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Maternal-child interaction during a problem-solving task

Karen Anne Sawchenko
University of Massachusetts Amherst

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MATERNAL-CHILD INTERACTION DURING A PROBLEM-SOLVING TASK

A Thesis Presented

By

KAREN ANNE SAWCHENKO

Submitted to the Graduate School of the University of Massachusetts in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

September 1979

Department of Psychology
MATERNAL-CHILD INTERACTION DURING
A PROBLEM-SOLVING TASK

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By
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Finally, my thanks and appreciation go to my husband, Paul, for his enduring support over the past year.
ABSTRACT

The present study investigated the relationship between maternal-child instructional interactions during a problem-solving task and the child's subsequent performance on the same task. Seventeen mothers were videotaped while they taught their 3½-year-old children (9 females, 8 males) two design-construction tasks. Pre-test and posttest measures on the task were also taken for each child. An observational system coded each maternal instructional intervention according to its level of specificity or intrusiveness and each child's response according to its correctness. Frequency measures and measured based on the relationship between the level of specificity of a maternal instruction, the accuracy of the child's response to that instruction, and the subsequent change in the level of the next maternal instruction were derived from the observations and correlated with the child's improvement scores (the difference between the pretest and posttest scores).

Children of mothers who repeated instructions at the same level of specificity after either a correct or incorrect child's response tended to have higher improvement scores, suggesting that repetition is an effective maternal teaching strategy. No relationship with the child's performance scores were found when mothers tended to differentially adjust the level of their instruction according to a specific pattern in response to the accuracy of the
child's response. This finding was attributed to task variables. Task variables should be considered when investigating effective maternal instructional strategies.

In addition, posthoc analyses suggested that children of mothers who provided many instructions, instructions at a fast rate, or physically-intrusive interventions tended to have lower improvement scores, suggesting that mothers who intervened more, in general, were ineffective teachers. On the other hand, children who had mothers who provided less specific, verbal and gestural instructions tended to have higher improvement scores, suggesting that mothers who provided less help were the more effective teachers.
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A child's problem-solving and play activities are often mediated, in the sense of assisted, accompanied, elaborated, or even directed, by an adult, particularly the mother; and a number of studies have reported that such early maternal mediation enriches the child's subsequent cognitive performance (For a recent review, see Ramey, Farren, Cambell, & Finkelstein, in press). For example, infants who have received a greater amount of maternally-mediated object play (Clarke-Stewart, 1973; Collard, 1971) or play activities (Rubenstein, 1967) have subsequently demonstrated higher levels of schema development and more complex exploratory behavior during solitary object-play.

Studies that have focused on mother-infant interactions have described early maternal mediations mainly in terms of "stimulation" and "responsivity" to the infant. However, as the child approaches pre-school age, maternal activities increasingly take the form of instructional-interactions during which the mother appears to intentionally teach her child (White, Watts, Barnett, Kaban, Marmor, & Shapiro, 1973). Naturalistic observations have indicated that mothers, for example, use modeling and corrective feedback to actively teach language to children between two to five years old (Holzman, 1974; Moerk, 1976). In fact, Carew, Chan, & Halfar (note 1) have identified
intentional transmission of knowledge and skills as one of four ways that adults transformed their child's natural activities into more intellectually valuable experiences.

The fact that maternal-child instructional interactions occur does not imply that such instruction is necessary for the child's cognitive development; however, maternal-child interaction is frequently hypothesized to be significant for cognitive development. For example, Bruner (1972) hypothesized that intentional teaching is unique to the human species, and suggests that such instructional interactions are adaptive in that they provide the human species with efficient means for transmitting an increasingly complex man-made culture, and research evidence has often been supportive of this general hypothesis. Findings from several longitudinal and observational studies have indicated that the amount of maternal-child instructional interactions during the child's first three years is a significant factor in the child's subsequent cognitive performance (Hertzig, Birch, Thomas, & Mendez, 1968; White et al., 1973; Carew et al., note 1). Hertzig et al. (1968) found that 3-1/2 year-old children from different ethnic backgrounds differed in the style of their responses to structured task activities, and, based on informal observations and parent interviews throughout the child's first three years, they attributed the response-style differences to the degree to which mothers became actively involved in their child's toy-play and problem-solving activities. In addition, White et al. (1973) found that children who were predicted to demonstrate more intellectually and socially competent
behaviors had mothers who provided more instructional interactions during the child's first three years.

The findings from a number of other studies using more restricted observations of mothers teaching their children to solve a particular task in a structured setting have also been used to infer that the quality of the maternal instructions is a significant factor in the child's cognitive development. Maternal teaching strategies do differ significantly with the mother's socioeconomic status (Bee, Van Egeren, Streissguth, Nyman, & Leckie, 1969; Brophy, 1970; Fessbach, 1975; Hess & Shipman, 1965; Hess & Shipman, 1967) and ethnic background (Feshbach, 1973; Steward & Steward, 1973). For example, lower-class mothers differed from middle-class mothers in such teaching strategies as the specificity of proactive instructions (Brophy, 1970; Hess & Shipmen, 1967; Steward & Steward, 1973), the ratio of positive to negative feedback (Bee et al., 1969; Feshbach, 1973; Hess & Shipman, 1967; Steward & Steward, 1973), and the amount of physical intrusion (Bee et al., 1969; Steward & Steward, 1973), and all of these factors have been implicated as contributing to social class differences in performance on a variety of intellectual tasks.

One major difficulty in all of these studies, however, is determining just how the maternal instructions specifically affect the child's cognitive development. Fortunately, other research findings have indicated that certain instructional interactions do seem to foster specific cognitive abilities. For example, children who differ in locus of control scores (Croft, Barocas, Sameroff, & Jones, note 2);
reading ability (Feshbach, 1973); verbal and spatial abilities (Bing, 1963); distractibility (Bee, 1967); verbal memory (Rogoff, note 3); and I.Q. scores (Hess & Shipman, 1967) have been found to have mothers who differ significantly in the teaching strategies used to help their child solve a problem. As a specific example, Croft et al. (note 2) found that mothers of internally-controlled preschool-age children tended to use initiating commands and challenged their children after a success. In contrast, mothers of externally-controlled preschool-age children simplified their commands after a failure and tended to use terminating commands, reinforcement and physical intrusions. Rogoff (note 3) found that nine-year-old children who scored higher on memory tests involving verbal recognition of sentences and verbal recall of stories tended to have mothers who used more verbal instructions than physical intrusions while teaching their child to construct a tinkertoy object. In another study (Feshbach, 1973) mothers of poor readers used more negative feedback and more verbally and physically intrusive interventions than mothers of successful readers. Finally, Bee (1967) found that mothers of non-distractible, nine-year-old children tended to give less specific instructions and more positive feedback for task persistance during a teaching interaction than mothers of distractible children.

More recently, mother-child instructional interactions have been hypothesized to influence development of the child's metacognitive ability, i.e., the child's ability to regulate his or her own problem-solving behavior (Wertsch, 1978; Hickman & Wertsch, note 4; Wertsch,
Wertsch, Hickman, McLane & Dowley, note 6). Wertsch has hypothesized that during instructional interactions the mother and child often share the responsibility for regulating the child's behavior, but that during such interactions the child begins to assume increasingly more regulatory responsibilities until, eventually, he acquires the ability to independently self-regulate his problem-solving behavior. Some of the specific elements of the interaction that may be responsible for the child's acquisition of metacognitive abilities have been identified in preliminary analyses of mother-child interactions during a problem-solving task and include the mother's evaluations and elaborations on how the child's behavior relates to the task requirements, the degree of regulation provided by the mother, and the child's use of egocentric speech during the interaction (Wertsch et al., note 6).

Although it is important to demonstrate whether or not mother-child instructional interactions have long-term consequences on cognitive development, another important goal is to determine whether maternal instructions have an immediate effect on the child's performance on a cognitive task. Quality of instruction should influence how well a child learns a particular task being taught by the mother. However, studies that have investigated the effectiveness of maternal instruction have provided contradictory results (Brophy, 1970; Feshbach, 1973; Filler & Bricker, 1976; Hess & Shipman, 1967; Kaye, 1977; Wood & Middleton, 1975). Brophy (1970) found that mothers who used positive feedback, orienting statements, and specific verbal commands
when instructing their preschool-age children to sort blocks had children who performed better on a post-test of the sorting task. Feshbach (1973) found that mothers who gave more negative feedback than positive feedback had children who made more incorrect responses during a maternal instructional interaction. On the other hand, Filler and Bricker (1976) found that mothers of retarded children were ineffective teachers because none of the children improved in their performance on a match-to-sample task after a maternal-instructional interaction. In addition, Kaye found that even though mothers used a variety of strategies to teach their infants to reach around a detour for a toy, none of the infants' performances improved from a pretest to a post-test of the detour task. However, Kaye suggested that the infants' failure to improve was not due to ineffective maternal teaching but due to an insufficient amount of time for the mothers to teach the task to their infants. Thus the general effectiveness of maternal instruction in improving a child's performance remains problematic.

For the most part, studies surveyed so far have focused on maternal instructions independent of the child's behavior during the instruction. In such cases, maternal instruction has been assumed to be a rigid mode of interaction which determined the child's cognitive performance. However, it is possible that the maternal instruction is partly determined by the child's behavior, suggesting a more flexible mode of interaction which incorporates feedback from the child (Bell, 1968). For example, Filler & Bricker (1976) and Feshbach (1973) both found a correlation between maternal reinforcement and the frequency
of the child's incorrect responding during instruction. However, there was no correlation between maternal reinforcement and the child's post-test performance (Filler & Bricker, 1976). Therefore, Filler and Bricker concluded that the frequency of maternal reinforcement was probably determined by the frequency of the child's incorrect responses during instruction.

Hess and Shipman's (1967) findings can also be similarly interpreted in terms of the child's behavior influencing the mother's instructional activity. Hess and Shipman found that children of lower-class mothers scored lower on I.Q. and concept formation tests than children of middle-class mothers, and this difference was attributed to the mother's teaching style. However, no pre-tests were given, and it is possible that the children varied in their initial ability to solve the particular task. This differential ability could easily translate into behaviors that required different types of maternal instructions. Thus, qualitative differences in maternal instruction would be a consequence, rather than a cause, of differences in children's abilities. If maternal instruction does vary as a function of the child's ability or performance, then the child's behavior and ability should be considered whenever comparisons are made between maternal-instructional styles.

Implicit in this concern with the child's behavior is the assumption that mothers are responsive to their child's ability and behavior. A number of studies have indicated that mothers change the complexity of their language as a function of their child's age (Long-
hurst & Stepanich, 1975; Moerk, 1975; Moerk, 1976; Reickle, Longhurst & Stepanich, 1976; Snow, 1972) and language ability (Moerk, 1975; Moerk, 1976; Siegal, 1963; Cross, note 7); mothers increase the complexity of their language as the child's language becomes more complex. Kaye (1977) observed mothers teaching their infants to reach around a detour for a toy. He found that the infant's performance on a pre-test predicted the type and level of maternal instruction. For example, mothers who observed that their infant was unable to reach for the toy in the pre-test tended to simplify the detour task during their instructional interaction; whereas mothers who observed that their infant was able to reach for the toy tended to demonstrate the detour task during their instructional interaction. Additionally, the type, frequency, duration, and onset of maternal instructions were determined by the infant's facial and body cues. Wertsch et al. (note 6) also found differences among mothers; the mother of a 4-1/2 year old child decreased the regulation of her child's behavior whereas the mother of a 3-1/2 year old child maintained the same level of regulation during an instructional interaction. Wertsch et al. concluded that the amount of maternal regulation was, in part, a function of the child's age and, consequently, the child's ability to solve the task.

There may also be differences among mothers in their ability to be responsive to their child's behavior (Als, Tronick, & Brazelton, 1979; Bell & Ainsworth, 1972; Clarke-Stewart, 1973; Filler & Bricker, 1976; Wood & Middleton, 1975; Cross, note 7). For example, Als et al. (1979) indicated that mothers vary in their ability to regulate their
stimulation in response to their infant's facial and body cues. Wertsch et al. (note 6) noted that some children asked their mothers for more help and others asked for less help during an instructional interaction, and inferred that such mothers were not responsive to their child's needs, i.e., they were unable to provide their child with the appropriate amount of regulation. Wood and Middleton (1975) found that mothers varied in their ability to differentially adjust the specificity of their instructions according to whether or not their child's puzzle constructions were accurate.

Moreover, there is some evidence that mothers who are responsive to their child's behavior facilitate the child's cognitive development (Bell & Ainsworth, 1972; Clarke-Stewart, 1973; Wood and Middleton, 1975; Cross, note 7). For example, Cross (note 7) found that mothers whose utterances were semantically related to the child's preceding utterance had children who demonstrated a greater ability to learn language. In addition, Wood and Middleton (1975) found that mothers who adjusted the specificity of their instructions in response to the accuracy of their child's puzzle constructions tended to have children who performed better on a post-test of the puzzle task.

