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CHAPTER TEN

Infants' Effects upon Their Mothers' Teaching Strategies

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Jerome Bruner sees skills as developing from the new combination of previously mastered subroutines. Three features distinguish Bruner's theory. First, the "intention" that guides action also guides learning; the adaptive use of old means for new ends enables even the young infant to accommodate his skills to environmental needs, without waiting for the gradual selective effects of reinforcement. Second, the integration and coordination of simpler skills for higher-order, specialized purposes cannot proceed until the necessary subroutines or "modules" are sufficiently practiced on their own, so as to free attention for the additional task of coordinating them. Third, some of the constituents that are to be combined in new skills develop in the infant autonomously, due neither to reinforcement nor to adaptation but to behavioral maturation "preadapted" in the evolution of the human species. (Bruner, 1971, 1972, 1973; Bruner & Bruner, 1968)

What implications does such a theory have for instruction or for facilitating the development of skill? The importance of intention would suggest that an instructor ought to take account of the learner's intrinsic motivations. The problem of modularization would suggest that instruction must be sensitive to the hierarchical structure of the skills that are to be taught. And both modularization and preadaptation imply that the instructor must take into account where the learner is, with respect to the skills and subskills involved in a given task.

Thus stated, the guidelines for instruction are reminiscent of a wide range of learning theories. Whether one is searching with Tolman for the appropriate goal object or with Hull for the appropriate reinforcer, and whether one analyzes task and learner to find the relevant habits, associations, operants, subroutines, or schemas, it makes common sense that one analyzes the learner's goals and abilities along with the task's structure and requirements, and tries to increase the fit between the two. In Skinner's (1954) terms:

> What behavior is to be set up? What reinforcers are at hand? What responses are available in embarking upon a program of progressive approximation which will lead to the final form of the behavior? (p. 93)

Bruner himself, long before he turned his attention to the skills of infants, organized *The Process of Education* (1960) around four themes, of which three were the structure of the subject matter, intellectual readiness, and the motives of the learner.

Although there is agreement and substantial research supporting the principle that instruction *ought to* take account of the learner's motivation, the structure of the task or subject matter, and the developmental fit between learner and task, there remains the question whether, under normal circumstances, human instructors do take account of these factors in selecting from among alternative strategies. And if they do so, how do they themselves acquire these teaching skills?

In the literature on skills from which the recent work of Bruner and his students derives most of its theoretical nourishment, we find strong arguments favoring an analysis of interaction in dyads or groups. Argyle and Kendon (1967), for example, discuss the model of skill that also underlies Bruner's theory—a programmatic system using feedback to realize intentions. They argue that groups of two or more persons with shared intentions can be system-analyzed in much the same fashion as a single organism. Communication between the partners will appear to be a matter of feedback loops. Dozens of studies support the hypothesis that interaction requires individuals to accommodate their posture, distance, attentional orientation, gestures, language, and various activity cycles to one another. Argyle

and Kendon also review evidence that what Goffman (1961) calls *focussed interaction*, in which people converse or cooperate in a task, differs in the above aspects from casual or unfocussed interaction. But as of 1967, and still as of the present writing, there were no studies in the skill literature that looked at the development of goal-attainment capabilities in teams, or at the goal-attainment strategies of children in social contexts, or at interaction where one partner is the instructor and the other the learner.

There is plenty of evidence that the characteristics of learners and instructional treatments interact in the statistical sense, though these interactions are rarely disordinal; that is, rarely has one type of instruction been shown to be better for some learners and another type better for others (Bracht, 1970). There is also growing literature on processes of behavioral interaction (Blurton-Jones, 1972; Lewis & Rosenblum, 1974). Our object was to combine the analysis of both kinds of interaction with the model of sensorimotor skill, and to investigate instructional strategies.

METHOD

Subjects

Almost any age group could have been used for this study so long as an appropriate task was available. The author had completed a study with Jerome Bruner and Karlen Lyons (Bruner, 1971) in which infants attempted to reach around a barrier to grasp a wooden cube. The six-month-old infants in that study, seated in their mothers' laps, were unable to solve the problem on their own. Since many of their mothers expressed frustration at not being able to help, the task and the six-month-old age group seemed appropriate for the following investigation.

Subjects were recruited from among the pool of mothers volunteering for studies at the Center for Cognitive Studies at Harvard University. Extra efforts were made to advertise among working-class families, so as to balance the large number of graduate student and professional families. Since we were interested in social class as a possible independent variable, the experimenter wished to remain ignorant, so far as possible, of the social class background of each subject until after the session was over. Furthermore, we did not want to call the subjects' attention to education or social class as a variable

Table 1
Design of the Study (Number of Subjects)

Experimental Condition	*Sex of Infant*	MOTHER'S EDUCATION LEVEL *(1) High School Only*	*(2) Some College*	*(3) College Grad*	*(4) Beyond College*	*Total*
Screen on left	Male	7	3	5	6	21
	Female	6	6	7	5	24
Screen on right	Male	7	4	4	6	21
	Female	6	6	7	6	25
Total		26	19	23	23	91

likely to affect their behavior, so no questions at all were asked of them until the end. This meant that it was not possible to assign subjects to cells of the design until we had already observed them. Therefore, we ran as many subjects as necessary for us to end up with at least 25 mothers who had no education beyond high school and at least 25 who had graduated from college. The total number of subjects turned out to be 91. Table 1 shows the design.

Subjects came to the Center for Cognitive Studies for only one visit, which lasted from 30 to 45 minutes. At the end of the session we asked questions regarding the parents' education, the number of siblings, the precise age of the baby, and the number of weeks it had been breastfed. The infants were all between 26 and 31 weeks old.

Apparatus

The detour reaching apparatus consisted of a large wooden box 18 inches high by 36 inches wide by 24 inches deep, as shown in Fig. 1. Across the front of the box the lower 5. inches were open, revealing a brightly lit white interior. The exterior of the box was painted gray, and there was no other source of illumination in the room outside the

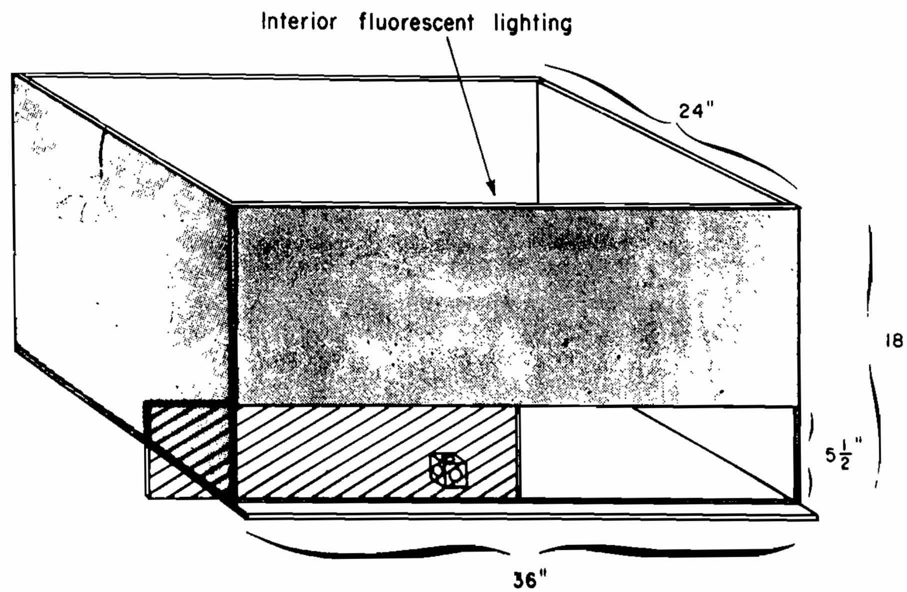

Fig. 1. Detour reaching apparatus.

box. The infants were seated in their mothers' lap in front of the box, with their eyes just above the level of the opening; together with the fact that the illumination came from inside, this meant that the infants saw no reflection in the plexiglass barrier that was mounted in the opening. The barrier extended from the infant's midline all the way across either the left or the right half of the box (See Table 1). The toy was placed in the apparatus through the open top, at a position just inside the edge of the barrier as shown in Fig. 1.

