004)

Muller, A. A., & Perlmutter, M. (1984). Preschool children's problem-solving interactions at computers and jigsaw puzzles. (ERIC Document Reproduction Service No. ED 248 013)

Nida, R. E., Lipinski, J. M., Shade, D. D. & Watson, J. A. (1984). Introducing a microcomputer to a preschool classroom: The effects on children's social interaction. Greensboro, NC: University of North Carolina. (ERIC Document Reproduction Service No. ED 243 607)

Nieboer, R. A. (1983). A study of the effect of computers on the preschool environment. (ERIC Document Reproduction Service No. ED 234 898)

Paris, C. L., & Morris, S. K. (1985). The computer in the early childhood classroom: Peer helping and peer teaching. College Park, MD: Microworld for Young Children Conference. (ERIC Document Reproduction ServiceNo. ED 257 555)

Patridge, S. (1984). Using computers with little children: A discussion. (EDRS Document Reproduction Service No. 253 349)

Piestrup, A. M. (1981). Preschool children use an Apple II microcomputer to test reading skills programs. (ERIC Document Reproduction Service No. ED 202 476)

Rosengren, K. S., Gross, D., Abrams, A. F. & Perlmutter, M. (1985). An observational study of preschool children's computing activity. Austin, TX. (ERIC Document Reproduction Service No. ED 264 953)

Rosie, the Counting Rabbit [Computer program]. (1987). Lexington, MA: D. C. Heath.

Scott, I., & Bell, S. (1985). Computers and language. (ERIC Document Reproductive Service No. ED 262 411)

Shade, D. D., Daniel, G. E., Nida, R. E., Lipinski, J. M. & Watson, J. A. (1983). Microcomputers: A close look at what happens when preschool children interact with age-appropriate software. Greensboro, NC: University of North Carolina. (ERIC Document Reproduction Service No. ED 243 608)

Shade, D. D., & Watson, J. A. (1987). Microworlds, mother teaching behavior and concept formation in the very young child. Early Child Development and Care, 28, 97-113.

Shaw, D. G., Swigger, K. M. & Herndon, J. (1985). Children's questions: A study of questions children ask while learning to use a computer. Computers and Education, 9(1), 15-19.

Sherman, J., Divine, K. P. & Johnson, B. (1985). An analysis of computer software preferences of preschool children. Educational Technology, 5, 39-41.

Stickybear Opposites [Computer program]. (1983). Middletown, CT: Weekly Reader Family Software.

Swigger, K. M., Campbell, J. & Swigger, B. K. (1983, January/February). Preschool children's preferences of different types of CAI programs. Educational Computer Magazine, 38-40.

Swigger, K. M., & Swigger, B. K. (1984). Social patterns and computer use among preschool children. Association for Educational Data Systems Journal. 17(3), 35-40.

Tough, J. (1979). Talk for teaching and learning. Plymouth, Great Britain: Latimer Trend & Co.

Williams, R. A., & Beeson, B. S. (1985). The effects of gender and age on preschool children's choice of the computer as a child-selected activity. Journal of the American Society for Information Science. 339-341.

Worden, P. E., Kee, D. W. & Ingle, M. J. (1985). Preschoolers' alphabet learning activities with their parents: Picture-books vs. personal computer software. Toronto, Ontario, Canada: Society for Research in Child Development. (ERIC Document Reproduction Service No. ED 258 710)

Wright, J. L. (1989). The microcomputer's effect on narrative competence of young children. Paper presented at the annual meeting of the National Association for the Education of Young Children, Atlanta, GA.

Wright, J. L. & Samaras, A. S. (1986). Play worlds and microworlds. In P. Campbell and G. Fein (Eds.), Young Children and Microcomputers (pp. 73-86). Englewood Cliffs, NJ: Prentice-Hall.

Ziajka, A. Microcomputers in early childhood education? Young Children, 1983, 38(5), 61-67.