One of the primary purposes of the present study was to further explore the relationship between maternal responsiveness during a maternal-child problem-solving interaction and the child's ability to perform a problem-solving task. Carew et al. (note 1) and Feshbach (1973) speculated that maternal responsiveness to the child's abilities, needs, and interests was important for instructional activity.
Wertsch et al. (note 5) also hypothesized that maternal responsiveness in the form of reducing the amount of regulation during an instructional interaction in order to fit the child's needs would affect the child's acquisition of self-regulatory behavior. However, perhaps the most direct evidence that maternal responsiveness to the child's ability has an important instructional effect has been provided by Wood and Middleton (1975) who observed mothers teaching their preschoolers to construct a three-dimensional puzzle. Wood and Middleton proposed that, in general, the optimal instructional interaction would be one in which the mother intervened as little as possible, so that the child was able to solve the problem and still be challenged. In order to test this hypothesis, Wood and Middleton formulated a procedure to determine the optimal instructional level for each child. The maternal instructions were first categorized according to one of five levels of specificity or intrusiveness. Then, the optimal instructional level (or what they termed the child's region of sensitivity) was determined by computing the frequency with which each instructional level led to a success or failure in the child's response. Using a binomial test, those intervention levels that led to a significantly greater number of successes than nonsuccesses, and those intervention levels that resulted in a nonsignificant number of successes over nonsuccesses were determined. The level at which the mother provided the most specific (or intrusive) instructions and the child failed to significantly succeed was designated the child's region of sensitivity. Not surprisingly, more
specific instructions were likely to lead to more successful responses by the child. That intervention level at which the mother provided the most specific (or intrusive) instructions, but the child failed to significantly succeed, was designated the child's region of sensitivity.

According to Wood and Middleton, the optimal instructional strategy had two facets. First, interventions which occurred in the child's region of sensitivity were assumed to be the most instructionally effective. Wood and Middleton suggested that mothers were not aware of the region of sensitivity but "discovered" it during instructional interactions. They likened the discovery process to a problem-solving task for the mother during which she would try various levels of intervention, relying on feedback from the child's immediate performance to evaluate the appropriateness of her interventions.

The second facet of the optimal-instructional interaction was that mothers discovered their child's region of sensitivity through a particular pattern of interaction. Wood and Middleton suggested the pattern would be: if the child fails, offer more help on the next intervention; if the child succeeds, offer less help on the following intervention. This interaction pattern was termed maternal sensitivity to feedback.

In summary, Wood and Middleton (1975) hypothesized two dependent measures, maternal sensitivity to feedback, i.e., the extent to which they provided more or less help following failure and success respectively, and the number of instructional interventions in the
child's region of sensitivity, i.e., the level at which the child failed to significantly make a correct response to the most intrusive (or specific) instruction would be related to instructional effectiveness. In fact, they found that both of these dependent measures correlated highly with the child's subsequent solitary performance on the post-test of constructing a three-dimensional puzzle. In addition, those mothers who intervened in the child's region of sensitivity tended to be more sensitive to feedback from the child's performance. This finding was used to support their hypothesis that mothers intervene in the child's region of sensitivity as a result of adjusting their instructions in response to their child's performance.

These results are interesting; however, the study has several procedural shortcomings. Wood and Middleton did not include a pre-test measure of the child's ability relative to the task. It is possible that initial pre-test differences were responsible for post-test differences and that subjects who had low post-test scores actually improved as much as subjects who had high post-test scores. In addition the subject sample was very small (12 subjects).

The present study attempted to replicate and extend Wood and Middleton's findings using modified procedures. In doing so, the present study included a pre-test and a larger sample (17 subjects) and attempted to extend the findings to a different puzzle task. Wood and Middleton used a three-dimensional block puzzle that fit together peg-to-hole fashion which, when constructed, formed a pyramid. The present study's task was a design-construction task that required the
child to construct a two-dimensional model of a one-dimensional design. The model was constructed from blocks that varied in color and shape. After pilot testing with some mothers and their children using the design-construction task and attempting to score the data using Wood and Middleton's scoring system, it became apparent that it would be necessary to modify their scoring procedure. In particular, additional levels of specificity were added to accommodate the interventions centering on the one-dimensional design and the blocks' color and shape dimensions.

In addition to the above modifications the present study was concerned with the mother's repetition of commands. Wood and Middleton noted that many instances of repetition occurred, but they suggested that repetition was an ineffective instructional strategy which would frustrate the child and that a more effective strategy would be to simplify the command. A possible contradiction of this hypothesis was suggested by Croft et al. (note 2) who proposed that the repetition of commands after instances of failure might be beneficial for the child's internal locus of control. Croft et al. found that simplifying commands after the child's failure was correlated with external locus of control scores. It is possible that repetition may be beneficial for locus of control, but detrimental in a learning task. The present study explored this issue further by investigating the relationship between maternal repetitions that occurred after failure and the child's post-test and difference scores.

In summary, the present study investigated the following hypo-
theses: (1) Maternal sensitivity to feedback will be positively correlated with the child's post-test performance and the difference score between the pre-tests and post-tests; (2) Maternal activity in the child's region of sensitivity will be positively correlated with both post-test scores and difference scores; and (3) Maternal sensitivity to feedback will be positively correlated with maternal activity in the child's region of sensitivity. In addition, the relationship between the frequency of the repetition of instructions and the child's post-test and difference scores was examined for possible confirmation of Wood and Middleton's assertion that repetition is an ineffective instructional strategy.
CHAPTER II

METHOD

Subjects

The subjects were 17 3½-year-old children (8 boys and 9 girls) from the Springfield, Massachusetts area. All subjects were contacted through the University of Massachusetts Child Study Center where the research was conducted. The subjects were selected from the Hamden County birth records according to the following procedure. A list of potential subjects were, first, randomly selected from the birth records. Letters were then sent to potential subjects informing them that they would receive a phone call requesting that they participate in a research project. Approximately one week later, the secretary at the Child Study Center telephoned the potential subjects and briefly described the procedures of the present study, noting that it involved participation from the mother as well as the child. An appointment was then scheduled if the mother agreed to be in the experiment with the child. In the past, positive response rates for research projects have been 50% to 60% of all subjects contacted. Table 1 presents a demographic description of the subjects in the present study.

Originally 25 subjects were scheduled to participate in the present study. However, five subjects were lost due to procedural problems that arose during the experiment. Specifically, subjects
### TABLE 1
DEMOGRAPHIC CHARACTERISTICS OF THE SUBJECTS

<table>
<thead>
<tr>
<th>Number of Years in School</th>
<th>Mother (14)</th>
<th>Father (14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;12</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>13-16</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>&gt;16</td>
<td>3</td>
<td>5</td>
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<table>
<thead>
<tr>
<th>Occupation Category</th>
<th>Mother (14)</th>
<th>Father (12)</th>
</tr>
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<tbody>
<tr>
<td>Professional</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>Professional/Teachers</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Managerial</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Technical (e.g., X-ray technician)</td>
<td>4</td>
<td>---</td>
</tr>
<tr>
<td>Clerical and Sales</td>
<td>2</td>
<td>---</td>
</tr>
<tr>
<td>Machine Trade</td>
<td>---</td>
<td>2</td>
</tr>
<tr>
<td>Service (e.g., Police Officer)</td>
<td>---</td>
<td>3</td>
</tr>
<tr>
<td>Homemaker</td>
<td>3</td>
<td>---</td>
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<table>
<thead>
<tr>
<th>Number of Siblings</th>
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<tr>
<td>0</td>
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</tr>
<tr>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>2-4</td>
<td>5</td>
</tr>
<tr>
<td>&gt;4</td>
<td>1</td>
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<table>
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<tbody>
<tr>
<td>first</td>
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</tr>
<tr>
<td>middle</td>
<td>0</td>
</tr>
<tr>
<td>last</td>
<td>9</td>
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<tr>
<th>Years in Neighborhood</th>
<th>N (15)</th>
</tr>
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<tbody>
<tr>
<td>&lt;6 months</td>
<td>1</td>
</tr>
<tr>
<td>6 months - 3 years</td>
<td>2</td>
</tr>
<tr>
<td>3 years - 6 years</td>
<td>8</td>
</tr>
<tr>
<td>&gt;6 years</td>
<td>4</td>
</tr>
</tbody>
</table>

\( ^a \)Numbers in parentheses indicate total N for the category.

\( ^b \)Based on the occupation categorical system of the U.S. Department of Labor (1977).

\( ^c \)Excludes children with no siblings.
were excluded if they made no attempt to move any pieces during a pre-test or posttest session (N=3) and/or they did not remain at the puzzle area during the teaching sessions (N=2). In addition, one mother-child interaction was unscorable due to a defective videotape, and two mothers presented maternal teaching strategies that were so different from any others they could not be incorporated into the present study's scoring system. As a result, the data from 17 subjects were analyzed in the present study.

**Materials**

The problem-solving activity was a design construction task for which blocks were used to construct a model of one of two depicted designs. The blocks were large parquetry blocks, manufactured by Developmental Learning Materials. The set of blocks included 32 wooden pieces that varied as to shape (squares, right-isosceles triangles, and diamonds) and/or color (six primary colors). Of the 32 blocks, 8 were squares (4 red, 4 green), 8 were triangles (4 blue, 4 yellow) and 16 were diamonds (4 purple, 4 orange, 4 blue, and 4 yellow). Only the blue and yellow colors were represented in two different shapes, and therefore presented a more difficult discrimination than the remaining pieces. All 32 blocks constituted the selection pool from which the subjects selected their pieces for construction. However, only a portion of the 32 blocks were necessary for constructing a model.

The depicted designs were large parquetry designs, manufactured by Developmental Learning Materials. Each design, pictured
individually on 21\(\frac{1}{2}\) x 28 cm. white cards, illustrated the colors, shapes, and actual sizes of its component pieces. Each component piece matched a parquetry block. The designs varied as to their overall shape and complexity, which was determined by the number of component pieces and variations in shape, color, placement, and orientation of those pieces. Four designs were used in the present study (see Figure 1). Designs 1 and 2 were practice designs used to familiarize the subjects with the task procedure. Designs A and B were the designs used for the problem-solving interaction. Note that Figure 1 displays dotted lines between several component pieces on Design A. These dotted lines indicate that the two component pieces appeared as one piece on the design (e.g., the two blue triangles appeared as one blue square).

The present study required two sets of the blocks and designs so that the mother and child could simultaneously become familiarized with the problem-solving task. In addition, a black and white Sony 3600 videotape machine, located behind a one-way mirror, was used to record the pretest and posttest procedures and the mother-child teaching interaction.

**Procedure**

Each mother and child pair were seen for one 1-hour session. The procedure consisted of: (a) familiarizing the mother with the materials; (b) a pretest of the child's design-construction ability; (c) an opportunity for the mother to teach the child to construct a design, followed by a posttest of the child's ability to construct
Figure 1. Illustrations of the four design standards: practice designs, 1 and 2, and problem-solving designs, A and B.
DESIGN 1

DESIGN 2

DESIGN A

DESIGN B
the design; and (d) an opportunity for the mother to teach her child to construct a second design followed by a posttest of the child's ability on that design.

Maternal Familiarization

At the beginning of the session the mother and child were met in the reception room where the mother was informed of the purpose and procedures of the task. At that time she gave written consent to participate in the study. She was then introduced to the design-construction task and given the opportunity to construct Designs A and B. In doing so she became familiar with the blocks and the particular procedures for constructing the designs without receiving specific instructional guidance from the experimenter. Formal instructions were not provided in order to avoid biasing her with a particular teaching style. She was instructed as follows:

This is the design-construction task that (child's name) will try to solve alone and with your help. The object of the task is to use some of these blocks to build a model of one of these designs. This is the one that you will help construct (experimenter points to the design). Why don't you try to make it now.

During this time the experimenter played with the child in a toy area in the reception room in order to establish rapport with the child. After rapport was established, the experimenter went with the child to the experimental room, furnished with a child-size table and three child-size chairs, in order to conduct the pretest.
Pretest

The child was invited to play a game at the table. The experimenter introduced the task materials to the child in such a way as to avoid teaching the child. First, she demonstrated the blocks by showing the child one of each color and shape combination, saying, "See, there's one like this." Then, she showed the child the practice Designs 1 and 2 to familiarize the child with the task.

The child was introduced to the task objective by constructing practice Design 1, the least complex design (see Figure 1). The experimenter said to the child, "You can make this picture with some of your blocks." Six of the 32 blocks were placed in front of the child. The experimenter placed Design 1 on the table, saying, "Let me see you make this picture with the blocks. Make it on the table and tell me when you're finished." If the child was unable to construct the design after the above instructions, then the experimenter demonstrated the task, saying, "Here's one way to make the picture." The experimenter then dismantled her model and instructed the child to try again.

After the child successfully constructed Design 1, the experimenter gave the child the entire set of 32 blocks and the child constructed practice Design 2, another simple design. The child worked on the design until indicating it was finished. At that time, the experimenter asked the child, "Does that (points to the child's model) look like that (points to the design standard)?" The child was free to continue the construction until stating it was
finished or until 3 minutes elapsed. In order to motivate the child, the experimenter presented verbal praise during and after each construction.

The child was then pretested on Designs A and B. The order of presentation of Designs A and B were counterbalanced. The procedures for administering the pretest were similar to the procedures used for practice Designs 1 and 2, except that the child was given 5 minutes to complete the construction.

Maternal-Child Interaction and Posttest

After the pretest the mother and child pair were brought to the experimental room. A set of blocks and either Design A or B were on the table. The mother was given instructions similar to those used by Wood and Middleton (1975).

We want you to help ___________ learn to construct this design. You can show him how to construct the design in any way you like. We have no idea how mothers might do this, so be as natural as you can. Let me know when you think ___________ can do the construction on his own.

The experimenter then left the room and the mother began to teach her child to construct the task. The interaction continued until the mother was satisfied that the child learned the construction or until 10 minutes had elapsed. Following completion of the teaching of the first design (A or B) the experimenter reentered the experimental room in order to give the child a posttest on the design. The mother remained in the room, but she was cautioned not to inter-
vene in any way. The procedures for administering the posttest were similar to the pretest procedures.

Once the posttest on the first design was completed, the mother was asked to teach the second design. Again, the experimenter left the room during the teaching interaction and returned upon its completion in order to administer the posttest on the second design.