The recording apparatus was one designed by Lentz (Lentz & Haith, 1969) for continuous recording of binary information in up to 32 categories. Onset and offset of the behavioral events to be described below were coded "live" by two observers and stored as a continuous electronic signal on magnetic tape. This tape was subsequently processed on a PDP-9T computer, which produced a printed transcript of each session and extracted summary statistics so that cross-subject comparisons could be made using the Harvard DATA-TEXT system on an IBM 7094 computer.

Procedure

The session consisted of a pretest, a teaching period, a posttest, and a transfer test. The length of the teaching period was entirely left to the mother's discretion. The other three periods were a little over two minutes in length. They were terminated when one of the following criteria was reached: (a) 30 consecutive seconds without progress toward a reach; (b) heavy crying that could not be ignored; (c) three successful retrievals of the toy from behind the barrier; or (d) two and one-half minutes. The mean length of the pretest was 123.8 seconds, with no systematic differences across any of the cells of the design. (Posttest and transfer were shorter, rarely reaching criterion d.)

When a mother entered the experimental room, she was offered an armchair a few feet away from the apparatus. We handed her infant the wooden cube (containing a bell). Nearly all babies reached for this toy and grasped it immediately; a few were so shy of the experimenter that they would only take the block from their mothers. Even something so apparently trivial as the fact that the baby was interested in the toy seemed to ease our rapport with the mothers as we began:

> We've done a rather large study in which babies were to solve this problem. The problem is simply to get this toy out from behind this screen. It looks easy but it isn't. One of the things we learned was that babies around six or seven months old couldn't

> figure out how to solve this problem without any help. What we want to find out now is whether they can learn the task when they have the help of an adult. But the first thing we have to do is to check that (COGNITA) can't solve the problem on her own—occasionally we get a baby who can reach around the screen at this age, in a clumsy sort of way. I don't expect that will happen, though. If you'll just sit in this chair and hold her so that her middle is about here, we'll watch her for about two minutes. Then we'll give her a rest. You should hold her loosely so she's free to reach around if she can, but sit back a bit so as not to give her any hints.

At the end of the pretest mother and baby returned to a more comfortable chair. Note that the mother had not yet been told who was going to be doing the training. When the child was calm and cheerful, the session resumed:

> Well, as we expected she didn't get the toy (*or*, she surprised us by getting the toy but there's still room for improvement in speed and smoothness). Now we want to find out if babies this young can learn to get the toy when they have the help of an adult. I've tried teaching them myself but that doesn't work very well: I think the best way is to try and have their mothers teach them. Since we don't know what the best method of teaching the solution is, we won't give you any advice; we'll be interested in seeing what works. You'll be completely on your own. Now she is one of our younger babies, but she might be solving the problem beautifully by the time you're through. Take as long as you like, and just tell us when she's either mastered it or gotten fed up with it. You can do anything at all that you think might help; you can even stand her on her head if that seems to work. When you tell us you're through, we'll just have her try it without any help, like we did before. When we test to see if she's learned it, she'll be sitting here and the toy will be right here, like before. You can try anything you like that you think might work. Any questions?

Needless to say, these instructions varied somewhat in response to the mothers' apparent reactions.

Behavioral coding proceeded in three stages. The first consisted of live continuous recording of six maternal behavior categories and six infant behavior categories. Mother and baby were observed independently by the two experimenters. Each observer had six small finger buttons which could be held down so long as an event was "on."

The six categories observed in the mothers were: RESETTING, or putting the toy back in its position behind the screen; MODELING the detour reach for the child; TEMPTING, by pointing at or shaking the cube; SIMPLIFYING the task by moving the toy to the open side of the apparatus; TUGGING the baby's hand or arm; and moving the BABY bodily in her lap. No attempt was made to interpret the mother's intent in any of these instances; for example, MODELING was scored every time the mother reached for the toy.

The other observer coded the baby as follows: POINTING at the toy through the screen; REACHING around the screen toward the toy; TOUCHING the toy inside the box; PLAYING with the toy outside the box; looking AWAY from the task; and DISTRESS indicated by crying or screaming. (These behaviors were also recorded in the pretest, posttest, and transfer test.)

Several factors constrained the choice of categories; they had to be few enough so that all possible combinations could be recorded as they occurred; they had to be discrete categories so that there was no ambiguity about classifying any event; and they had to exhaust all of the salient behavior that seemed relevant to the task.

Our measure of reliability was the proportion of discrete events coded, in the same sequence, by two pairs of observers from a videotape. The actual observers had trained the two additional teams using videotapes made during pilot sessions. Reliability was based upon the first codings of an additional 10-minute videotape the observers were seeing for the first time. There were 160 events on this tape, of which 153 were coded by both sets of observers in exactly the same sequence. Thus, reliability was estimated at 96 percent; it was about the same for the observers of the infant as for the observers of the mother. This videotape was randomly selected from among tapes we made of our first ten sessions. We assume that some sessions were coded less, and some perhaps more, reliably. The method of estimating reliability is conservative in that (a) we use discrete events rather than units of time for comparison between the two teams; (b) we used the total number of events known to be visible on the videotape as our denominator rather than the total number coded by either team; and (c) we used interobserver reliability *between* observers whom we trained, which can be assumed to be lower than the reliability *within* the experienced observers who actually saw all 91 subjects.

However, it should be pointed out that our highly satisfactory reliability estimate refers to the sequence and frequencies of events, not to their latencies and durations. Although the vast majority of differences in response latency between the two sets of observers were less

than 2 seconds, we did not measure the reliability of our response latencies. The latencies of interest for the paper would be those of only 1 to 2 seconds, and therefore we will report no results dealing with latencies.

In the second stage of analysis the computer reconstructed meaningful acts from the sequences of discrete categories. For example, MODEL-TEMPT-RESET meant that the mother's purpose had been to demonstrate the skill, while MODEL-SIMPLIFY, though counted as an opportunity for the baby to observe the detour reach, was considered from the mother's point of view to be an attempt at breaking down the task.

The twelve behavioral categories were not all treated alike at this stage of processing. For example, the category BABY was used primarily as a flag to indicate how other events were to be interpreted. If the mother moved the baby bodily at any time between the start of a reach and the point at which the baby touched the toy, even if the baby then took the toy out of the box, this was not scored as a success. If the categories of BABY and AWAY continued simultaneously for more than a few seconds, this indicated that the mother had removed the baby from the task to console it. All such signal combinations were established by the observers during practice sessions and became routine, so that they could be interpreted unambiguously.

The sequence RESET-REACH-TOUCH-PLAY meant that the infant scored what we arbitrarily called a success, unless HAND-TUGGING, BABY, or SIMPLIFYING had been coded between the onset of REACHING and the onset of TOUCHING.

The final stage of processing, after obtaining transcripts and summary statistics of each session but before analyzing the results, was a rating of the mother's predominant teaching strategy. Pilot studies had led us to expect three basic types of strategy—one based on MODEL-TEMPT-RESET, one based on SIMPLIFYING, and one based on HAND-TUGGING. In fact, it was fairly easy to sort the subjects into three groups using the following criteria, listed in the order with which we weighted them: (a) repetition of an action pattern, such as MODEL-TEMPT-RESET or MODEL-SIMPLIFY, throughout the session (75 subjects were classified unambiguously on this basis alone); (b) supporting evidence of the mother's intention, such as RESETTING the toy behind the screen after a series of SIMPLIFYINGS; and (c) the behavior that predominated earlier rather than later in the session. Using these criteria there was independent agreement between two raters on 90 of the 91 subjects.

