

# Comparative Preschool Study: High and Low Socioeconomic Preschoolers Learning Advanced Cognitive Skills

by Siegfried Engelmann

## Foreword

During the summer of 1964, the investigator, Siegfried Engelmann, a research associate with the Institute for Research on Exceptional children at the University of Illinois, worked with two groups of preschool children, teaching them content that would be highly unfamiliar to any preschoolers. The children in Group 1 were African American children of lower socioeconomic status (SES). The children in Group 2 were Caucasians of higher SES.

On every working day during the experiment, the investigator worked with each group for about 20 minutes. The concern in 1964 over children who experienced “cultural deprivation” made the experiment important in two ways. It provided a detailed comparison of two groups that were to be taught the same content. The content required children to learn “formal operations” as described by Piaget. The goals of the study were to demonstrate the extent to which a) preschool children could learn formal operations, b) the learning patterns differed across the two groups, and c) the type of mistakes and problems children had in learning the content.

The instructional objective of the study was to see if the children could pass a test that required them to play detective and figure out what happened to a teeter-totter that had a freshly painted top surface. It had been left level and now one side was down. To solve the problem the children had to first consider the two ways the teeter-totter’s position could be changed (push up on one side or push down on the other). Then they had to use evidence about the paint to figure out whether somebody pushed up on one side or pushed down on the other side. During training, the children never encountered this problem, but they worked with others that are parallel in structure.

The investigator’s daily log starts with a set of predictions that were made after both groups had been taught during four sessions. These predictions indicate which children the investigator believed would be able to pass the posttest problem. Following the investigator’s observations and predictions are the summaries the investigator wrote each day after working with the groups. The first summary tells about day one of the experiment, June 23, 1964. The last summary was for August 6, 1964.

*The investigator’s remarks have not been edited for current usage. African American children are referred to as blacks. Low SES children are referred to as being “culturally deprived.” Some of the investigator’s predictions about what the children would be able to learn were correct. Many weren’t. The daily log describes the changes in the investigator’s knowledge as much as what the children learned.*

*During this study, the investigator learned many important principles that shaped Direct Instruction. As repeated entries show, the investigator's teaching practices and exhortations were appropriate for the high-SES children but were inappropriate for the low-SES children. By the end of the study, the investigator had learned many details about the language deficit of at-risk children and reasonable places to start instruction with them. He had learned about the dangers of rote learning in instructing them, about the need for homogeneous grouping, and about the need for a higher degree of mastery for at-risk children than for more advantaged children. Finally, he learned a great deal about the relationship between the children's level of motivation and their performance on challenging tasks. The self-image that children held was clearly shaped not only by their performance, but also by how well they performed in comparison to others in the group.*

## Observations and Predictions After First Four Sessions

Subjects in Group I, Tot Lot Nursery School, 5 members (Low SES)

1. Eric S., Age 5

Bright and verbal. Learns fast. Good self-confidence. Good application. Should pass criterion problems with no trouble.

2. Ramona S., Age 5

Bright and verbal. Learns fast. Good self-confidence. Good application. One of the helpers at the school has known her since she was a toddler, and commented, "She always was a smart one." Should pass the criterion problems with no trouble.

3. Junior C., Age 5

Bright and verbal. Learns reasonably fast. Fair self-confidence. Protects himself by clowning quite a bit. Poor application. He should be able to pass the criterion problems if he gets more serious about the task. Would guess that he'll succeed.

4. Debby R., Age 5

Not extremely verbal. Learns fast but has been cast into the role of the good quiet little girl. When she plays with other children, she rarely talks. Instead she takes a passive, silent role. Application is good. She is extremely motivated and has indicated on several occasions that she thinks and thinks about what we've learned before she goes to sleep at night. Her self-image is not too conducive to learning. She has a ready-made excuse, "I got mixed up," and she uses it whenever the task is taxing. She is not as verbal as a child should be to succeed in propositional type learning, and I would have not selected her, except that she was one of the best available. She may pass the criterion problem. Maybe.

5. Sherry H., Age 4

Not too bright, not too verbal. Is sorely lacking in prerequisite skills and therefore learns slowly. She is quite rigid in her use of the concepts and phrases presented. She uses them as song lyrics. She doesn't know quite when to start singing, because she doesn't know how to ask herself the right questions about what she knows, what she doesn't know, what work signifies what, etc. She apparently doesn't recognize words as building blocks. Rather, she seems to view a phrase as a thing that must be transported *en bloc*. Her motivation is apparently good. She behaves much like a chronologically younger child who is trying to stay interested in something, but just can't quite cut it. I don't know how fast she will be able to pick up the prerequisite skills. At this point I would guess that she will not be able to learn enough in time to pass the criterion test.

Subjects in Group II, Playtime Nursery School, 5 members (High SES)

1. Lynn S., Age 5

Bright and verbal. (Lisps.) Learns fast. Good application. Reasonably good self-confidence. Should pass criterion problems with no trouble.