At the end of the experimental session the mother and child were paid $5.00 for their participation in the study. In addition, the child was given a balloon.

### Scoring Procedures and Scores Derived

**Pretest and Posttest**

In order to construct a model successfully, the child had to perform the following four operations: (a) identify a piece on the design standard; (b) select the appropriate block, according to shape and color, from all 32 blocks; (c) place the block in the appropriate space in the model (i.e., the design construction); and (d) appropriately orient the piece. A rotated model was considered a successful construction, provided all the blocks were appropriately selected, placed, and oriented. In addition, successful completion of the task required that the model be built on a clear surface; not on the surface of the design standard.

Two scoring systems were used to analyze the child's constructions on the pretest and posttest. The first system was an analysis of the final products. A numerical score was derived that represented the final product's approximation to success. The second
system was an adaptation of Wood and Middleton's (1975) scoring procedure. This system evaluated the child's ongoing activity, which was recorded on videotape, in terms of its task appropriateness.

**Final product's approximation to success**

The child's pretest and posttest final-product constructions were recorded on a scoring sheet that included a drawing of each design (see Appendix A). Each piece was first rated on the correctness of its shape and color dimensions, and then each connection between the pieces (i.e., a complete side of one piece joining the side of a second piece) was rated for correctness in terms of placement and orientation. Each rating was translated into a score consisting of the total number of correct dimensions divided by the number of possible correct dimensions. In the present analysis, those colors that appeared in only one shape (red and green squares) had two possible correct dimensions: (1) correct color and (2) correct shape. Thus a subject choosing the correct color necessarily had to choose the correct shape. Those colors that appeared in two shapes (blue and yellow triangles and diamonds) had three possible correct dimensions: (1) correct color, (2) correct shape, and (3) the combination of correct color and shape. The additional point was given for both correct color and shape because both dimensions had to be attended to in order to be totally correct. The connections between the pieces had two possible correct dimensions: (1) correct placement and (2) correct orientation (which included a correct placement).
The scores, computed for each piece and their connections, were then totaled to yield the final product's approximation to success. Design A consisted of nine pieces and ten connections between the pieces (a complete side of one piece joining the side of a second piece) so that the final approximation to success score varied between 0 and 19 points (a perfect construction). Design B consisted of eight pieces and seven connections so that the final product's approximation to success varied between 0 and 15 points. Any excess pieces, appended to the model, were ignored in the present scoring system.

The final-product's-approximation-to-success scores were computed separately for the pretest and posttest products. Difference scores were calculated by subtracting the pretest score from the posttest score yielding a score that reflected the child's improvement as a result of training.

*Probability of an appropriate task construction*

The videotapes of the ongoing movements during the pretest and posttest constructions were analyzed by the experimenter in the following manner. Whenever the child selected a piece the appropriateness of its shape and color were scored, and whenever he placed a piece in the model the appropriateness of its placement and orientation were scored (see Appendix B for sample scoring sheet). In order to determine the appropriateness of each movement a complex series of decisional rules (see Appendix C) was necessary and was adhered
to rigidly.

A second observer was trained to score ongoing movements using the decisional rule system in order to demonstrate scorer reliability. The observer was a female, senior, undergraduate student for whom English was a second language. She was majoring in psychology at the University of Massachusetts and working as a work-study student in the Developmental Area of the Psychology Department. Her participation in the present study was paid for through the work-study program.

In order to calculate reliability, the student observer and the experimenter scored the entire protocols (pretest and posttest for Designs A and B) of four randomly-selected subjects. Reliability was calculated on the accuracy of all four dimensions (color, shape, placement, and orientation) by dividing the number of agreements between the experimenter and the student observer by the number of agreements plus disagreements. Overall reliability was 84%. The individual reliabilities for each subject were 75%, 83%, 92%, and 86%. Reliability was also computed separately for each dimension and, averaged over subjects, equaled 82% for color, 83% for shape, 81.7% for placement, and 89% for orientation.

The proportion of correct responses for each dimension (color, shape, placement, and orientation) was determined. One was added to each proportion to avoid zero scores, and these were then multiplied in accordance with the procedures described by Wood and Middleton (1975) to determine the probability of an appropriate task
construction (see Appendix B for a sample scoring sheet). Therefore, a perfect score for each dimension equaled 2 points and a perfect score for the entire construction equaled 16 points.

Wood and Middleton's procedure included errors of omission in that incorrect excess movements reduced the proportion score. However, the procedure did not include errors of omission, i.e., movements that were omitted were not scored. Consequently, a child who constructed only a part of the model could possibly receive a perfect score. To avoid this potential bias, the number of omitted selections and placements was included in deriving the proportion score (the denominator of the proportion had to equal, at least, the minimum number of movements required for a perfect construction). Design A required nine selections for a perfect score on the color and shape dimensions and eight placements for a perfect score on the placement and orientation dimensions. Design B required eight selections and seven placements for perfect scores.

The probability-of-an-appropriate-task-construction scores were computed for the pretests and posttests of Designs A and B. The difference scores, indicating improvement as a result of training, were calculated for each design by subtracting the pretest scores from the posttest scores.

In addition to the final-product's-approximation-to-success measure and the probability-of-an-appropriate-task-construction measure, the pretest times and the posttest times were computed for each design.
Maternal-Child Interaction

An observational system similar to the one devised by Wood and Middleton (1975) was used to analyze the mother-child interaction. After scoring some pilot tests, however, it became necessary to modify and extend the categories within the system. The observational system used in the present study more closely resembled Croft et al.'s (note 8) system, which was also a modification of Wood and Middleton's system. In addition, the complexity of the observational system made it difficult to score the interaction directly from the videotapes. Therefore, the interactions were transcribed from the videotapes into written descriptions of the verbal and gestural interactions (see Appendix D for sample transcript). Every maternal-child pair had two interaction transcripts (or protocols), one for Task A and one for Task B.

In general, the observational system scored each maternal intervention and the child's response to the intervention. Table 2 presents a summary of the scoring system. There were two types of maternal interventions: (a) maternal instructional interventions, and (b) nonmovements. The maternal instructional interventions were further categorized according to: (a) content (instructing to select, place, or orient a piece), and (b) level of specificity (8 levels varying in the degree of maternal specificity and intrusiveness). No additional categorizations were made for the nonmovement maternal-interventions. The child responses were categorized as either correct or incorrect. Definitions and examples of the observational
<table>
<thead>
<tr>
<th>Maternal Intervention</th>
<th>Content</th>
<th>Level of Specificity</th>
<th>Child Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I) Maternal Instruction</td>
<td>(S) Selection (P) Placement (O) Orientation (M) Mapping (U) Unscorable</td>
<td>(1a) General Verbal Cue (1b) General Gestural Cue (2a) Specific Verbal Cue (2b) Specific Gestural Cue (3a) Verbal Instruction (3b) Gestural Instruction (4a) Specific Verbal Instruction (4b) Specific Gestural Instruction (5) Physical Prompt (6) Dismantled Demonstration (7) Direct Physical Assistance (8) Demonstration (U) Unscorable</td>
<td>(C) Correct (Inc) Incorrect (NR) No response (if followed by a goal change in the next instruction)</td>
</tr>
<tr>
<td>(Nm) Nonmovement (no maternal instruction)</td>
<td>(not scored)</td>
<td>(not scored)</td>
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system's categories are presented below (see Appendix E for additional maternal-intervention and child-response categories that were scored but not analyzed in the present study).

Maternal interventions

Maternal instructional interventions

The first task in scoring the maternal instructions was that of determining when an instruction occurred. Instructions were defined as any statement, question, command, or nonverbal response that preceded the child's response and had the effect of promoting from the child a puzzle-constructing response (i.e., a physical selection or movement of a piece). Note that a puzzle-constructing response excluded verbal or gestural behaviors that were puzzle-related but not puzzle-constructing. The definitions and examples of puzzle-constructing responses are elaborated below in the child-response category.

A maternal instruction was terminated when the child made a puzzle-constructing response. The instruction was also terminated when the child made no response or a non-puzzle-constructing response, provided the mother's next intervention addressed a new goal (i.e., a change in what she wanted her child to do). The following examples illustrate several kinds of maternal instructions and different ways in which they could be terminated.

Example: An instructional intervention terminated by a puzzle-constructing response.
Mother (M): "You wanna start with the red one?"
(points to red square)

Child (C): "Ok."
(incorrectly picks up a green square)

Example: A maternal instructional intervention terminated, not by a child's response, but by a change in the goal of the next maternal instructional intervention.

M: "You wanna start with the red one?"
(points to the red square on the standard)
C: "I don't know."
M: "Let's get the blue one."
(a goal change)

Example: A series of maternal statements, questions and gestures that vary in degree of specificity but address the same goal (selecting a blue diamond). It is considered one instructional intervention and is eventually terminated by a puzzle-constructing response.

M: "Which one is first?" "Which one?"
C: "Blue."
(points to blue diamond on standard)
M: "Ok, get the blue diamond."
C: "I can't."
M: "There."
(points to blue diamond on standard)
C: (correctly picks up blue diamond)
Example: An instructional intervention that occurs in response to an incorrect child response and appears to be an evaluation of the child's response. It is an instructional intervention because it served to promote the child to correct his error.

C: (incorrectly selects green square)
M: "Is that right?"
C: (picks up a red square)

Note that an evaluation statement, made after the child responded correctly, was not considered a maternal instructional intervention when it did not serve to promote the child to correct an error. Furthermore, maternal interventions that did not have any direct instructional function and typically served to motivate the child were not considered maternal instructional interventions. Some examples of such interventions are: "When we finish we can go for ice cream," "I don't know what that noise is," "I know it's hard," and "That's good."

Once each maternal instructional intervention was determined, each was then scored according to content and level of specificity.

Content

Every maternal instructional intervention was scored as addressing one of the following operations: (a) selection of a piece, (b) placement of a piece, and (c) orientation of a piece. In order to identify the operation for a particular instruction, the context of the interaction was taken into account. It was assumed that only one operation was being addressed and that it was the next operation
needed for the particular piece involved. This is exemplified in the following situations. Note that in each situation, one of the maternal instructions includes an explicit request for an operation, whereas the other does not. However, both are scored similarly, regardless of the explicitness of the request.

Example: It is the beginning of the interaction and the mother and child are not working with any pieces. The mother says, "You wanna start with the red ones?" or "Find the red ones." Both are scored as a selection operation because it is necessary before placement and orientation can occur.

Example: The mother and child have constructed part of the puzzle so that some pieces are placed and oriented. The child has selected a red square and a yellow triangle, both of which are on the table. The mother says, "You wanna start with the red one?" or "Put the red one on top of the blue diamond." Both are scored as a placement operation, because placing the red piece is the next step. Even though the mother may expect the child to orient the piece, only placement is assumed.

Example: The child has correctly placed but incorrectly oriented the red square in the puzzle. The mother says, "Is that like the picture?" or "Make it go flat against the blue edge." These are scored as orientation because it is the remaining step.

Occasionally, a mother and child constructed the puzzle on the design standard. Such cases were considered a fourth operation, called mapping.
There were situations when the instructional intervention contained no explicit request for an operation, and an analysis of the context of the situation indicated that there was more than one alternative for an operation. In such cases the child's response was used as a guide to identify the operation.

Example: Part of the puzzle has been constructed. A red square and yellow triangle have been selected and put on the table. A blue diamond has been incorrectly placed in the puzzle, and a blue triangle has been incorrectly oriented in the puzzle. The mother says, "What's next?" The child has the option of (a) selecting a new piece (a selection operation), (b) placing the incorrectly placed blue diamond or placing the red or yellow pieces (placement operations), or (c) correcting the blue triangle's orientation (an orientation operation).

Occasionally, the mother's reaction to the child's response was used as a guide to determine the operation. The mother's reaction to the child's response could specify the operation that she meant to imply in her preceding instruction. For example, given the example described above, if the child responded by selecting a new piece, the mother could say, "No, where should you put the red one?" Her reaction indicates that the preceding instruction was a placement instruction and should be scored accordingly.

Level of specificity

The level of specificity reflected the degree to which the mother assumes responsibility for the task. Recall that the puzzle-
construction task consisted of three major operations: selection, placement, and orientation. In addition, each of these operations was preceded by an identification component (i.e., the child must identify the operation needed and the particular parameters of the operation, before he can perform the operation). For example, the child must identify that a selection operation is necessary and that a particular piece (the parameters) is required, before the piece can be selected. The mother can vary the degree to which she assumes responsibility for these task operations and components; thereby varying the degree of autonomy given to her child. In the present observational system, this variance was considered a difference in the instruction’s level of specificity and intrusiveness.

There were eight levels-of-specificity categories. Level 1 was the least intrusive intervention, i.e., at which the mother assumed the least amount of task responsibility. Level 8 was the most intrusive intervention, i.e., at which the mother assumed the greatest amount of task responsibility. Every maternal instructional intervention was scored as occurring at one of the eight specificity levels which are defined below. Table 3 indicates the task responsibilities that were assumed by the mother and child at each specificity level.

Level 1a. General verbal cue--the mother activated or motivated the child toward some generally stated goal. At this level the child was required to (a) independently identify the operation and its parameters, and (b) independently perform the operation. No
### TABLE 3

**DISTRIBUTION OF TASK RESPONSIBILITY BETWEEN MOTHER AND CHILD AT EACH SPECIFICITY LEVEL**

<table>
<thead>
<tr>
<th>Specificity Level</th>
<th>Task Responsibility</th>
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<tbody>
<tr>
<td></td>
<td>Identify Operation</td>
</tr>
<tr>
<td>1</td>
<td>C</td>
</tr>
<tr>
<td>2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>M</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
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<tr>
<td>4</td>
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<tr>
<td>7</td>
<td>M</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
</tr>
</tbody>
</table>

**NOTE:** Letter C indicates child assumes responsibility. Letter M indicates mother assumes responsibility. Letters MC indicate mother and child share responsibility; the information within parentheses specifies the maternal role.