RESULTS

The three principal teaching strategies came to be known as *showing, shaping,* and *shoving.* The most important thing we can say about these strategies is that most of the mothers used all three. Of the 37 whom we characterized as relying principally on a demonstration or *showing* strategy, most tugged the infant's hand at least once and most simplified at least once. Hand-tugging and demonstration also tended to be used by the 25 *shaping* mothers (whose major strategy was to begin with a direct reach and gradually build up to the detour reach). Most of the 29 mothers who relied mainly on *shoving* the infant around the screen also simplified and demonstrated the task one or more times. It was not our purpose to typologize mothers as different kinds of teachers, though independent maternal variables did predict teaching strategies to some extent. The real reason for grouping our subjects in this way was our hypothesis that the predominant teaching methods would depend upon behavioral differences in the infants, and would in turn have different degrees of success.

The first set of results to be considered involves the immediate context of the mother's teaching behavior, the teaching period itself. We will then consider the pretest as predictor of the mothers' strategies in teaching; then the background variables that accounted for some of the variance in both infant and maternal variables; and finally the question of which strategies led to success as measured on the posttest and transfer test.

Teaching Period

Although we were able to categorize our subjects according to the principal teaching strategy that seemed to dominate their sessions, we are more concerned with the objectively coded acts within sessions. We did test the hypothesis that basic teaching strategy would affect the infants' success in the task, and those results will be discussed below. For the most part, however, results for the three basic strategy groups simply confirmed our findings based upon frequencies of different maternal acts across the sample as a whole; we regard the latter type of findings as more meaningful.

The sequence MODEL-TEMPT-RESET (MTR) occurred 636 times, or an average of seven times in each teaching session. This meant that the mother reached around the barrier for the toy, took it out and shook it without giving it to her infant, and placed it back behind the barrier. Ten mothers never did this; in the other 81 sessions it occurred between 1 and 30 times. The context in which it occurred was very consistent; almost never when the infant was actively reaching toward the toy, most often when the infant had looked away from the task and back to it again. Table 2 does not reveal the fact that the most common infant sequence before *pointing* was also looking away and looking back to the task. And although we do not have a category in Table 2 for "looking back," we can report that 75 percent of the infants in the upper-right-hand cell of that table had already looked back to the task when their mothers modeled, or looked back *as she reached* for the toy. So the typical pattern of behavior is represented in Fig. 2.

This conclusion from the quantitative data is confirmed by observation of any of our live sessions or videotapes (see appendix). Furthermore, we know that it takes many repetitions of the sequence before an infant imitates the mother's reaching around the barrier. Only 8 percent of the MTRs were followed immediately by the infants' reaching, and these reaches were often thwarted when the infants knocked the toy away, failed to grasp it, or withdrew their arm after banging their wrist on the edge of the barrier. Of course there were also some successful and unsuccessful reaches that did not immediately follow an MTR. The general picture was that the infant gradually accommodated to the spatial requirements imposed by the barrier, improving over many trials which alternated with demonstrations by the mother. Although we will report below that the success rate of learning by these infants was far from impressive, a more important result was that the cases that conformed to this idealized "typical" pattern of gradual accommodation over trials also conformed to the idealized "typical" pattern of looking away, looking back, MTR, try again.

The fact that MTR did not always lead to imitation would be ac-

Table 2
Infants' Activity Just Before, During, and After Mothers' MODEL-TEMPT-RESET Sequences (Percent of 636 MTR Sequences Across all Subjects)

Infant Act	*Passive Looking*	*Pointing*	*Reaching*	*Looking Away*
Immediately preceding	21[a]	35	7	37
During MTR	62	23	4	11
Immediately following	28[b]	40	8	24

[a]Continuously since previous RESET by mother.
[b]Continuing until next intervention by mother.

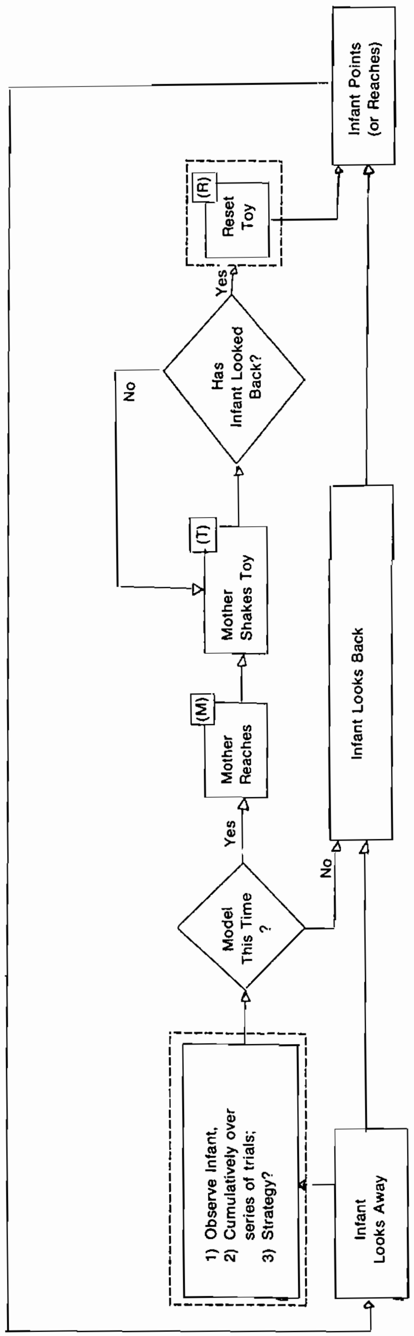

Fig. 2. Model representing temporal relation between infant sequence AWAY-BACK-ATTEMPT and mother sequence MODEL-TEMPT-RESET.

counted for in part by our finding that 25 percent of the models occurred when the infant was still looking away. This is probably an indication that the mothers were reaching for the toy so as to shake it and ring the bell, thus hoping to attract the infants' attention back to the task. But of course in such instances the infants would not have had an opportunity to observe the mother's reaching.

When we ignored the time before each infant first looked away, which was often 15 seconds or more, and the time after he last looked away, which was sometimes prolonged distress, we found that the cycle *look away-look back-look away again* occurred between 7 and 10 times per minute, and this was no diferent during the teaching period than during pretest, posttest, and transfer periods. So the mother's intervention cannot be said to have been responsible for bringing the infant back to the task. Gaze aversion was consistently self-terminating even on the pretest. Although in the teaching period it did elicit a maternal response, which was typically followed by the infant's looking back to the task, the *looking back* could not be said to be contingent upon maternal intervention.

Since MODEL meant only that a mother reached for the toy, a high rate of MODELS did not necessarily mean a high rate of MTRs or, in other words, a *showing* strategy. Sometimes the sequence was AWAY-MODEL-SIMPLIFY; the infant's gaze aversion still triggered an intervention by his mother, but for the purpose of simplifying the task. It is of interest that this maternal response, when it occurred, did so at the same point in the sequence where an MTR might have occurred. The dotted line around the "RESET" step in Fig. 2 indicates that we wonder why the mother sometimes SIMPLIFIES instead. Apparently the behavior categories we used were not subtle enough to allow us to detect the immediate elicitors of SIMPLIFY as opposed to MTR; in fact, there might not have been any such immediate elicitors. When we looked at the rate of simplifying over the whole teaching period, however, we found that it was predicted by aspects of the infant's pretest behavior (this will be discussed in the following section).

HAND-TUGGING did not typically occur at the same point in a sequence where MTR or MODEL-SIMPLIFY might have occurred. Instead, mothers who attempted to pull or push their infants' hands around the barrier did so when the infants were looking at the toy and resting their hands either on the plexiglass (POINTING) or on the ledge at the front of the apparatus. The infants' responses to these attempts were highly consistent, and our experience with other infants as well as children of other ages suggests that it is a fairly universal response: increased tonus, flexion of the arm, resistance to passive movement, and gaze aversion. In addition, some infants cry when their mothers persist with such a strategy; curiously, others do not cry and may even lessen their reluctance over the course of the session, suggesting that the infants might be reinforced by the effectiveness of this strategy at obtaining the toy for them.

There is reason to suppose that the subjects who fell into our *shoving* group did so because the babies allowed themselves to be tugged; it cannot be simply a matter of the mothers' inclinations. At any rate it did not turn out that the *shoving* strategy led to crying. Despite the fact that the infant's negative reaction to passive extension of his arm and hand is so universal and so marked that we almost expect him to cry or scream when his mother persists, our data suggest that mothers relied heavily on HAND-TUGGING primarily when their infants were already crying. This is best demonstrated by the analysis of pretest determinants in the following section. It should be mentioned here, however, that how *early* in the teaching period an infant began to cry correlated .32 with HAND-TUGGING ($p<.025$ two tailed; N = 37 babies who cried). In other words, instead of a pattern in which mothers would try HAND-TUGGING and then abandon it in the face of their infants' distress, it was more often the case that mothers began and/or persisted in HAND-TUGGING *after* their infants had become upset.

In order to give a more vivid account of the interaction of our subjects during the teaching session, we have included in an appendix (in prose translation) our coded observations of one pair.

Pretest Determinants

The two ways in which mothers deviated from the MODEL-TEMPT-RESET strategy were in SIMPLIFYING and in HAND-TUGGING. We divided the number of times each of these responses occurred by the length of the teaching period. We could then ask how the rate of SIMPLIFYING and the rate of HAND-TUGGING were affected by the principal ways in which infants differed on the pretest. Table 3 presents the multiple regression coefficients for each of these dependent variables.

SIMPLIFYING was predicted mainly by the infant's failure to respond to the task on the pretest; none of the 17 mothers whose infants succeeded at all on the pretest fell into the *shaping* strategy group, and few of them even simplified the task once. This suggests merely that the mothers were satisfied that the task was not too difficult for their babies. More interestingly, mothers tended to SIMPLIFY if their infants had looked AWAY a great deal on the pretest, thereby

not even POINTING very much. Recall that in the teaching period SIMPLIFYING (when it occurred) typically followed gaze aversion, though gaze aversion did not most typically lead to SIMPLIFYING.

In the case of HAND-TUGGING distress on the pretest was the major predictor, and as we reported above, the sooner an infant began to cry during training, the more his mother tended to resort to TUGGING. Furthermore, 8 of the 29 babies in the *shoving* group had succeeded on the pretest, and most of the others in all groups, like Lise (appendix), had shown some sign of being close to success, either in the pretest or in the teaching period itself, before their mothers first attempted HAND-TUGGING.

None of the pretest variables predicted the rate of MODELING. This is understandable, since MODELING was coded every time the mother reached for the toy, regardless of purpose. However, the pretest behavior of subjects in our *showing* group was just what should be expected in the light of Table 2: some successes (9 of 37 subjects), less crying than the *shoving* group (NS), and less looking away than the *shaping* group ($p<.025$ two-tailed). Differences among the three basic strategy groups are reported in Table 4. Note that a variable that predicts maternal behavior in the sample as a whole, such as pretest crying, does not necessarily discriminate significantly among the three groups. The result presented earlier, that crying correlated with HAND-TUGGING, was true of all three strategy groups. Each group merely represents one end of a distribution, arbitrarily divided.

Background Variables

The design of the study allowed an analysis of variance with three

Table 3
Standardized Regression Coefficients,
Mothers' Training Techniques, on Infants' Pretest Behavior

Pretest Variable	*Rate of Simplifying (87 d.f.)*[a]	*Rate of Tugging (87 d.f.)*[a]
Number of successes	−.30**	−.0[a]
Crying (% time)	.0[a]	.46***
Away (% time)	.17*[b]	−.16
Point (% time)	−.09	−.05
(Multiple correlation squared	(.17)***	(.25)***

[a]Stepwise regression halted when r^2 increased less than .01.
[b]Significant at .05 level when entered with successes, but drops below significance when pointing is entered.
*p < .05
**p < .01
***p < .001

Table 4
Background, Pretest, and Teaching Variables, by Basic Strategy Group

	Shove (29)	*Shape (25)*	*Show (37)*	*Total (91)*	*Significance*
Sex (boys/girls)	15/14	9/16	18/19	42/49	NS
Screen side (L/R)	14/15	12/13	19/18	46/45	NS
Mother's education level (see Table 1)	2.4	3.0	2.2	2.5	Shape > Show** (60 *d.f.*, *t*=2.81) F(2,88)=3.77*
Pretest successes (mean number)	0.4	0.0	0.5	0.3	Shove > Shape* (52 *d.f.*, *t*=2.65) Show > Shape* (60 *d.f.*, *t*=2.27) F(2,88)=2.89*
Percent of pretest time:					
pointing	38	31	32	34	NS
away	24	31	24	26	Shape > Shove* (52*d.f.*, t=2.11) F(2,88)=2.47
crying	1	0	0	1	NS
Mother's rate/minute, in teaching period:					
hand-tugging	2.9	0.7	0.9	1.5	F(2,88)=35.59***
simplifying	0.8	2.5	0.8	1.3	F(2,88)=33.15***
modeling	1.4	2.0	3.1	2.3	F(2,88)=17.66***

*p < .05
**p < .01
***p .001

Table 5
***F* Values from Analyses of Variance (See Text)**

	d.f.	*Pretest Success*	*Pretest Pointing*	*pretest Away*	*pretest Crying*	*Rate of Simplify*	*Rate of Tugging*	*Posttest Success*
Sex	1	0.93	10.25**	3.06[a]	0.21	1.77	0.07	0.39
Screen	1	2.88[a]	0.83	1.05	0.30	0.80	0.63	0.97
Education	3	1.74	0.75	0.66	0.46	0.85	0.48	0.17
Sex × screen	1	0.84	0.74	3.64[a]	1.17	2.45	0.42	0.37
Sex × educ	3	0.69	0.64	2.63[a]	0.92	0.39	0.44	0.56
Screen × educ	3	1.37	0.88	1.49	0.92	4.29	0.23	1.58
Sex × scr × ed	3	0.13	3.43*	0.13	0.91	0.23	1.10	0.55

[a] $.05 < p < .10$
** $p < .01$
* $p < .05$

independent variables; sex of infant, mother's educational level, and screen side. Recall that half the subjects were trained with the screen on the left (right hand appropriate) and half with the screen on the right (left hand appropriate). Although hand preference is far from being established in six-month-old infants, the study by Kaye, Bruner, and Lyons (Bruner, 1971) found slight superiority of learning when the screen was on the left. In addition, the fact that dominant right-handedness was certain to be found in our sample of mothers led us to control for the variable of screen side.

Table 5 presents F values for the seven dependent variables: number of successes on pretest; proportions of time POINTING, CRYING, and looking AWAY on pretest; rates of SIMPLIFYING and HAND-TUGGING during teaching; and success or failure on the posttest. The full ANOVA tables are condensed here in view of the paucity of significant effects. The marginal superiority of the right hand, on the pretest, was confirmed. The Screen X Education interaction effect upon rate of SIMPLIFYING was curious; with the screen on the left (right hand used) SIMPLIFYING increased linearly with