<sup>a</sup>Level 2 also includes instructions for which the mother does not identify the operation, but narrows down the work area to help the child identify the parameters. In such cases the distribution of task responsibility is: identify operation - C, identify parameter - MC (general cue), perform operation - C.
gestural prompts occur.

Examples: "Okay?"
"What's next?"
"Let's finish."
"Do another."

**Level 1b.** General gestural cue--this was similar to Level 1a with the addition of a gesture or statement that focused the child's attention to a general work area (i.e., to the standard, the puzzle construction, or the block pile). The gesture or statement either accompanied or occurred without a Level 1a verbal cue. By focusing the child's attention, the mother added a nonspecific cue that helped the child identify the operation and its parameters. Thus again the child was required to (a) identify both the operation and its parameters, and (b) independently perform the operation.

Examples: Gestural interventions.

(a general point to the standard, model, or block)
(standing the standard up from a flat position)
(moving blocks randomly in the block pile)

Examples: Verbal interventions.

"Look at the picture."
"Make the puzzle go like the picture."
"Look at the blocks."

**Level 2a.** Specific verbal cue--the mother activated the child toward one of the three major operations (selection, placement, or orientation) by identifying the operation. It required that the
child (a) identify the operation's parameters, and (b) perform the operation.

Examples: Interventions identifying selection.
"Can you find the piece you need?"
"We need one more piece."
"Another what? What color?"
"That's the wrong shape."

Example: Intervention identifying placement.
"Put it in the puzzle."

Example: Intervention identifying orientation.
"How does it go?"

Occasionally the mother provided a verbal cue that did not identify the operation, but narrowed the work area for the child. This served as a cue for identifying the operation and its parameters and was also a Level 2a intervention.

Example: The top part of the model had been constructed. The mother says, "Do the bottom part."

Example: The right side of the puzzle has been constructed. The mother says, "How about the other side?"

**Level 2b.** Specific gestural cue--this was similar to Level 2a with the addition of a gesture or statement that focused the child's attention to a general work area. The gesture or statement either accompanied or occurred without a Level 2a verbal cue. See Level 1b for examples of the gestures and statements.

**Level 3a.** Verbal instruction--the mother identified the
operation and identified some (but not all) of the particular operation-parameters. The child was required to (a) identify the remaining unspecified parameters, and (b) independently perform the operation. At this point, the mother and child shared the responsibility for identifying the operation's parameters.

Example: The mother says, "Find the piece that goes under the red one." The mother identifies the selection operation (find the piece) and provides some specific information regarding the parameters of the piece that must be selected (it is the piece under the red square).

It was not necessary for the instruction to explicitly state the operation as in the above example. The context of the situation could indicate that the operation had already been identified by the mother and child. This typically occurred when the child and/or mother were already involved in a particular operation.

Example: The child has just oriented a blue triangle. The mother says, "Up, no the other way." Orientation has already been identified. This was scored at Level 3a because the mother identified some specific parameters (up, other way).

Example: C: (incorrectly selected a blue diamond)
M: "A yellow one."

Example: C: (incorrectly oriented a yellow triangle)
M: "I think it's upside down. Try the other way."

Example: C: (puts two triangles near each other on the table)
M: "Can you make a square out of those two?"
Level 3b. Gestural instruction--this instruction was the same as Level 3a except that gestures were used to identify some of the operation's parameters. Most of the gestures were to the design standard.

Example: "Find the piece that goes next to the red one."
   (points to red square on standard)
Example: "What goes under this one?"
   (points to the blue triangle in standard)
Example: "We need two for this."
   (points to the blue square on the standard, which is composed of two triangles but appears as one piece on the standard)

Level 4a. Specific verbal instruction--the mother identified the operation and identified all of the operation's particular parameters. The child was still required to perform the operation (by simply following the mother's specific instruction) in order to complete the instruction successfully.

Example: "Do you need a yellow triangle?" The mother provides the necessary parameters (yellow and triangle).

Example: "Get the red one." or "Get the red square." Both statements identify the necessary parameter (red). This is because there is only one red shape in the puzzle set.

Examples: "Put the long side on the bottom."
   "Turn it so that it points down."
   "Shouldn't you put it under the red square?"
   "Make the two long sides touch each other."
**Level 4b.** Specific gestural instruction--gestures were used to provide the same function as a Level 4a intervention. The gestures either accompanied or occurred without a Level 4a verbal instruction. Most of these gestures were directed to the standard.

Example: M: "Can you find this?"
(points directly to the red square on the standard)

Example: C: (selected a red square)  
M: "Here."
(points to red square on standard; thereby identifying the placement parameters)

Example: M: "Find a red square."
(holds up a red square)

Example: C: (selected a yellow triangle) 
M: "Put it on top of the red square."
(points to yellow triangle on standard or points to red square in puzzle)

Note that the distinction between Level 3 and Level 4 is difficult. The nature of the task had to be considered in order to determine if the mother provided all of the operation's parameters (Level 4) or if the child had to identify additional parameters (Level 3). For example, the instruction, "Get the blue one," is a Level 3 instruction because there are two blue shapes in the puzzle set (triangle and diamond). A Level 4 instruction would be "Get the blue triangle." Furthermore, the instruction, "Find a blue square," is a Level 3 instruction because the blue square consists of two
blue triangles. The child must identify additional parameters (two blue triangles) in order to perform the selection operation.

Level 5. Physical prompt--the mother physically prompted the construction of the puzzle by pointing out the operation so that the action was clearly indicated. In doing so, the mother assumed responsibility for identifying the operation and the parameters, and she shared, with the child, the responsibility for performing the operation. The child simply followed the physical prompt to perform the operation.

Example: C: (selected a blue triangle)
M: (points to blue triangle placement spot in the puzzle)
Example: M: "Get that one."
(points to the red square in the block pile)
Example: C: (incorrectly oriented a blue diamond)
N: "Turn it up here."
(points out the location in the puzzle)

Level 6. Dismantled demonstration--the mother physically intervened in the construction of the puzzle by demonstrating the particular operation and then dismantling the demonstration, allowing the child to imitate the exact operation. The mother assumed responsibility for identifying the operation and its parameters and shared, with the child, the responsibility for performing the particular operation.
Example: M: "You need a red one like this."

(selects the red square and returns it to the pile)

**Level 7.** Direct physical assistance—the mother physically intervened in the puzzle's construction by placing the piece in a suitable orientation, leaving the child the task of pushing the piece into place. Level 7 intervention typically occurred for the orientation operation. Once again, the mother assumed responsibility for identifying the operation and its parameters, and shared, with the child, the responsibility of performing the operation.

Example: M: "Here."

(oriented the yellow triangle in the puzzle, about ½ inch away from the red square; child simply has to push the piece to complete the operation)

**Level 8.** Demonstration—the mother physically intervened in the construction of the puzzle by demonstrating the entire operation and moved on to another operation. No participation was required by the child. The mother assumed responsibility for identifying the operation, identifying its parameters, and performing the operation.

When multiple levels of intervention occurred within one maternal instruction, the highest (i.e., most specific or intrusive) level was scored. In addition, many of the maternal instructions did not explicitly state a request for a puzzle-constructing response. In order to score the level of specificity for these instructions, the statement needed to be transformed so that it contained an explicit request. The explicit request was whichever operation
(selection, placement, orientation) was identified as the instruction's content.

Example: Transform "What color is that?" into "Find that color."

Example: Transform "What's next?" into "Do what's next?"
Example: Transform "The big red one." into "Find the big red one."

Example: Transform "Is that right?" into "Make it right."
Example: Transform a point to the red square on the standard into "Put it like this?"

Nonmovement maternal interventions

Nonmovement maternal interventions were the absence of any maternal instructional intervention prior to a puzzle-constructing child-response. Such interventions typically occurred after the mother and child completed a construction, and the child took the initiative by constructing the puzzle before the mother gave a new instruction.

Example: M: "When we finish we can get an ice cream."
C: "Ok."
(sselects a red square)
C: (places and orients the red square correctly in the puzzle)
M: "Good boy!"
C: "A blue one."
(selects a blue triangle)
Child Response

Once the maternal intervention was scored, the child's response to that intervention was categorized as correct or incorrect. Only puzzle-constructing responses were scored. A puzzle-constructing response was any response that produced a movement in the blocks, a change in the puzzle, or a selection of a block, regardless of the correctness of the movement. However, when the child moved the blocks in the block-pile in order to select a piece, this movement was not considered a puzzle-constructing response unless the child physically selected (pointed out or picked up) a specific piece.

Example: Puzzle-constructing responses.

M: "What color do you need?"
C: "This."
(looks in pile and incorrectly picks up a red square)
M: "Is that right?"
C: "Ah?"
(retums the red square to the pile)
M: "Show me where it goes."
C: (turns blue diamond around in the incorrect place and continues turning)
Example: Non-puzzle-constructing responses.

M: "What color do you need?"
C: "Blue."
M: "Get the next piece."
C: (points to the blue diamond on standard)
M: "Try it."
C: "No."

After a maternal instructional intervention, the accuracy of the child's response was determined first, in relation to the preceding maternal instruction and then to the overall task demands. Examples of correct and incorrect child-responses are provided below.

Example: Only a yellow triangle and a red square are required to complete the puzzle construction (i.e., the task demands). The mother says, "Get the yellow one." A correct response would be to select a yellow triangle, based on the maternal request for a "yellow one" and the task demand for a yellow triangle. Incorrect responses would be to select a yellow diamond, which violates the task demand for a triangle, or to select a red square, which violates the maternal request for a "yellow one."

In the above situation, the correct response (selecting a yellow triangle) was the only possible correct response to the particular instruction and task demands. However, it was possible to have more than one correct response to a given instruction. This typically occurred with greater amounts of task demands and less specific maternal instructions.
Example: A yellow triangle and a red square are required to complete the puzzle. Also, a blue triangle is incorrectly oriented in the puzzle. The mother says, "What's next?" Correct responses would be to select a yellow triangle or a red square, or to reorient the blue triangle into the correct orientation. Some incorrect responses would be to select any other pieces or to reorient the blue triangle so that it remains incorrect.

Finally, rejecting an error was not considered a correct response unless the rejection was accompanied by a correction of the error.

Example: The child incorrectly selected a red square after the mother requested that the child, "Get a yellow triangle." The mother says, in response to the child's error, "Is that yellow?" The correct response would be to either reject (return to block pile) the red square and select a yellow triangle or to just select a yellow triangle. Rejecting the red square, without selecting a yellow triangle, would be an incorrect response.

After a nonmovement maternal intervention, the accuracy of the child's response was determined solely in relation to the overall task demands because there was no maternal request.

Example: A red square is required to complete the puzzle construction. No maternal instruction occurs prior to the child's response. A correct response would be to select a red square. Some incorrect responses would be to select any other piece or to move
a piece that is already correctly placed in the puzzle so that it is incorrectly placed.

In summary, the present observational system reduced the mother-child protocol into a series of two-unit interactions that consisted of a maternal intervention followed by the child's response to that intervention.

All of the protocols were scored by the experimenter. In order to demonstrate reliability, a second observer was trained to score the transcripts using the mother-child interaction scoring system. This second observer was not the same student who scored the pre- and posttest videotapes in order to demonstrate reliability. However, this observer was also a female for whom English was a second language. She was also a senior, undergraduate student, majoring in psychology at the University of Massachusetts. Her participation in the present study was voluntary.

The student scored the interaction protocols of three mother-child pairs. The protocols were selected by randomly selecting protocols until three were found that included a wide range of specificity levels. This procedure avoided repetitious maternal-teaching interactions that were easier to score. First, the student identified the maternal-instructional interactions in the three protocols. Reliability was then determined by dividing the number of agreements between the experimenter and observer by the number of agreements and disagreements. Based on a total of 181 maternal instructions, overall reliability was 86.7% for the identification of
the maternal instructional interactions. The individual reliabilities for each protocol were 81.1%, 87.3%, and 89.2%. The student then scored the content of those maternal instructional interactions for which the experimenter and observer had reached agreement. Reliability for the identification of content was 98.7%. The individual reliabilities for each protocol were 96.6%, 98.5%, and 100%.

Then the instruction's level of specificity and the accuracy of the child's response to the instruction were scored for the agreed upon maternal instructions of 2½ (task A of one protocol was unscored) of the three maternal-child protocols. Based on 129 maternal instructions, reliability for the overall level of specificity was 84.5%. The individual reliabilities for each protocol were 77%, 82.8%, and 96.7%. Individual reliabilities for each specificity level were as follows: Level 1a--100% (based on 2 interventions); Level 1b--83.3% (based on 6 interventions); Level 2a--88.9% (based on 9 interventions); Level 2b--50% (based on 2 interventions); Level 3a--78.6% (based on 14 interventions); Level 3b--85.7% (based on 7 interventions); Level 4a--50% (based on 10 interventions); Level 5--84.6% (based on 13 interventions); Level 6--100% (based on 2 interventions); Level 7--100% (based on 2 interventions); Level 8--96.4% (based on 28 interventions).

The reliability for the level of specificity was reached only after some discussion of the disagreements. The student had misunderstood the distinction between two categories and consistently scored them incorrectly. There were 11 such disagreements. After
the category distinction was clarified, the disagreements were changed to agreements. In addition, six disagreements that were due to the student misreading the transcripts were also changed to agreements.

Finally, the reliability for the accuracy of the child's response was 95.2%.