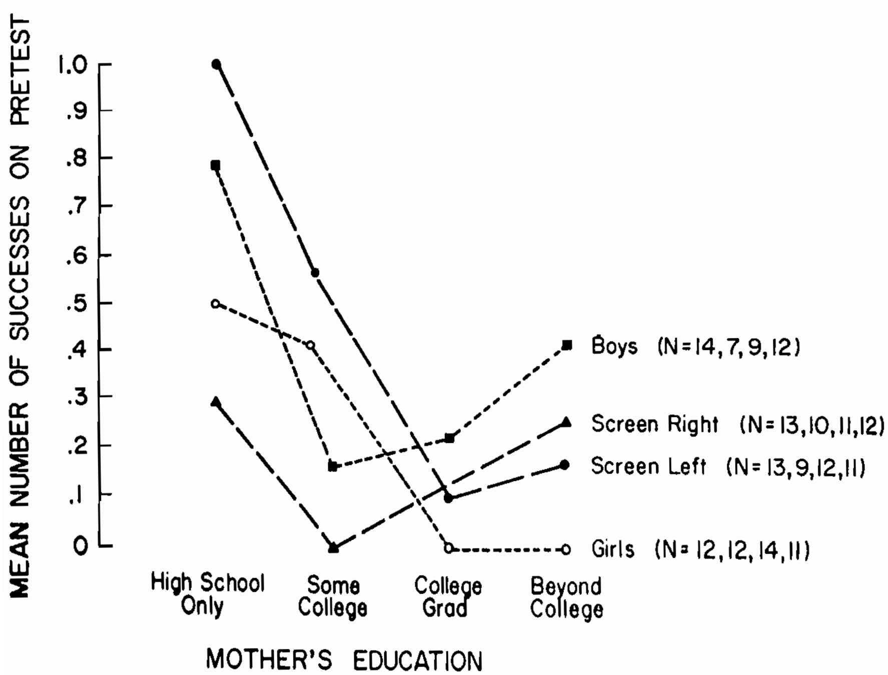

Fig. 3. **Pretest success as a function of social class, sex, and screen side.**

mothers' educational levels, whereas with the screen on the right it decreased linearly. We regard this as uninterpretable. There are two direct effects, however, that might be important. First, boys tended to do more POINTING and less looking AWAY than girls; the two variables, obviously, were intercorrelated (r=−.44). Second, the infants of more educated mothers were less successful on the pretest. This fell short of significance because the effect was not completely linear; but a glance at Fig. 3 shows that the infants in the lower social class were clearly superior in pretest performance.

Either of these two background variables, sex and education, might have been indirectly responsible for the relations between pretest behavior and maternal teaching techniques. The fact that the latter correlations were higher than those between education or sex and the pretest behaviors suggests, however, that the background variables were less important.

This was tested by multiple regression (Table 6). In the path analysis diagram of Fig. 4 the arrows on the left side of the diagram are labeled with standardized coefficients obtained by regressing each

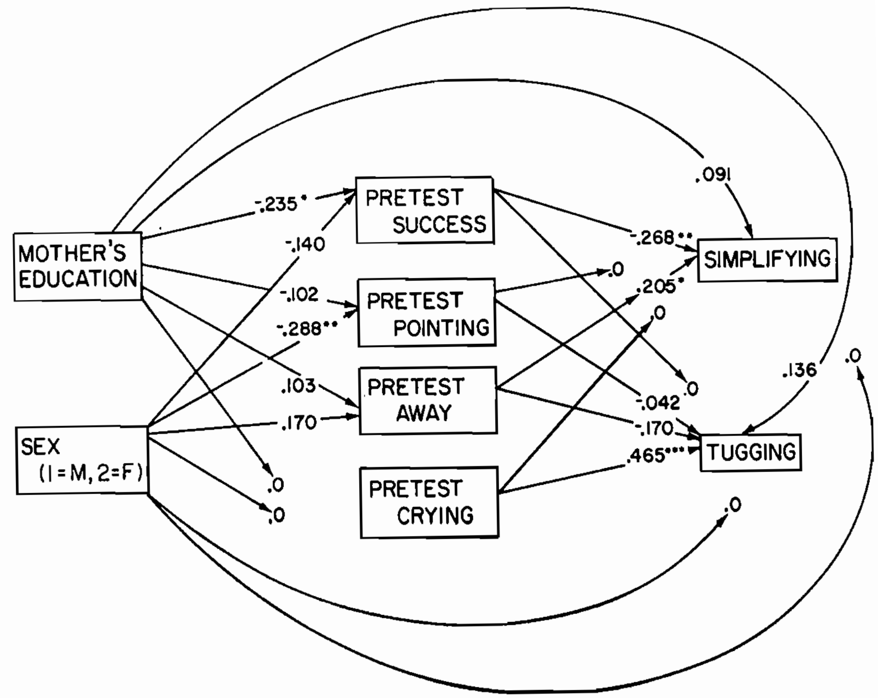

Fig. 4. **Path analysis of effects on mothers' teaching behavior.**

of the pretest variables on education and sex. The arrows extending to the right-hand side of the diagram are labeled with the standardized coefficients from Table 6, which were obtained by regressing each of the teaching variables on all six prior variables.[2] In summary, the mothers were influenced more by their infants' actual behavior in our task than by either their own educational level (social class) or the infant's sex. And entering these two variables, which receive by far the most attention in the literature as probable influences upon maternal behavior, accounted for no additional variance as compared with Table 3.

Table 6
Standardized Regression Coefficients, Mothers' Training Techniques, on Pretest and Background Variables

Prior Variables	*Rate of Simplifying (87 d.f.)*[a]	*Rate of Tugging (86 d.f.)*[a]
Sex of baby	.0[a]	.0[a]
Mother's education	.09	.14
Pretest successes (#)	−.27**	.0[a]
Pretest pointing (%)	.0[a]	−.04
Pretest away (%)	.21*[b]	−.17
Pretest crying (%)	.0[a]	.47***
(Mult. correln squared)	(.17)***	(.27)***

[a]Stepwise regression halted when r^2 increased less than .01.
[b]Significant at .05 level when entered with successes, but drops below significance when education is entered.
*$p < .05$
**$p < .01$
***$p < .001$

Success on the Posttest

Of the 74 babies who failed the pretest, 17, or 23 percent, succeeded on the posttest. Only one variable predicted success on the posttest: number of successes on the pretest. This is indicated in Tables 5 and 7. Multiple regression analysis revealed that neither the maternal teaching variables, nor any other pretest variable, nor the background variables (also tested by ANOVA in Table 4) predicted posttest success.

Success in the teaching period predicted posttest success no better (r−.46) than did pretest success (r−.46) perhaps the most telling result was that for infants whose first success came during the teaching period, the chances were still 3 to 2 *against* success on the posttest. This is shown in italics in the left-hand column of Table 7.

Table 7
Success in Training as Related to Pretest and Posttest Success

	Succeed in Training	*Fail in Training*	*Total*
Succeed on pretest	12	5	17
Succeed on posttest	12	2	14
Fail on posttest	0	3	3
Fail pretest	40	34	74
Succeed on posttest	*16*	1	17
Fail on posttest	*24*	33	47
Total succeed on posttest	28	3	31
Total fail posttest	24	36	60

Did a mother's basic teaching strategy affect her infant's success in the task? Fig. 5 suggests that it did so in only one sense: the initial inferiority of babies in the *shaped* group was eliminated, apparently as a result of the shaping strategy their mothers employed. But we can hardly call this instruction successful, since half the infants who had "learned" by this method subsequently failed the posttest.

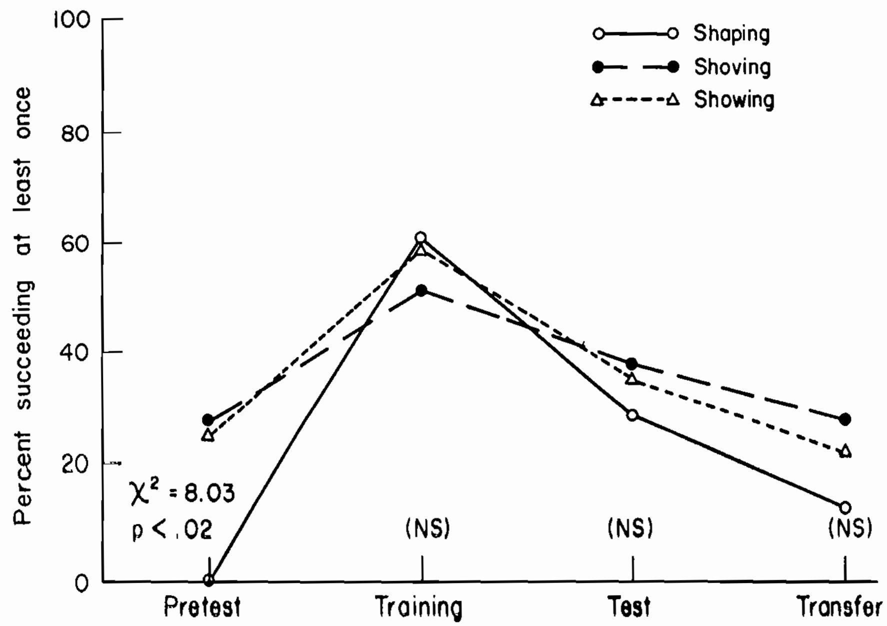

Fig. 5. **Success (at least once) on each of the four parts of the session, for the three basic strategy groups.**

Transfer

In cases of successful learning where I served as the model, we have consistently found positive transfer effects when the screen was switched to the other side, or a new toy substituted, or both (Kaye, 1970). In one case the new skill transferred to the other hand even though we waited several days between posttest and transfer test. However, normally we have not done this, since we had no way of controlling the mother's interventions during the interim. In all of our studies to date success on the transfer test has been less than that on the posttest but better than on the pretest. In the study reported here, however, as indicated in Fig. 5, the transfer success was not impressive and was apparently unaffected by mothers' basic strategies. Nonetheless, when infants who succeeded on the pretest were omitted from the analysis, transfer of the detour reaching skill to the opposite hand was statistically significant beyond the .05 level (Table 8, chi square—5.97).

Table 8
Effect of Initial Learning on Transfer
(74 Infants Who Failed Pretest)

	Succeed on Transfer	*Fail Transfer*	
Succeed on posttest	6	11	17
Fail posttest	6	51	57
	12	62	74

Further details of the infants' behavior on the transfer test help to shed some light on the nature of what is learned in the detour reaching task. The majority of the infants appeared no different on the transfer test than on the pretest; indeed, for those who had not succeeded in learning with one hand we could say that this was simply a pretest for the other hand. (Thus, it is not surprising to find a sex difference on the transfer test, as shown in Fig. 6.) But 28 of the 91 infants did behave in a noticeably different way on the transfer test. They favored either the left or the right hand to the exclusion of the other hand, at least for the first half-minute, a time period during which they would normally, on a pretest, have switched back and forth between the two hands several times for pointing, exploring the edge of the barrier, and reaching into the open side of the apparatus. This was so noticeable that we were able to rate these infants (only when both observers agreed) as transferring either negatively or positively. Negative

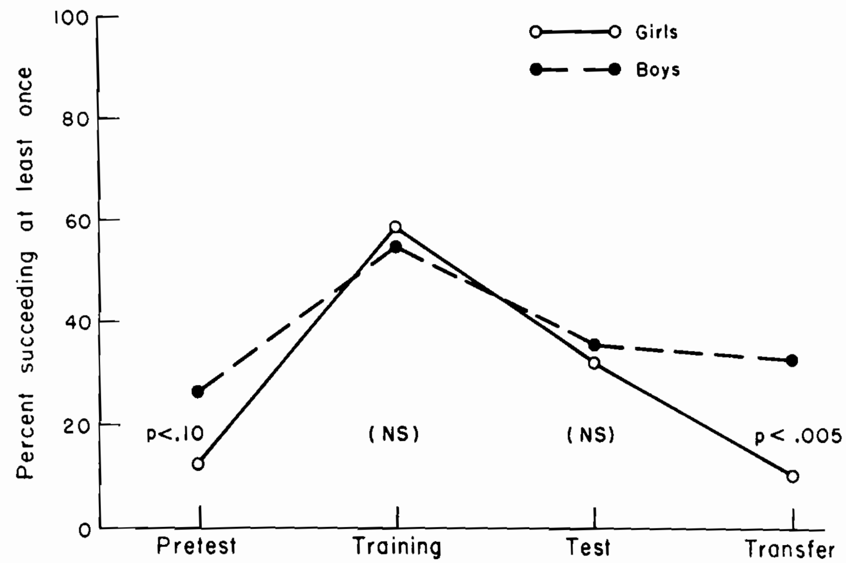

Fig. 6. Success (at least once) on each of the four parts of the session, by sex of infant.

transfer was scored when the infant favored the hand that had been appropriate during training, but was now blocked by the barrier; positive transfer was scored when the infant favored the hand that was now appropriate. These ratings were made regardless of the infants' history of success. The results are shown in Table 9. The numbers italicized in the left side of the table indicate that success on the posttest significantly predicted either negative or positive transfer, as opposed to no transfer at all (chi square=25.46, $p<.001$). Figures in the right-hand column indicate that while only 6 percent of the infants showing no asymmetry of approach to the transfer test succeeded in

Table 9
Hand Preference Noted by Experimenters
During Transfer Test

	Fail Posttest	*Succeed Posttest*	*Total*	*Succeed on Transfer Test*
No asymmetry noted	52	*11*	63	4 (6% of 63)
Positive transfer (open side)	*5*	*10*	15	12 (80% of 15)
Negative transfer (Barrier side)	*3*	*10*	13	3 (23% of 13)
Total subjects	60	31	91	19 (21% of 91)

getting the toy, 23 percent of the negative transfer group and 80 percent of the positive transfer group did so (chi square=39.83, p1.001). Even the advantage of those showing negative transfer (that is, initial transfer to the wrong hand) over those showing no transfer at all is almost significant (Fisher's exact p=.078.)

In summary, the detour solution as learned with one hand did not simply transfer immediately to the other hand, as though there were some sort of mirror transformation of a cognitive map. Nor was it the case that the infants behaved like split-brain preparations. Infants who had been taught to reach around the barrier on one side were able, despite exhaustion and cumulative frustration, to learn the solution on the other side without help. Although this statement accurately describes only a minority of our subjects, we feel it can be inferred that what they learned was *how to solve* a detour problem, rather than merely a set of hand movements.

DISCUSSION

We have tried to describe a composite image of what we regard as the "typical" responses of mother-infant pairs to the detour task, as well as to convey our results indicating that differences in teaching behavior across mothers can be explained to a large extent by differences among their infants. Both the generalities and the individual differences are important for an understanding of early cognitive development.

The basic strategy adopted by mothers in Cambridge—and no doubt, with variations, by mothers everywhere—consists of demonstrating the detour reach over and over again, alternating with pauses in which the infants could make their own attempts. Mothers typically combined their demonstrations with pointing and shaking the toy, to maintain the infants' orientation and arousal, and with the use of their own voice (not studied here) to soothe and encourage as well as to arouse the babies. The two most important things we can report with a great deal of certainty about this strategy are: (1) it is the infant who controls the timing of the mother's demonstrations, their frequency, onset, duration; and (2) the *showing* strategy is often effective. Although posttest performance in this study was no better than pretest performance, a high proportion of the mothers did succeed in the teaching period to do what they were asked to do—get their infants to reach around the barrier and retrieve the toy.

I regard the "typical" picture referred to earlier as more meaningful in this context than the pretest-posttest scores for the various groups. From the point of view of traditional theories of learning, and even from Piaget's account of the sensorimotor period, it is surprising that *any* infants were able to accommodate their detour reach under the "typical" *showing* condition purely by imitation without extrinsic reinforcement. Under a strict behaviorist learning theory this sort of learning could not be explained even for adults (though it is obviously our fundamental way of developing skills); even if we postulate the necessary intervening cognitive processes to mediate the learning, these processes have not usually been attributed to six-month-old infants. Furthermore, by using the *showing* strategy as we saw it employed by a few of our most graceful and relaxed subjects, we have been able to teach 60 to 80 percent of six-month-olds to reach around the detour; we have been able to elicit certain phoneme sequences from eight-month-olds and random sequences of tone or typewriter-key sequences from four-year-olds (Kaye, 1971). The method requires an adult to be willing to keep repeating the desired pattern dozens of times, ignoring (not reinforcing or commenting upon or making an accommodation to) the child's attempts, but allowing the children to signal when they are ready for the next presentation of the model. This signal may take the form, for example, of dropping their hands, as speakers do when yielding the floor (Duncan, 1972); of averting their eyes from the task, as in the present study; or of returning their eyes to contact with the adult (Stern, 1974). We find that it normally takes six-month-old infants sitting in their mother's lap facing the experimenter only one or two trials to realize that the experimenter's "Ba-ba-ba-ba" is under the control of their own eye movements. Operant learning, of course, accounts for this—head and eye movements being the most easily conditioned of infant operants—but it does not account for the fact that many of these infants after twenty minutes or so are saying "Ba-ba-ba-ba" themselves.