Dependent Measures

The following dependent measures were derived from the scored protocols. Separate dependent measures were computed for Task A and Task B protocols, after which the data was collapsed across the task types to yield overall measures.

Percent usage for each level of specificity category

The subcategories (a and b) for Levels 1 through 4 were collapsed within each level so that there were 8 major levels of specificity (i.e., Levels 1, 2, 3, 4, 5, 6, 7, 8). The frequency of instructions at each level was tabulated and divided by the total number of maternal instructional interventions for each child.

Child's region of sensitivity

After determining the frequency of instructions at each specificity level, the frequency with which each level was followed by a correct child-response was tabulated. A binomial test was used by Wood and Middleton (1975) to determine the level at which the child had significantly more correct responses than incorrect responses ($p = 0.05$, $p = q = \frac{1}{2}$, one-tailed). The child's region of
sensitivity was the next, less specific level at which the child did not have a significantly greater number of correct responses. The calculations for this measure were modified in the present study because the region of sensitivity, as defined by Wood and Middleton, could not be found for 14 subjects in Task A and 14 subjects in Task B. For these subjects, there were no levels at which the child was significantly more correct than incorrect at the $p = 0.05$ level. In such cases, the level at which the number of correct responses exceeded the incorrect responses by the most significant amount ($0.05 < p < 0.5$) was designated as the region of sensitivity. However, despite this procedure, the region of sensitivity could not be calculated for 4 subjects in Task A and 4 subjects in Task B because (a) none of the levels had an excess of correct responses at $p < 0.5$ level or (b) there were two or more levels that were equally significant. As a result, the region of sensitivity measure was determined for only 13 children in Task A and 13 children in Task B.

**Percentage of maternal activity in the child's region of sensitivity**

The frequency of maternal instructions that occurred in the child's region of sensitivity was tabulated, divided by the total number of maternal instructions, and converted to a percentage. These percentages were only computed for those subjects in Task A and Task B for which a region of sensitivity could be determined. Furthermore, an overall percentage of maternal activity in the child's region of sensitivity (i.e., an average of Task A and Task B
measures) could only be determined for 11 subjects.

The remaining dependent measures represented different interaction patterns. All of the patterns were based on the relationship between the level of specificity of a maternal instruction, the accuracy of the child's response to that instruction, and the subsequent change in the level of the next maternal instruction.

**Percentage of maternal sensitivity to feedback pattern**

Wood and Middleton's (1975) pattern that represented the frequency with which (a) a correct child-response was followed by a maternal instruction that was less specific than the preceding instruction, and (b) an incorrect child-response was followed by a maternal instruction that was more specific than the preceding instruction.

**Percentage of the opposite-interaction pattern**

This pattern was the opposite of the sensitivity to feedback pattern. It represented the frequency with which (a) a correct child-response was followed by a maternal instruction more specific than the preceding instruction, and (b) an incorrect child-response was followed by a maternal instruction less specific than the preceding instruction.

**Percentage of repetitive-interaction pattern**

This pattern represented the frequency with which correct and incorrect child-responses were followed by a maternal instruction
of the same level as the preceding instruction.

**Percentage of Croft et al.-interaction pattern**

Croft et al.'s (note 2) pattern that represented the frequency with which (a) a correct child-response was followed by a maternal instruction less specific than the preceding instruction, and (b) an incorrect child-response was followed by a maternal instruction that was the same level as the preceding instruction.

The above four measures were computed as follows. First, based on the content scores, the maternal instructions requesting selection-operations were separated from those instructions requesting placement or orientation operations. A frequency of each interaction-pattern was tabulated from the instructions requesting selection-operations. A second frequency of each interaction-pattern was tabulated from the instructions requesting placement or orientation operations. The two frequencies were then summed, divided by the total number of pattern cases, and converted to a percentage.\(^2\)

This derivation differs from Wood and Middleton's (1975) procedure which did not involve separating the instructions based on content. The present study's task involved different types of operations (selection, placement, orientation). In addition, each operation had movements that varied in topography and difficulty. On the other hand, Wood and Middleton's task involved similar operations that were repeated throughout the task (interlocking two blocks peg-to-hole fashion). Separating the instructions based on content was an attempt to adjust the derivation to allow for the task
differences between the present study and Wood and Middleton's study. By separating the instructions, comparisons were made between maternal instructions that involved more similar types of operations.

Finally, Appendix F includes a list of additional posthoc dependent measures that were derived. Most of these proved to provide little additional information, however, several are described in further detail in the results section on posthoc analyses.

Data Analysis

The primary means for analyzing the data were \( t \)-tests and Pearson-Product-Moment correlations. One-tailed analyses were carried out on data related to specific hypotheses outlined in the introduction; otherwise tests were two-tailed.

Preliminary Analysis

Correlations (one-tailed) were calculated between the corresponding pretests, posttests, and difference scores of the two child performance-variables: (a) final product's approximation to success, and (b) probability of an appropriate task response.

\( t \)-tests (two-tailed) were computed comparing task type (A vs. B), task sequence (AB vs. BA), task position (first task vs. second task) and sex for the various maternal and child measures. In addition, \( t \)-tests were computed between the following child variables: (a) final-product's-approximation-to-success pretest score and posttest score (one-tailed), (b) probability-of-an-appropriate-task-response pretest score and posttest score (one-tailed), and
(c) pretest time and posttest time (two-tailed) to determine whether performance changed from the pretest to the posttest.

Intercorrelations (two-tailed) were computed between the pretest time, posttest time, and the pretest, posttest, and difference scores of each of the child performance variables. Furthermore, maternal teaching times were correlated (two-tailed) with the pretest, posttest, and difference scores.

Primary Analysis

Correlations (one-tailed) were computed between the five maternal interactional patterns (i.e., maternal sensitivity to feedback, maternal activity in the region of sensitivity, Croft et al. interaction, repetitive interaction, and opposite interaction) and the child variables [i.e., final product's approximation to success (pretest, posttest, and difference scores) and probability of an appropriate task response (pretest, posttest, and difference scores)]. In addition, the measure of maternal activity in the region of sensitivity was correlated (one-tailed) with the remaining maternal interactional pattern measures. A total of 44 primary correlations were computed.

Posthoc Analysis

Posthoc correlations (two-tailed) were computed between the additional maternal variables (enumerated in the procedure section) and the various child performance measures, for a total of 184 correlations. In addition, these maternal variables were intercorrelated, for a total of 529 correlations.
CHAPTER III

RESULTS

Preliminary Results

Correlations Between Child-Performance Variables

Pretest, posttest, and difference scores for the two child performance measures—the final product's approximation to success and the probability of an appropriate task response—were found to be significantly and highly correlated (pretest, \( r (15) = .8184; \) post-test, \( r (15) = .9736; \) difference score, \( r (15) = .9403; \) \( p < .001, \) one-tailed). Consequently, only the results for the probability-of-an-appropriate-task-response measure, which was used by Wood and Middleton (1975) are reported. Any disagreements with the final-product's-approximation-to-success measure are noted.

Independent-Variables T-test Analyses

In order to provide justification for collapsing the data across sex, task type, task position (first task vs. second task) and task sequence, t-tests (\( p < .05, \) two-tailed) were computed on all of the maternal and child variables. The t-tests indicated no significant differences as a function of sex, task type, task position, and task sequence for any of the maternal variables. Similarly, the t-tests indicated that sex, task type, task position, and task sequence significantly affected few of the child variables. Only one variable,
task type, significantly affected the final product's approximation to success for which differences were found only on the posttest and difference scores (posttest, \( t(16) = 4.26 \); difference scores, \( t(16) = 4.21 \); \( p < .001 \), two-tailed). Task type A's posttest and difference scores were significantly greater than the corresponding posttest and difference scores for Task type B. Note that this difference was not found for the probability-of-an-appropriate-task-response posttest and difference scores. In addition, only task position significantly affected the pretest and posttest times. Pretest time of the first task was significantly greater than the pretest time of the second task (\( t(16) = 2.97, \ p < .01 \), two-tailed) whereas posttest times of the first task was significantly less than the posttest time of the second task (\( t(16) = 2.17, \ p < .05 \), two-tailed).

Within-Group \( t \)-tests on the Child Variables

In order to determine if the children significantly improved in their ability to construct the puzzles, \( t \)-tests were computed between the children's pretest and posttest scores (see Table 4 for means and standard deviations for probability-of-an-appropriate-task-response and time to complete the task). As can be seen in Table 4, a marked improvement on the posttest scores is evident. The posttest scores were significantly greater than the pretest scores (\( t(16) = 3.61, \ p < .001 \), one-tailed). These differences were found even though there was no corresponding significant difference in the amount of time spent on the pre- and posttests (\( t(16) = .56, \ p = .582 \), two-tailed).
TABLE 4
MEANS AND STANDARD DEVIATIONS FOR PRETEST, POSTTEST, AND DIFFERENCE SCORES FOR PROBABILITY OF AN APPROPRIATE TASK RESPONSE AND TIME TO COMPLETE TASK

<table>
<thead>
<tr>
<th></th>
<th>Means</th>
<th>Standard Deviations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Probability of an Appropriate Task Response</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest Score</td>
<td>6.78</td>
<td>2.20</td>
</tr>
<tr>
<td>Posttest Score</td>
<td>12.77</td>
<td>7.99</td>
</tr>
<tr>
<td>Difference Score</td>
<td>5.99</td>
<td>6.83</td>
</tr>
<tr>
<td><strong>Time to Complete Task(a)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest Time</td>
<td>3.54</td>
<td>1.43</td>
</tr>
<tr>
<td>Posttest Time</td>
<td>3.70</td>
<td>1.24</td>
</tr>
</tbody>
</table>

\(a\)Time is expressed in minutes.
Correlations Between Time Variables and Child Performance

To determine whether the child's performance was influenced by (a) the amount of time subjects spent on the pre- and post-tests, and (b) the amount of time the mothers spent teaching the tasks, additional correlations were carried out between the maternal teaching time, the pre- and post-test times, and the child performance scores. The amount of time subjects spent on the pretest was significantly correlated with the amount of time spent on the posttest ($r(15) = .6117, p \leq .01$, two-tailed). Moreover, the amount of time spent on the pretest was significantly correlated with the probability-of-an-appropriate-task-response pretest score ($r(15) = .5105, p < .05$, two-tailed). However, there was no correlation between posttest time and posttest performance ($r(15) = .1219, p > .05$, two-tailed). Furthermore, pretest time was not correlated with posttest or difference scores; nor was the posttest time correlated with the difference score.

Finally, the amount of time that mothers spent teaching the task was not correlated with the child pretest, posttest, or difference score ($p > .05$, one-tailed).

Intercorrelations Between the Pretest and Difference Score

To determine whether the significant improvement in the child's ability to construct the puzzle was related to the child's initial ability on the pretest, the probability of an appropriate task response on the pretest score was correlated with the difference
score and was found to be not correlated ($r (15) = .4116, p > .05$, two-tailed). However, this finding was true only for the probability-of-an-appropriate-task-response performance measure. The final-product's-approximation-to-success pretest score was found to be significantly correlated with the difference score ($r (15) = .6621, p < .005$, two-tailed). Further examination of subgroups, task type and task position was carried out to determine the basis for this correlation. These analyses uniformly indicated nonsignificant correlations between the final-product's-approximation-to-success pretest and difference scores ($p > .05$, two-tailed) except for Task B ($r (15) = .4886, p < .05$, two-tailed).

**Primary Analysis**

Table 5 contains the percent means and standard deviations for the instructions occurring at each level of specificity. Instructions that occurred most often were Level 8, demonstrations (27.13%) and Level 4, specific instructions (25.9%). Instructions that occurred least often were Level 6, dismantled demonstrations (.9%); Level 7, direct physical assists (2.36%); and Level 1, general cues (6.14%). Instructions occurring moderately often were Level 3, general instructions (17.76%); Level 5, physical prompts (10.54%); and Level 2, specific cues (9.55%). However, the standard deviations for these percent means indicated a great amount of variability among the mothers, especially at the most frequent levels, Levels 4 and 8. In addition, the distribution of the child's region of sensitivity levels, calculated for 13 children in Task A and 13 chil-
**TABLE 5**

PERCENT MEANS AND STANDARD DEVIATIONS FOR THE INSTRUCTIONS AT EACH LEVEL OF SPECIFICITY

<table>
<thead>
<tr>
<th>Level of Specificity</th>
<th>Percent Means</th>
<th>Standard Deviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.14</td>
<td>6.11</td>
</tr>
<tr>
<td>2</td>
<td>9.55</td>
<td>6.68</td>
</tr>
<tr>
<td>3</td>
<td>17.76</td>
<td>8.70</td>
</tr>
<tr>
<td>4</td>
<td>25.90</td>
<td>13.17</td>
</tr>
<tr>
<td>5</td>
<td>10.54</td>
<td>7.12</td>
</tr>
<tr>
<td>6</td>
<td>.90</td>
<td>2.10</td>
</tr>
<tr>
<td>7</td>
<td>2.36</td>
<td>4.82</td>
</tr>
<tr>
<td>8</td>
<td>27.13</td>
<td>16.77</td>
</tr>
</tbody>
</table>
dren in Task B, indicated that the region of sensitivity typically occurred at either Level 4 (11 cases; 4a--5 cases, 4b--6 cases), Level 5 (8 cases) or Level 3 (5 cases; 3a--2 cases, 3b--3 cases).