For those who wish to try this method, it is the same as the "typical" mother's pattern in this study: let the infants signal their readiness for an MTR, show them slowly, then wait for their own attempts, which will improve gradually over trials (Kaye, 1971).

In the present study the analysis of gaze aversion from the task highlighted the importance of cyclic alternation in the responses of infant and mother. The "turn-taking", or rhythmic attention and withdrawal, has emerged as a pervasive pattern in interaction beginning at birth, an example of the "preadaptation" referred to by Bruner. Kaye and Brazelton (1971) found origins of mother-infant reciprocity in the burst-pause patterns of neonatal sucking, and Brazelton, Koslowski, and Main (1974) studied rhythms of about the same order of magnitude (5 to 10 seconds) in the face-to-face interaction of mothers and infants between one and five months. There is a direct comparison between what we have found in the burst-pause pattern of neonatal sucking (Kaye, 1972; Kaye, in press) and what we find in the present study. During feeding, an infant's pause elicits jiggling or stroking by the mother, which in turn is typically followed by a resumption of sucking. However, while the mother's jiggling is contingent upon the infant's pause, a resumption of sucking is not contingent upon jiggling. In the case of modeling the detour reach at six months, as in the case of jiggling in the first month of life, mothers express a belief that their behavior is instrumental in their infant's resumption of the task; but this conviction is not supported statistically. The infants would look back to the task anyway. It is easy to see sequellae of these early forms of turn-taking in such studies as Bruner and Sherwood's (1974) of the game of peekaboo at one year of age, and in the vast numbers of studies of language acquisition in which the mother-child dialogue is the inevitable unit of analysis.

In all such studies one is impressed by the extent to which infants control their mothers' intervention. In the detour reaching study, as well as in the study by Brazelton et al., the movement by the baby that was most likely to elicit a change in maternal behavior was gaze aversion. In our study, when the infants *first* looked away from the task during the training period, the median latency of their mothers' responses was under 2.5 seconds, with the majority of these responses being MODEL-TEMPT-RESET. Face-to-face interaction, and particularly gaze aversion, have been subject to much study during the first few months of life, primarily because of an ethological interest in the face's innate releasing properties (e.g., Robson, 1967; Freedman, 1974) and a psychoanalytic interest in mirroring as a process in ego formation (Kohut, 1971). Our present concern with gaze aversion, however, is merely one instance of a class of infant responses that signal the appropriateness of adult intervention, and thus at least partly control the instructor.

Yet that control is not so simple that the mother responds every time her infant looks away. As the problematic box at the upper left of Figure 2 indicates (surrounded by a dotted line to suggest a cloud), the mother must be responding to more than just the momentary event. By analyzing differences among our subjects, we found that the teaching session as a whole could also be regarded as under the control of the infants. In the response to gaze aversion, for example, Fig. 7 illustrates the way mothers were apparently integrating two different types of information from their infants: the signal as to when to intervene and the evidence from the pretest (as well as from the rest of the session), which apparently guided the choice of how to intervene. When the infants averted their gaze, their mothers modeled a detour reach if the babies' pretest behavior had indicated the task was within their range of learning, but simplified the task if their pretest had seemed completely hopeless.

Other factors external to the session, such as the mother's education or her infant's sex, must of course also be taken into account in explaining differences among our subjects. But we have tried to show that such factors are often predictive without being causal. It might be noted that Goldberg and Lewis (1969) found differences in maternal treatment of boys and girls at six months, which they regarded as causing or contributing to the development of sex differences in the infants over the course of the next year. Yet the present study and others show that the differences in maternal treatment are themselves based on sex differences already established in the infants. The original discriminatory treatment presumed to cause sex differences might be pursued all the way back to birth or even earlier, but to do so would be to miss the real subtlety and complexity of interactive processes.

What implications do these findings have for a theory of instruction and for Bruner's theory of early skill development with which we began? If we conceptualize the development of a skill as involving the putting together of constituents (Bruner 1971, 1972, 1973), there are a number of functions that a tutor might serve:

Motivating. The tutor can present a problem and provide incentives in the form of encouragement or threats. Presenting the problem may take the form of a verbal or gestural challenge—"Can you do this?" "Can you achieve this result?"—or of physically forcing the learner into a situation where learning is the only escape route. As a child I was told that the American Indians used to throw their children

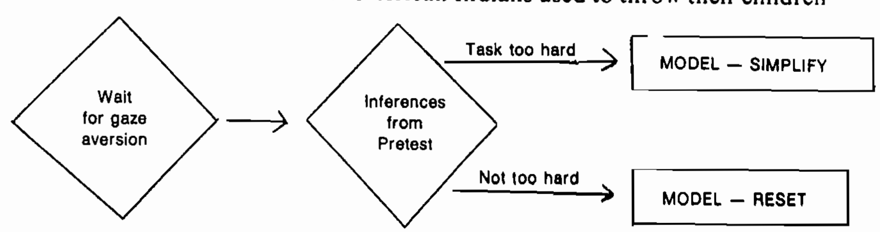

Fig. 7. Process model representing mothers' decisions to simplify or demonstrate the detour reaching task.

into a lake and that those who did not drown learned to swim. (Whether or not this was true the story motivated me to learn to swim.)

Breaking down. The tutor can help break the task down into its constituents. The learner must select from his repertoire of skills those that can be recombined in the new routine. Sometimes the process of recognizing a schema in one's repertoire requires a kind of minipractice, confirming the adequacy of a constituent just by trying it in the absence of competing responses. This is as true of an adult learning to play squash after tennis as it is of an infant learning to pronounce sounds. Often the constituent proves insufficiently mastered. Separate constituents need to be practiced and smoothed, because even though they will have to be reshaped somewhat in integration with each other, each of them must be able to be executed relatively free of attentional monitoring and control, so that attentional capacity can be focussed on the integration of the whole and on the end to be reached. Bruner (1971) has called this perfection of the individual constituents *modularization.*

The selection of constituents can be facilitated by tutors who make them salient, either exaggerating the segments of their own modeled acts or structuring the task so as to elicit separate segments in the learner. By reducing the degrees of freedom in a task they can enable components to be executed singly. And they can maintain an appropriate balance between providing opportunity for practice of the components and pushing for solution of the new problem.

Ordering. Once the constituents are accessible, the learner has to see or hear how to put them together. This is the function served by a model. However, we would not suggest that the modeling wait until the constituents have been identified and perfected. Normally the learner cannot select the right skills from his repertoire until he has a sense of the whole in which they are to be embedded. What he needs from the model, apparently, is a chance to analyze the task by synthesis of recognized parts (Neisser, 1967), and this often means that modeling the new skill is the best means of breaking it down for a learner as well as of ordering the constituents in time. In the development of sensorimotor skills, as in conceptual development, it helps to have "advance organizers" (Ausubel, 1968) that let the system know what it is going to be doing with the information it is storing.

These three types of intervention in the acquisition process can be illustrated in terms of the basic teaching strategies we observed in all of our mothers when they were asked to "help in any way you can." If each mother seemed to be emphasizing one of the three strategies more

than the others, it may have been that her infant was in a stage of acquisition, with respect to the particular task given, which made that strategy more appropriate.