The percent means and standard deviations of the five maternal instructional variables of primary interest in this study are contained in Table 6. Overall, the majority of maternal instructional interactions fit the maternal sensitivity to feedback strategy (50.24%), which would suggest that mothers were responsive to their child's performance; that is, mothers tended to become less specific after a child responded correctly to the preceding instruction, and more specific after the child responded incorrectly to the preceding instruction. Therefore, just as in Wood and Middleton's study, mothers tended to use the strategy hypothesized to be an effective interaction pattern. Use of the opposite-interaction pattern (28.53%) where the mother became more specific after the child responded correctly and less specific after the child responded incorrectly was, however, quite high and occurred even more frequently than use of the repetitive-interaction pattern (21.82%) (the only remaining alternative). This finding contrasts Wood and Middleton's finding that the repetitive interaction pattern occurred more frequently than the opposite interaction pattern. Finally, an analysis of the maternal interaction in terms of the Croft et al. interaction pattern, which was a combination of the repetition and the sensitivity to feedback patterns, revealed that mothers tended to use this pattern (30.88%), i.e., they became less specific after a correct child response and
<table>
<thead>
<tr>
<th>Maternal Interaction Patterns</th>
<th>Percent Means</th>
<th>Standard Deviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of Maternal Sensitivity to Feedback</td>
<td>50.23</td>
<td>10.80</td>
</tr>
<tr>
<td>Percent of Opposite-Interaction Pattern</td>
<td>28.53</td>
<td>8.56</td>
</tr>
<tr>
<td>Percent of Repetitive-Interaction Pattern</td>
<td>21.82</td>
<td>7.85</td>
</tr>
<tr>
<td>Percent of Croft et al.-Interaction Pattern</td>
<td>30.88</td>
<td>7.31</td>
</tr>
</tbody>
</table>
repeated the same specificity level after an incorrect child response, less than the sensitivity to feedback pattern and more than the repetition pattern.

Table 7 contains the correlations relevant to the hypotheses of the present study. One of the main goals of the present study was to replicate Wood and Middleton's (1975) finding that maternal activity in the child's region of sensitivity and maternal sensitivity to feedback were significantly and positively correlated with the child's probability of an appropriate task response during the posttest. In support of Wood and Middleton, for those 11 subjects for whom a region of sensitivity was calculated, a positive correlation was found between maternal activity in the child's region of sensitivity and the child's posttest score, although it was nonsignificant ($r_9 = .3028, p > .05$, one-tailed). In contrast to Wood and Middleton, a nonsignificant, negative correlation was found between maternal sensitivity to feedback and the child's posttest score ($r_{15} = -.1371, p > .05$, one-tailed).

A second goal was to determine if the Wood and Middleton findings were evident when the child's pretest performance was taken into account. Again, the correlation between maternal activity in the child's region of sensitivity and the child's difference score was found to be positive, but nonsignificant ($r_9 = .3963, p > .05$, one-tailed), and the correlation between maternal sensitivity to feedback and the child's difference score was found to be nonsignificant and negative ($r_{15} = -.1890, p > .05$, one-tailed) as
TABLE 7
CORRELATIONS FOR PRETEST, POSTTEST, AND DIFFERENCE SCORES BETWEEN MATERNAL INSTRUCTIONAL STRATEGIES AND PROBABILITY OF A TASK APPROPRIATE RESPONSE BY THE CHILD

<table>
<thead>
<tr>
<th>Maternal Instructional Strategies</th>
<th>Probability of a Task Appropriate Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pretest</td>
</tr>
<tr>
<td>Percent of Maternal Activity in the Child's Region of Sensitivity</td>
<td>-.099</td>
</tr>
<tr>
<td>Percent of Maternal Sensitivity to Feedback</td>
<td>.089</td>
</tr>
<tr>
<td>Percent of Opposite-Interaction Pattern</td>
<td>-.098</td>
</tr>
<tr>
<td>Percent of Repetitive-Interaction Pattern</td>
<td>.056</td>
</tr>
<tr>
<td>Percent of Croft et al.-Interaction Pattern</td>
<td>-.015</td>
</tr>
</tbody>
</table>

NOTE: r ≥ .413, p < .05, one-tailed. However, r ≥ .521, p < .05, one-tailed, for correlations on percent of maternal activity in the child's region of sensitivity which were based on an N of 11.

*Significant, p < .05, one-tailed.
were the correlations with the posttest scores.

Correlations were also computed between probability-of-an-appropriate-task-response scores and the opposite-interactional pattern in order to provide additional support for the relationship between maternal sensitivity to feedback and the child's posttest score inferred by Wood and Middleton. However, nonsignificant, negative correlations were found (posttest, \( r(15) = -.1766 \); difference score, \( r(15) = -.1752 \); \( p > .05 \), one-tailed).

However, the repetitive-interaction pattern was significantly and positively correlated with the difference score (\( r(15) = .4448 \), \( p < .05 \), one-tailed). This correlation was found only for the probability-of-an-appropriate-task-response measure. This finding contrasts Wood and Middleton's suggestion that repetition was an ineffective teaching strategy and supports Croft et al.'s (note 2) suggestion that repetition was an effective strategy. However, the Croft et al.-interaction pattern, which was the specific repetition strategy identified by Croft et al. (note 2) to be effective, was found to be nonsignificantly and negatively correlated with both the posttest and difference scores (posttest, \( r(15) = -.2029 \); difference score, \( r(15) = -.2326 \); \( p > .05 \), one-tailed).

One final goal of the present study was to replicate Wood and Middleton's finding that maternal activity in the child's region of sensitivity was correlated with maternal sensitivity to feedback. In contrast to Wood and Middleton's finding, a nonsignificant, negative correlation was found (see Table 8). In addition, the maternal
TABLE 8
CORRELATIONS BETWEEN MATERNAL ACTIVITY IN THE CHILD'S REGION OF SENSITIVITY AND THE MATERNAL INTERACTION PATTERNS

<table>
<thead>
<tr>
<th>Maternal Interaction Patterns</th>
<th>Percent of Maternal Activity in the Child's Region of Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of Maternal Sensitivity to Feedback</td>
<td>-.274</td>
</tr>
<tr>
<td>Percent of Opposite-Interaction Pattern</td>
<td>.153</td>
</tr>
<tr>
<td>Percent of Repetitive-Interaction Pattern</td>
<td>.196</td>
</tr>
<tr>
<td>Percent of Croft et al.-Interaction Pattern</td>
<td>.83</td>
</tr>
</tbody>
</table>

**NOTE:** $r \geq .521$, $p < .05$, one-tailed.
activity in the child's region of sensitivity was correlated with the remaining maternal instructional patterns: opposite-interactional pattern, Croft et al.-interactional pattern, and repetitive-interactional pattern. None of these correlations were significant (see Table 8).

Posthoc Analyses
As indicated in the procedure section a number of other variables were examined (see Appendix F for posthoc variables). The variables were selected because they represented additional ways in which the mothers seemed to differ. The present analysis is limited to those correlations that were interesting because they elaborated Wood and Middleton's general theory regarding the optimal maternal teaching interaction (i.e., offering the least amount of help necessary in order for the child to be successful). See Appendix G for a complete list of the correlational findings from the posthoc analysis.

Correlations between maternal and child variables
Significant, positive correlations ($p < .05$, two-tailed) were found between the difference score for the probability of the appropriate task response by the child and the following maternal variables: percentage of instructions at Level 2 ($r (15) = .5161$), percentage at Level 1-2 ($r (15) = .5018$), percentage at Level 1-2-3 ($r (15) = .4923$), percentage at Level 1-2-3-4 ($r (15) = .5839$), and the percentage of the repetitive-interactional pattern divided by the total number of maternal instructions$^2$ ($r (15) = .5078$). Significant, negative correlations ($p < .05$, two-tailed) were found between
the child-difference score and the percentage of maternal instructions at the more specific levels, Level 5-6-7-8 ($r (15) = -.4973$), the total number of maternal instructional interventions ($r (15) = -.6449$), and the rate of the maternal instructional interventions ($r (15) = -.5597$). Correlations with difference scores for the final product's approximation to success revealed a pattern of results similar to those obtained for the probability of an appropriate task response except that the positive correlation with the percentage of instructions at Level 1-2-3 failed to be significant. Interestingly, none of the maternal variables that were significantly correlated with the child's difference score were significantly correlated with the child's pretest score.
CHAPTER IV
DISCUSSION

General-Maternal Teaching Effectiveness

The results from the preliminary analyses indicated that, overall, the children's performance improved from the pretest to the posttest. However, the standard deviation of the improvement score (difference score) indicated that the degree of improvement was quite variable among the children. This variability in improvement can, in part, be attributed to the maternal-child instructional interaction because preliminary analyses eliminated some potential sources of variability. Specifically, the amount of time children spent during the pretests and posttests was not correlated with their improvement. Also, the improvement did not vary with sex, task position, or task sequence.

There were some potential sources of variability that were not eliminated. More improvement was found in Task B than in Task A. However, this finding does not reduce the influence of the maternal-instructional interaction but suggests that Task B was probably either easier to learn or easier to teach than Task A. A more serious problem was that children with higher pretest scores for Task B tended to improve more than children with lower pretest scores for Task B. One interpretation for this finding is that children with greater initial ability may be easier to teach or require less
teaching; thereby reducing the influence of the maternal instructions. However, an equally plausible interpretation is that the child's initial ability is a consequence of past maternal instructions, which will be evident in the present maternal-instructional interaction.

In summary, the pretest scores, in the present study, allow the inference to be made that the quality of the maternal-child instructional interaction affected the child's performance. However, it is still possible that the overall improvement was simply due to extra exposure to the task during the interaction and not due to the maternal instructions. The fact that, typically, children voluntarily stopped working on the pretest after three minutes suggests that they would not have benefited just from extra exposure to the task. Nevertheless, more direct evidence for the effectiveness of the maternal instructions would be provided by a yoked control group that did not receive any maternal instructions. Children in the control group would independently interact with the design-construction task for durations that corresponded with the maternal-child interactions.

Finally, the preliminary results indicated that it was not the quantity of the maternal-instructional interaction, but the quality of the interaction that was related to the child's improvement. Specifically, mothers who taught for longer durations did not tend to have children with better improvement scores.
Replication of Wood and Middleton's Findings

The main purpose of the present study was to replicate Wood and Middleton's (1975) findings that suggested (a) a positive relationship between two maternal-instructional strategies—maternal sensitivity to feedback and maternal activity in the child's region of sensitivity—and the child's posttest performance, and (b) a positive relationship between the two maternal instructional strategies. More specifically, the present study attempted to generalize the findings to a different problem-solving task and to replicate these findings when the child's initial ability was taken into account.

Results from the present study failed to replicate Wood and Middleton's findings. No significant, positive relationships were found between the two maternal-instructional strategies and the child's posttest or difference scores. However, the positive correlations between maternal activity in the child's region of sensitivity and the child's difference score approached significance. It is possible that the failure to replicate was due to inaccuracies in Wood and Middleton's findings. However, Wood, Wood, and Middleton (1978) recently found that the sensitivity-to-feedback instructional strategy was also effective under more controlled experimental conditions. They compared four instructional strategies: maternal sensitivity to feedback (contingent strategy), demonstration, swinging from demonstration to Level 1 instructions, and verbal instructions. Children were assigned to receive only one of the above instructional strategies. An experimenter used only the assigned strategy to teach
the child to construct the same three-dimensional pyramid puzzle as in their earlier mother-child interaction study. The children who received the sensitivity-to-feedback strategy had significantly higher posttest scores than each of the remaining three, noncontingent strategies.

The failure to replicate could also be due to inaccuracies in the present study's findings. One source of error in the present study was that no reliability was taken on the videotape transcriptions. Some information may have been lost when the mother-child interactions were translated from the videotapes to the transcripts. A more probable explanation is that the failure to replicate was due to the differences in the problem-solving tasks of the two studies. The dependent measures and scoring procedures used by Wood and Middleton to analyze the mother-child interaction were not easily generalized to the problem-solving task in the present study.

The essential difference between the two tasks was the degree to which the same task operations were repeated throughout the task. Wood and Middleton's three-dimensional, pyramid puzzle consisted of five levels with four equally-sized blocks at each level. The procedure for interlocking the four blocks was the same at each level, the only difference being that the four blocks varied in size across the levels. The repetitive nature of Wood and Middleton's task contrasts with the nonrepetitive nature of the design-construction task in the present study. The present study's task presented greater variation in the color and shape of the task pieces
and in the placement and orientation of the pieces. Furthermore, not only did the topography of the selection, placement, and orientation operations vary, but their degree of difficulty varied throughout the task.

The effectiveness of the sensitivity-to-feedback strategy may then be limited to tasks with repetitious operations. For tasks with repetitive operations, it is appropriate to predict that the mother should decrease her level of specificity after the child correctly carries out an operation. One can assume that the next operation will be similar to the one just carried out correctly. However, when the task operations differ in topography and difficulty, it is not appropriate to predict that the mother should decrease her level of specificity after the child correctly completes an operation. The next operation addressed may be different and more difficult than the one just completed. The sensitivity-to-feedback measure also predicts that mothers should increase their specificity level after an incorrect child response. However, this prediction seems appropriate for both tasks with repetitive operations and tasks with varying operations because after an incorrect response the mother will be addressing the same operation.

The effectiveness of maternal activity in the child's region of sensitivity also appears to depend upon a task with repetitive operations. The child's region of sensitivity reflects the single, optimal level of specificity at which the child is given the least amount of help necessary in order to successfully respond. When the
task consists of a variety of operations that differ in difficulty, it seems unlikely that one particular level of specificity would be optimal for the various operations.

In an attempt to deal with those task differences, Wood and Middleton's scoring procedures and their derivations for the maternal instructional strategies were modified in the present study. First, the levels of specificity were expanded to accommodate the maternal instructions that were addressed to the standard. Second, due to the variations in the design-construction task, the task assembly was divided into three major operations--selection, placement, and orientation--so that the child only had to perform one of these operations in order to be correct. Wood and Middleton were unclear as to their criteria for a correct response but it appears that the child had to make a complete assembly (interlock two blocks) in order to be correct. In the present study two sensitivity-to-feedback measures were calculated; one for the selection operations, and the other for the placement and orientation operations. This was an attempt to have more similar operations within each measure. This separation was only somewhat helpful. Within the selection operation, the individual selections still varied in difficulty. Furthermore, the placement and orientation operations varied in topography and difficulty, and therefore separate sensitivity-to-feedback measures should have been calculated for each operation.

The above procedural modifications were attempts to apply Wood and Middleton's system for analyzing mother-child instructional
interactions to the present study's design construction task. Future attempts to replicate Wood and Middleton's procedures should be restricted to simple tasks that repeat the same operation throughout its construction. Tasks that consist of a variety of operations and that also vary in difficulty present a more complicated teaching situation for the mother. She may still have to rely on her child's responses, but she can no longer automatically apply the simple rule--if the child is incorrect, offer more help; if the child is correct, offer less help on the following intervention. In fact, in such cases, there is no reason to predict that any consistent maternal pattern should occur after the child responds correctly. However, even with the more complex task in the present study, it is reasonable to predict that offering less specific help after an incorrect child response is an ineffective teaching strategy. It is probably for this reason that the opposite-interaction pattern (more specificity after correct responses; less specificity after incorrect responses) was not positively correlated with the child's performance scores.

Repetition Variables

The present study found a positive relationship between repetition, in general, and the child's improvement scores. This finding is contrary to Wood and Middleton's suggestion that repetition would be frustrating for the child and, consequently, ineffective as an instructional strategy. It is important to note that, overall, repetition was not used frequently by the mothers. Perhaps a certain
amount is effective. For example, one repetition after an incorrect child response might offer the child more time to process the instruction. However, if the child continues to incorrectly respond, any additional repetitions could prove to be frustrating for the child and mother.

The present study also investigated the role of repetition as an instructional strategy. Croft et al. (note 2) suggested that following a correct child response with a less specific instruction and an incorrect child response with an instruction of the same specificity level was a more effective strategy than Wood and Middleton's sensitivity-to-feedback strategy. However, the present study found that Croft et al.'s pattern was also not related to the child's performance scores. Perhaps this finding is also due to the problem, in the present study, of predicting any consistent maternal pattern after the child responds correctly.

**Maternal Variables Supporting Wood and Middleton's Theory**

Wood and Middleton's instructional strategies—maternal sensitivity to feedback and maternal activity in the child's region of sensitivity—were operationalized measured representing a general theory of optimal maternal instruction. The general theory suggests that those mothers who optimize their child's success while providing the least amount of instruction will be the more effective teachers. Wood and Middleton's instructional strategies are two ways that mothers can apply this general theory of effective instruction in
practice. However, it appears that these strategies are effective only when mothers are teaching a simple, repetitive operation. In more complex problem-solving activities, such as in the present study, mothers may apply different instructional strategies that also have the effect of optimizing their child's success while providing the least amount of instruction. For example, some mothers in the present study simplified the task for her child by instructing the child to first make the puzzle directly on the standard. The child was then better able to solve the task independently. Another mother limited her child's choices while the child was selecting a piece. Filler (1976) found that limiting the child's choices was an effective strategy for mothers of mentally retarded children. He trained mothers of mentally retarded children to limit their child's choices and to gradually remove the limits as the child experienced success. This strategy was more effective than reinforcement procedures and verbal instructions alone.

Furthermore, in the present study, when mothers were asked after the instructional interactions to explain their particular teaching strategies, many mothers suggested that they were trying to get the child to participate as much as possible. One mother specified that she simplified the task by having the child make the puzzle on the board (standard) so that the child could do it himself. Many mothers stated that if they taught the task again they would first let the child construct the puzzle on the standard. Another mother mentioned that she tried to start with the easiest part (the
of the puzzle. These maternal verbalizations suggest some instructional strategies that mothers may use to increase the likelihood of their child's success while offering minimal intervention. In addition, many mothers verbalized that they thought the task was too difficult for their child. This verbalization, in combination with the mothers' attempts to simplify the task, reflects Kaye's (1977) finding that mothers who observed that a task was too difficult for their infants (i.e., infants failed on the pretest) tended to simplify the task during their teaching interactions.

In addition to the strategies described above, findings from the posthoc analyses in the present study reflected this optimal instructional strategy as well. Mothers who gave more instructional interventions and mothers who gave the instructions at a faster rate tended to have children who improved less from the pretest to the posttest. An earlier study found that the frequency and rate of maternal interventions during a teaching interaction varied in mothers from different social and racial backgrounds (Steward & Steward, 1973). The present study showed that there was a relationship between these two maternal variables and how well a child learns a task, i.e., the frequency and rate of instructions were negatively related to the degree of improvement in the child's performance, suggesting the variables were ineffective teaching strategies. Too much intervention or interventions given at a fast rate may rob the child of any chances for successful assemblies. The mother may be providing more help than is necessary for her child to successfully
construct the puzzle.

In addition, the posthoc analyses indicated that mothers who gave less specific instructions (Levels 1 through 4) had children who improved more from the pretest to posttest. On the other hand, mothers who used the physically-intrusive instructions (Level 5-6-7-8) had children who improved less from the pretest to the posttest. Earlier studies have found that mothers from different social backgrounds differed significantly in the specificity of their verbal interventions (Bee et al., 1969; Brophy, 1970; Hess & Shipman, 1967; Steward & Steward, 1973) and in the frequency of physically-intrusive interventions (Bee et al., 1969). Brophy (1970) found that middle-class mothers tended to use instructions similar to Level 1-2-3-4; whereas lower-class mothers tended to not give these levels at all. Bee et al. (1969) found that middle-class mothers used significantly more nonspecific instructions (comparable to Level 1-2 in the present study) than the lower-class mothers. On the other hand, the lower-class mothers used significantly more physically intrusive interventions (comparable to Level 5-6-7-8 in the present study) than the middle-class mothers. These earlier studies indicated that mothers differ in the degree to which they use verbal and physical interventions during a teaching interaction. Additional studies have found that these maternal differences are related to specific cognitive child variables (Feshbach, 1973; Croft et al., note 2; Rogoff, note 3). Mothers who tended to use more physically intrusive interventions during a teaching interaction have been found to have
children who are poor readers (Feshbach, 1973), externally controlled (Croft et al., note 2), and score lower on verbal memory tests (Rogoff, note 3).

It appears that mothers who used Level 5-6-7-8 may have been providing too much help and, again, not giving the child the opportunity to construct the puzzle. Whereas, mothers who used Levels 1 through 4 provided information about the puzzle in varying degrees, but left the actual construction of the puzzle to the child.

It is important to note that these posthoc variables were correlated with the child's difference scores and not correlated with the child's pretest scores. Consequently, the mothers who tended to provide more interventions, interventions at a faster rate, or Level 5-6-7-8 interventions did not have children who tended to score lower on the pretest. Similarly, mothers who tended to provide more Level 1 through 4 interventions did not have children who scored higher on the pretest.

Additional Maternal Instructional Variables

The present study focused on a general theory of maternal instruction that suggests the optimal instructional interaction involves the least amount of instruction necessary in order for the child to be successful. However, there may be other optimal instructional interactions. The importance of a specific teaching dimension may vary with task type and task demands. Furthermore, tasks with many variations, as in the present study's task, may encourage a wider variety of teaching strategies, all of which may be effective. After
scoring the mother-child interactions it was apparent that the mother-child pairs differed on some dimensions that could reflect critical differences in their teaching strategies and effectiveness.

One such dimension was the use of puzzle-related discrimination questions. These interventions required that the child make verbal or gestural puzzle-related discriminations. In general, these questions addressed the identification component of the task operations. Similarly, the children varied in the degree to which they provided puzzle-related discrimination responses. Some mother-child pairs spent much of their interaction in verbal/gestural puzzle-related conversation. Hess and Shipman's (1967) findings provide evidence that this discrimination dimension is an effective teaching strategy. They found that mothers who sought verbal feedback (i.e., verbal information about the task) from their child tended to have children who did better on a posttest than mothers who sought physical feedback (i.e., a task-constructing response) from their child. Wood and Middleton's dependent measures ignored this type of non-puzzle-constructing interaction between the child and mother.

Other interesting maternal dimensions were (a) the degree to which mothers evaluated both the child's correct and incorrect responses with specific feedback, (b) the degree to which the mother focused the child's attention on the standard, and (c) the amount of time mothers gave the child to respond before providing another instruction. Future research should address these teaching dimensions.
Conclusion

In summary, the present study failed to replicate Wood and Middleton's findings. The failure to replicate was probably due to the differences in the problem-solving tasks used in the two studies. Future replications should be restricted to simple tasks that repeat the same operation throughout its construction. The failure to generalize Wood and Middleton's findings to the more complex task in the present study does not imply that, in general, maternal responsiveness to her child's correct and incorrect responses is an ineffective instructional strategy. It simply indicates that the specific pattern for the maternal response—less specificity following a correct response; greater specificity following an incorrect response—may be insufficient for teaching more complex tasks. Future research should investigate procedures for measuring maternal responsiveness when the instruction involves a complex task.

Finally, the present study suggested that mothers who tended to provide many instructions, instructions at a fast rate, or physically-intrusive interventions were less effective teachers. On the other hand, mothers who tended to provide less specific, verbal and gestural instructions (Levels 1 through 4) or repeated instructions at the same level of specificity were more effective teachers.
1Cognitive development is broadly defined here. Other investigators have used such terms as skill acquisition (Bruner, 1972), intellectual competence (White et al., 1973) and intellectual development (Hunt, 1961).

2A pattern case consisted of a maternal instruction followed by a child response which was then followed by a second maternal instruction. Pattern cases excluded the following maternal instructions: (a) the subsequent instruction to a Level 1a instruction that was followed by a correct child response because the mother could not get less specific in her subsequent instruction; (b) the subsequent instruction to a Level 8 instruction because there was no child response for comparison; and (c) the subsequent instruction to a maternal instruction that was followed by no child response. The derivation for the four interaction-pattern dependent measures was to divide the number of cases of the particular interaction pattern by the total number of pattern cases; thereby excluding the above maternal instructions. Posthoc variables were devised to include the excluded instructions by dividing the number of cases of a particular interaction pattern by the total number of maternal instructions (see Appendix F).
REFERENCE NOTES


REFERENCES


Siegell, G.M. Adult verbal behavior with retarded children labeled as "high" or "low" in verbal ability. *American Journal of Mental Deficiency, 1963, 68, 417-424.*


APPENDIX A

SCORING SHEET FOR FINAL-PRODUCT'S-APPROXIMATION-TO-SUCCESS MEASURE
APPENDIX B

SCORING SHEET FOR THE PROBABILITY-OF-AN-APPROPRIATE-TASK-RESPONSE MEASURE
<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>S1</th>
<th>P</th>
<th>O</th>
<th>T</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/6</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R/S1</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T = Placed Above 2 Pieces together</td>
</tr>
<tr>
<td>6/12</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/6t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R/S1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/S1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I asked if he was finished</td>
</tr>
<tr>
<td>9/A1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/S2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/S1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I asked if he was finished</td>
</tr>
</tbody>
</table>

Adjust:
3/8 3/8 3/7 9/7 6/7
Add rop:
11/8 1 4 9/7 7/7

Multiply: = 2.46

3/6 3/6 2/7 2/7

Time = 1'53"
APPENDIX C

DECISIONAL CUES FOR SCORING THE PROBABILITY-OF-A-N-APPROPRIATE-TASK-RESPONSE MEASURE
DO NOT SCORE UNTIL S DOES SO.

PROCEED TO BOX 5.

DID S ATTEMPT TO DO WHAT WAS IN BOX 2 WITH THE PIECES?

DID S SELECT MORE THAN ONE PIECE AT A TIME?

DID S SELECT 1 PIECE?

DID S ATTEMPT TO PLACE, ORIENT, REPLACE, OR REORIENT A PIECE ALREADY SELECTED?

DID S ATTEMPT TO PLACE, ORIENT, REPLACE, OR REORIENT A PIECE ALREADY SELECTED?

DID S ATTEMPT TO PLACE, ORIENT, REPLACE, OR REORIENT A PIECE ALREADY SELECTED?

DID S ATTEMPT TO PLACE, ORIENT, REPLACE, OR REORIENT A PIECE ALREADY SELECTED?

DID S STOP THE MOVEMENT OF THE PIECE EITHER BY:
A) PAUSING FOR ≥ 2 5 sec.
B) BEGINNING TO WORK WITH A NEW PIECE

Criteria for Identifying Selection

Criteria for Placement Scoring

KEY:
SD - STANDARD
MD - MODEL
C - COLOR
SH - SHAPE
PL - PLACEMENT
ORT - ORIENTATION
S - SUBJECT
COR - CORRECT
INC - INCORRECT


IS 50% OF THE PIECE WEIGHTED NEAR THE HYPOTENUSE?

SCORE THE TWO PIECES COR IN PL, REGARDLESS OF HOW THEY ARE ROTATED RELATIVE TO THE MIDDLECENTER.

DO NOT SCORE THE PIECE UNTIL IT IS PLACED. THEN PROCEED TO BOX 4. IF THE PIECE NEVER IS PLACED, SCORE IT AS COR IN SH AND INC IN C.

CRITERIA FOR SCORING - A. SELECTION

IS IT SIMILAR IN SH, BUT NOT C, TO ANY OF THE UN-TAGGED SD PIECES? (CONSIDER TWO SD TRIANGLES IN SQUARE SHAPE AS = A SQUARE PIECE IN SH)

IS THE PIECE SIMILAR IN C AND SH TO A SD PIECE THAT HAS NOT ALREADY BEEN TAGGED?