The mothers who used primarily a *shaping* strategy, letting their infants work on the constituents of reaching into the open side of the box and grasping the toy, were those whose infants had shown no sign of being able to solve the problem on the pretest. In fact, they had spent a significantly higher proportion of the pretest averting their eyes from the apparatus. Many of the mothers told us they concluded the task was too difficult; the infants needed to have it broken down into simpler steps, and they also needed to be reinforced and shaped up to the more difficult task. In short, these mothers were concentrating on the *motivating* and *breaking-down* tutorial functions.

Those who depended extensively on *shoving* could also be seen as attempting both to provide encouragement and to emphasize a critical constituent of the task. Considering the influential pretest as a very short history, one can argue that a mother who chose *shoving* as opposed to *shaping* was probably reflecting her relationship with the infant over the preceding six months. This suggests hypotheses for future work, involving bidirectional effects.

Although lacking data about the history of interaction of subjects in this study, we did discover some situational determinants of strategy. If the shoving mothers were trying to make salient a constituent of the task, it was a different constituent from those made salient by the shaping strategy. Instead of simplifying the task, the mothers in this group pushed the babies forward, in time as well as space, so that they could get past the "appropriate hand" and "open side" hurdles so as to work on the "behind screen" constituent. Several mothers told us afterward that they felt that if their babies could only see their hands behind the screen, they would realize that they could get the toy. Thus, making the infants see that the task was within their capabilities was very much part of the motivating process. Mothers tended to use hand-tugging as a last resort after their infants had been frustrated by the task to the point of crying. Their subconscious assumption may have been that it was too late to build up the task step by step, but that getting the baby closer to the solution might still save the day.

As for those who relied upon *showing*, it must be said that they were doing much more than simply presenting a challenge, on the one hand, or modeling an ordered sequence of constituent acts on the other. The whole manner with which mothers modeled the detour reach was clearly slowed down and exaggerated to give saliency to the hand, the trajectory of movement, the open side of the box, the edge of the screen, and the grasping of the toy.

The 91 mothers in our study were implicitly asking themselves questions about the presence of certain relevant skills or parts of the detour reaching skill in their infants' repertoires. An unpublished study by Greenfield and Childs (reported in Bruner, 1969) made use of a completely different task—the embedding of a series of nested plastic cups within one another—with Zinacanteco Indian mothers of children in the second year of life. They found striking confirmation of our general findings: task simplification for children who were at the lowest level, demonstration for those who had used a more intermediate strategy, and physical interference with the children who had already performed the crucial embedding component of the task. "This sensitivity to the child's level is amazing when one considers that it occurs without any sort of task analysis, in reference to a task that is alien to the culture" (Bruner, 1969, p. 25).

Although our mothers' success as instructors was not impressive under the stressful conditions of our laboratory, a prima facie argument has been made that their instructional strategies were highly adaptive. Furthermore, we believe that these mothers had spent the preceding six months not just picking up knowledge about what their babies could and could not do, but more importantly learning to respond to subtle signals in interactive situations of various kinds—feeding, bathing, playing, and teaching. Their infants, too, had been learning to respond to signals as well as to give them. The two together, mother and infant, form an interaction system that undergoes its own development. Our current work attempts to trace the adaptation of such signal systems in a longitudinal sample, with attention both to the "typical" and to the individual patterns of interaction.

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APPENDIX

This pair of subjects is no more "typical" than any other, but it is a good illustration of how easy it is for us to differentiate repetitive sequences in the stream of behavior. We are helped in this account by having a filmed record that provides a few details not normally a part of our observations.

Lise is the firstborn daughter of parents who both have master's degrees. Her father is a pharmacist and her mother had been a teacher. On the pretest Lise spends about 30% of the time POINTING and 46% AWAY; she looks away 14 times, averaging 4.4 seconds each. She never REACHES around the edge of the barrier, which is on the right side of her midline.

The mother begins the training period by SIMPLIFYING, placing the toy so that it is only partly blocked by the barrier. Lise immediately REACHES for it, bumping the screen but groping to the left of it and getting the toy (TOUCH, PLAY). Her mother RESETS it behind the screen, and Lise looks AWAY. As she looks back, her mother MODELS, shakes the toy (TEMPTS), and puts it back in the SIMPLIFIED position, where Lise gets it immediately (RTP). Her mother puts it behind the screen (RESET) but then slides it out to the open area again (SIMPLIFIES) without waiting for an attempt by Lise. At the simplified position Lise reaches and gets the toy (RTP). It is put back, only partly protruding around the edge of the screen (SIMPLIFIED). She gets it easily (RTP). Then the mother RESETS the block behind the barrier, and Lise POINTS and then looks AWAY. The mother MODELS, shakes the toy, and RESETS it (MTR). Lise POINTS, then REACHES and TOUCHES the toy, but withdraws her hand and POINTS.

After another MTR her mother TUGS at Lise's hand for one second; the infant reacts with flexion and looking AWAY. Her mother MODELS, shakes the toy (TEMPTS), and SIMPLIFIES. Lise REACHES, grasps, and retrieves the toy (RTP). It is RESET behind the screen, and Lise looks AWAY. When she looks back and POINTS, her mother takes her hand and guides it around the screen (TUGGING), releasing it as Lise continues the REACH, grasps and retrieves the toy (RTP). Another RESET leads to a look AWAY, during which the mother MODELS, TEMPTS, and RESETS. Lise looks back, POINTS, looks AWAY, looks back, POINTS, and then REACHES and succeeds (RTP). Again the mother SIMPLIFIES so that the toy is only partly behind the barrier; Lise POINTS, REACHES, and takes it out.

So repetitive are interaction patterns within a mother-child dyad that the following paragraph must be read twice, exactly as one would repeat a passage of music:

‖: The toy is RESET by the mother, who waits less than two seconds before MODELING, TEMPTING, and RESETTING again. Lise looks AWAY. Another MTR, this time followed by a POINT and then a look AWAY. Lise looks back, her mother MODELS, TEMPTS, and RESETS the toy, Lise POINTS, then looks AWAY and back, her mother MTRs again, Lise POINTS, looks AWAY, looks back, and her mother MODELS again. This time she SIMPLIFIES, and Lise POINTS, REACHES, grasps, takes the toy out (RTP), and looks AWAY while playing with it. :‖

After the second time through this sequence, the mother RESETS the toy and waits while Lise POINTS. She then takes the baby's hand (TUGS), but Lise resists, looks AWAY, and the hand is released. Lise looks back, POINTS, then succeeds (RTP). When the toy is RESET, she looks AWAY and back, then again POINTS and succeeds (RTP). For the next 100 seconds, however, she will not reach around the screen; six MTRs lead to POINTING and then looking AWAY. Finally her mother SIMPLIFIES, but Lise does not REACH, and when she looks AWAY for four seconds, training ends, at 352 seconds.

Both the posttest and the transfer test are very much like the pretest. On the posttest Lise POINTS 6 percent of the time and is AWAY 39 percent; on transfer she POINTS 16 percent and is AWAY 48 percent.

Note that while Lise got the toy out of the apparatus 12 times, her mother had SIMPLIFIED for eight of these and TUGGED her hand around the edge for one more. So she actually succeeded only three times, and for some reason did not succeed on the posttest or transfer test. This was fairly typical, as the results in figure 5 and 6 will show. (This subject, incidentally, was classified in the *shaping* group.)

Notes

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[1]A path analysis diagram is merely a way of visualizing the results of multiple regression. The six arrows converging on SIMPLIFYING, for example, represent six independent variables that competed with one another to ac-

count for the variance in mothers' rates of simplifying the task. Pretest success (or failure) accounted for the largest share of this variance (albeit only $.268^2$, or 7 percent); time looking away during the pretest accounted for about 4 percent additional variance after partialling out pretest success; and error variance, or other variables not measured in the experiment, accounted for the remaining variance.