IS THE PIECE TOUCHING OR AT LEAST 1 INCH CLOSE TO ANOTHER PIECE?

IS IT SIMILAR TO AN UN-TAGGED SD PIECE IN C, SH, PL, AND ORT? (C AND SH ARE SCORED ON A SEPARATE LINE FROM PL AND ORT)

IS IT SIMILAR TO AN UN-TAGGED SD PIECE IN C AND SH, BUT NOT PL AND ORT?

IS IT SIMILAR TO MORE THAN ONE SD PIECE IN C AND SH, BUT NOT PL AND ORT?

IS IT SIMILAR TO AN UN-TAGGED SD PIECE IN SH AND PL, BUT NOT SH AND ORT?

SCORE IT AS INC ON ALL 4 PARAMETERS: C, SH, PL, AND ORT.

SCORE IT AS INC IN SH AND C.

IS IT ALSO SIMILAR IN C TO ANOTHER SD PIECE THAT HAS NOT BEEN TAGGED? (E.G. A BLUE/DIAMOND IS SIMILAR IN C AND SH TO A BLUE/DIAMOND OF SD AND SIMILAR IN C TO A SD BLUE/TRIANGLE)

IS IT ALSO SIMILAR IN C TO ANOTHER SD PIECE THAT HAS NOT BEEN TAGGED? (E.G. A BLUE/DIAMOND IS SIMILAR IN C AND SH TO A BLUE/DIAMOND OF SD AND SIMILAR IN C TO A SD BLUE/TRIANGLE)

SCORE IT AS COR IN C AND SH, IF AND WHEN THE PIECE IS PLACED, PROCEED TO BOX 4 TO SCORE ON PL AND ORT.

DO NOT SCORE THE PIECE UNTIL IT GETS PLACED (SEE BOX 4). IF THE PIECE DOES NOT GET PLACED, THEN SCORE IT CORRECT IN C AND SH.

TAG THE SD PIECE AND SCORE THE PIECE AS COR IN C AND SH (ON ONE LINE) AND COR IN PL AND ORT (ON THE NEXT LINE).

TAG THE SD PIECE AND SCORE IT COR IN C, SH, AND PL, AND INC IN ORT. (C AND SH ARE SCORED ON A SEPARATE LINE FROM PL AND ORT)

TAG THE SD PIECE AND SCORE IT COR IN C AND PL, AND INC IN SH AND ORT. (C AND SH ON SEPARATE LINES FROM PL AND ORT)

ARBITRARILY TAG ONE OF THE ALTERNATIVE SD PIECES AND PROCEED TO BOX 22.

ARBITRARILY TAG ONE OF THE ALTERNATIVE SD PIECES AND PROCEED TO BOX 22.

TAG IT AS THAT SD PIECE AND PROCEED TO BOX 22.
In general, tagging a standard piece means that the piece a child selects while constructing the model represents a particular standard piece. For example, when the child selects, places, and orients a piece exactly like a standard piece, the standard piece is tagged as the model piece. The scoring system allows partial credit for selections that are similar to a standard piece on some, but not all, parameters. Rules for tagging such selections are provided in the flow chart. However, frequently a partially correct selection, which has been scored for a particular standard piece, is followed by a more correct selection for the same standard piece. In such cases the child is given credit for the latter, more correct selection. The less correct selection no longer represents the standard piece and is rescored as incorrect on all dimensions. Finally, if the child dismantles part of the model that has already been scored, a line is drawn under the scores for the dismantled pieces. The standard pieces, tagged by the dismantled pieces, are then considered untagged and can be retagged by later selections.
APPE N D I X  D

SAMPLE TRANSCRIPT OF A MATERNAL-CHILD INTERACTION
<table>
<thead>
<tr>
<th>Subj: J.T.</th>
<th>No: 20-F</th>
<th>Task: 6</th>
<th>Pj: 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Verbal</strong></td>
<td><strong>Gestural</strong></td>
<td><strong>Verbal</strong></td>
<td><strong>Gestural</strong></td>
</tr>
<tr>
<td>7. Right, can you find a red square?</td>
<td>pots to R/S on St.</td>
<td>Pots to R/S on St.</td>
<td>Correctly sel. R/S.</td>
</tr>
<tr>
<td>Very Good! You're just terrific.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Now what shape is this next to it?</td>
<td>pots to 1/2 next to 1/2 on St.</td>
<td>pots to 1/2 on 1/2.</td>
<td></td>
</tr>
<tr>
<td>What?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Yellow color what shape?</td>
<td>outline 1/2 on St.</td>
<td>triangle</td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>That's it.</td>
<td></td>
<td></td>
<td>Looks at pile</td>
</tr>
<tr>
<td>How you gonna put it in the right direction.</td>
<td>gestures along hypo-</td>
<td></td>
<td>Carefully sel. 1/2</td>
</tr>
<tr>
<td>OK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Is that way? Then it's 1/2 in Md.</td>
<td>搬迁, 1/2 in Md.</td>
<td>搬迁, 1/2 in Md.</td>
<td></td>
</tr>
<tr>
<td>搬迁, 1/2 in Md.</td>
<td>搬迁, 1/2 in Md.</td>
<td>搬迁, 1/2 in Md.</td>
<td>That way</td>
</tr>
<tr>
<td>搬迁, 1/2 in Md.</td>
<td>搬迁, 1/2 in Md.</td>
<td>搬迁, 1/2 in Md.</td>
<td></td>
</tr>
<tr>
<td>搬迁, 1/2 in Md.</td>
<td>搬迁, 1/2 in Md.</td>
<td>搬迁, 1/2 in Md.</td>
<td>On the bottom</td>
</tr>
</tbody>
</table>
APPENDIX E

ADDITIONAL CATEGORIES FOR THE MOTHER-CHILD OBSERVATIONAL SYSTEM
ADDITIONAL CATEGORIES FOR THE MOTHER-CHILD OBSERVATIONAL SYSTEM

The maternal-instructional intervention category also included any intervention that preceded a verbal or gestural puzzle-related response from the child (defined below). In addition, maternal instructions were categorized according to (a) form, and (b) explicitness of the puzzle-constructing request.

1. Form: Every maternal instruction was scored as one or more of the following forms: (a) command, (b) question, (c) statement (neither a command nor question that serves to supply task-related information), (d) nonverbal gesture, and (e) discrimination question (questions that require a discrimination of the puzzle and its parameters; e.g., "Is that blue?", "What color is this piece?", "What shape do you need?").

2. Explicitness of the puzzle-constructing response: Every maternal instruction was scored as either (a) an explicit request (the instruction included a direct request for a puzzle-constructing response; e.g., "Do the puzzle," "Find a piece," "Can you get a blue one?"), or (b) an implicit request (the puzzle-constructing response must be inferred from the instruction; e.g., "Is that right?", "You need red," "This is the long side").

The child-response category also included a non-puzzle-constructing response--a gestural or verbal puzzle-related response.
This included any verbal or gestural response to a maternal instruction that required a puzzle-related discrimination. For example, the child replies, "Blue" or points to the blue triangle on the standard in response to the maternal intervention, "What color do you need?" Verbal and gestural responses that did not require such a discrimination or reflected the child's ability and motivation were not included. For example, the child replies, "No" or "I don't want to" in response to the question, "Can you find a blue one?" The accuracy of a verbal/gestural puzzle-related response was determined in relation to the preceding maternal instruction, based on the discrimination being requested, and in relation to the task demands.

Finally, in addition to the two major categories--maternal intervention and child response--maternal responses that evaluated a child's response were scored as a third major category. These were categorized as either (a) a positive, nonspecific response (mother says, "Good" and/or gives the child a hug), (b) a negative, nonspecific response (e.g., mother says, "No, that's wrong"), (c) a positive, specific response (e.g., mother says, "Yes, that's a square" or "That looks like a picture"), (d) a negative, specific response (e.g., mother says, "That's not red" or "That's not like this," while pointing to a red square on standard), or (e) a neutral evaluation response (e.g., mother says, "Is that like the picture?"). Note that these responses were also scored as maternal instructions if they were followed by a puzzle-constructing child response.
APPENDIX F
POSTHOC DEPENDENT MEASURES
POSTHOC DEPENDENT MEASURES

1. Total number of maternal instructions.
2. Total teaching time.
3. Rate of maternal instructions (i.e., the total teaching time divided by the total number of maternal instructions).
4. Frequency of teaching episodes (i.e., the number of complete puzzle constructions during the teaching interaction).
5. Mean episode time (i.e., total time divided by the frequency of teaching episodes).
6. Percentage of instructions requesting a selection operation (i.e., the number of selection instructions divided by the number of maternal instructions).
7. Percentage of instructions at Levels 1 and 2, combined (i.e., the frequency of Levels 1 and 2, combined, divided by the total number of maternal instructions).
8. Percentage of instructions at Levels 3 and 4, combined.
9. Percentage of instructions at Levels 1, 2, and 3, combined.
10. Percentage of instructions at Levels 1, 2, 3, and 4, combined.
11. Percentage of instructions at Levels 5, 6, 7, and 8, combined.
12. Frequency of nonmovement maternal interventions followed by a correct child response (reflects the child's independent correct responses).
13. Frequency of nonmovement maternal interventions followed by an incorrect child response (reflects the child's independent incorrect responses).

14. Frequency of maternal instructions that led to a correct child response.

15. Frequency of maternal instructions that led to an incorrect child response.

16. Percentage of total maternal instructions that led to a correct child response (i.e., frequency of maternal instructions that led to a correct response divided by the total number of maternal instructions).

17. Percentage of total maternal instructions that led to an incorrect child response.

18. Percentage of maternal instructions (excluding Level 8 instructions) that led to a correct child response (i.e., frequency of maternal instructions that led to a correct child response divided by the number of maternal instructions that led to either a correct or incorrect response).

19. Frequency of sensitivity-to-feedback interaction pattern divided by the total number of maternal-instructional interactions.

20. Frequency of opposite-interaction pattern divided by the total number of maternal-instructional interactions.

21. Frequency of Croft et al.-interaction pattern divided by the total number of maternal-instructional interactions.
22. Frequency of repetitive-interaction pattern divided by the total number of maternal instructional interactions.

23. Frequency of sensitivity to feedback pattern divided by the combined frequency of the sensitivity to feedback pattern plus the opposite interaction pattern (removes the repetition cases).
APPENDIX G

MEANS AND CORRELATIONS
### VARIABLE  | CASES | MEAN | STD DEV
--- | --- | --- | ---
WM - sensitivity to feel | 17 | 50.7143 | 10.7126
CT - conflict | 17 | 30.8974 | 7.3194
PP - repulsion | 17 | 21.8275 | 7.8950
OP - opposite | 17 | 28.5204 | 8.5045
NRPM - d | 17 | 63.5407 | 11.4168
CTM - 0 | 17 | 35.8824 | 12.0060
CT - e | 17 | 23.3529 | 7.7976
CRP - c | 17 | 14.9412 | 8.0401
CP - v | 17 | 19.7647 | 6.8767
P1 - percentage at level 1 | 17 | 6.1353 | 6.1119
P2 - level 2 | 17 | 4.6471 | 6.6729
P3 - g | 17 | 17.7459 | 8.2979
P4 - f | 17 | 25.9410 | 13.1712
P5 - 5 | 17 | 10.5363 | 7.1248
P6 - 6 | 17 | 9.0119 | 2.0969
P7 - percentage at level 2 | 17 | 2.3447 | 4.8127
P8 - x | 17 | | 16.7664
P9 - percentage at level 3 | 17 | 45.1199 | 8.1073
TOL - selection | 17 | 71.2941 | 26.7319
TOL - 1 | 17 | 6.9776 | 1.6706
TCHM - 3 | 17 | 3.1124 | 2.0669
TCHM - 4 | 17 | 11.3910 | 3.0011
TCHM - 5 | 17 | 4.1756 | 1.5487
TCHM - 6 | 17 | 53.9012 | 12.5455
TCHM - 7 | 17 | 39.2824 | 14.6184
TCHM - 8 | 17 | 32.6941 | 10.0427
TCHM - 9 | 17 | 24.7099 | 5.3025
TCHM - 10 | 17 | 24.7241 | 13.8088
TCHM - 11 | 17 | 7.3529 | 9.1268
TCHM - 12 | 17 | 4.9142 | 3.8179
P12 - 1 | 17 | 15.6634 | 11.1476
P36 - 2 | 17 | 47.6588 | 16.0575
P123 - 4 | 17 | 33.3412 | 15.7951
P1234 - 6 | 17 | 59.7612 | 17.2524
P5678 - 8 | 17 | 40.9753 | 19.6288
PRFP final Prod - Pres | 17 | 10.7388 | 3.3121
PRFP - Post | 17 | 17.0100 | 8.8699
PRFP - 3,5 | 17 | 6.6712 | 6.3122
PRAS Approp. Res - Prec | 17 | 6.7771 | 2.0777
PRAS - Post | 17 | 12.7029 | 7.9058
PRAS - 3,5 | 17 | 5.9469 | 8.6345
PRAS Pres - Time | 17 | 3.5394 | 1.4373
PRAS Post - Time | 17 | 3.7018 | 1.2459

*Note that - 0 - indicates posthoc variable reference in Appendix F.*
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### Norther Child Interactions During a Problem Solving Task

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## Mother Child Interactions During a Problem Solving Task

### File Name (Creation Date = 79/02/02)

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(COEFFICIENT / CASES / SIGNIFICANCE) (99.00% MEANS INCOMPATIBLE)