2. David F., Age 4

Bright and verbal. (Has tendency to stutter.) Learns fast. Reasonably good self-confidence. Fair application. He attends to tasks when he is performing, but he loses interest when the others are working. Should pass the criterion problems with no trouble.

3. Audrey W., Age 5

Fairly bright. A little shy on many verbal skills. She is thought to be very smart by the nursery school teacher because she reads. The investigator would rate her as not the brightest in the group. Application fair. Confidence, good. Should pass the criterion problems with no trouble.

4. Ellen R., Age 5

Bright and verbal. She has been in with the group only during the last two sessions. She caught up quickly. Good self-confidence. Good application. She should pass the criterion problems with no trouble.

5. Eran G., Age 3

I selected members of the group on the basis of the nursery school teacher's evaluation of which children were the most verbal. I was reluctant to consider Eran, but the teacher insisted that he was quite verbal. He is. He is nearly the quickest in the group. On some tasks, his sheer lack of years is evident, but he has no trouble learning the phrases and "rules." He has no trouble using them. If he continues at his present pace, he should have no trouble with the criterion problem. However, perhaps the tasks that are to come will prove too much for him. I think he'll make it.

Tuesday, June 23, 1964

**Tuesday, June 23, 1964**

The investor spent twenty minutes with each of the groups today working on the following tasks:

1. The same

He made two marks on the board with different colors. Then he asked, “Are these the same?” He repeated with four or five different combinations, some the same, others not the same. He encouraged the subjects to talk loudly, “Come on, say it. Are they the same?... Say it...yes, they’re the *same*.”

2. If-then rule

Then the investigator introduced the first if-then rule to the children. “Are these the same?... No...Well, if they’re not the same, *they must be different*.” He had them recite the rule in unison (in response to different examples he put on the board). And then, he had them say the rule individually. “Say it: If they’re not the same, they must be different.” Each group spent about five minutes applying this rule to different examples.

3. Longer and shorter

The investigator defined these concepts operationally. He drew a line on the board and then showed how the line can be made either longer or shorter. “Look. How do I make it longer? I just draw onto it. How do I make it shorter? I just erase part of it.” He then asked each of the children to explain how he made the line longer.

4. The same length

The investigator drew two lines on the board and asked the children to tell which one was longer. The children could tell that the lines were the same.

5. If-then with longer and shorter

The investigator drew two lines horizontal of the same length on the board. He then erased part of the lower line. “Are they the same now?... Good. Which one’s longer?... Which one’s shorter?... Good. Here’s a rule. If one is longer, *the other one must be shorter*.” He had them recite the rule in unison, and then he began erasing the line a segment at a time, making the top line sometimes longer than the bottom, sometimes not. He asked each child to tell which one was shorter and apply the rule. “If this one is shorter....” He repeated the exercise, asking which one was longer.

6. If-then, parts, and whole

The investigator then raised the question about how one knows whether or not two things are the same. He gave the rule, “When the parts are the same, the whole thing is the same.” He drew a diagram on the board—two rows of “cookies”

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Tuesday, June 23, 1964

He asked if these rows were the same. The children agreed they weren't. "But how do you know? Let me show you. Use the rule: If the parts are the same, the whole thing is the same. If the parts are the same, there's a part in the top row for every part in the bottom row." He demonstrated by drawing lines from each cookie in the top row to each cookie in the bottom row. (In Group II, he sensed that the children were getting a little bored so he demonstrated the application of this rule to various forms. He drew several asymmetrical blobs on the board, then he asked if they were the same. The children didn't know. So he showed how to figure it out by applying the rule. If the parts are the same, the whole thing is the same. See this part?... It isn't the same on this one. The parts aren't the same.")

He had the group repeat the rule in unison and individually.

He concluded the session with a brief review pointing out the rules and how they apply. He said each rule before allowing the children to attempt it.

### **Progress**

*Motivation.* Group I seems more highly motivated than Group II. When the subjects in Group I were told by the investigator that they were chosen for the experiment because they were very smart boys and girls, they beamed. Subjects in Group II seemed far less impressed with the statement.

*Learning pattern.* The pattern of learning rules seems to be easier for the subjects in Group I than those in Group II. The investigator introduced rules with a kind of beat. He began tapping his feet. Then, in cadence, he said, "If this one's bigger, this one must be smaller." The children responded admirably to this presentation. Not so with Group II (three subjects in Group II responded; two didn't). The subjects in Group I got more of a charge out of saying the rules.

*Learning rate.* Surprisingly, the groups are about the same after the first lesson, especially when one considers the difference in general verbal skills between the groups. Only one member in Group I knew his colors, while every child in Group II did. The members of Group I use language far less while playing than those in Group II; and the level of verbal performance is quite obviously higher in Group II. Yet, both groups are about the same at this point.

### Wednesday, June 24, 1964

The investigator spent twenty minutes with each group today, working on the following operations and concepts:

#### 1. Review of previous material

*The same color, the same length.* Group I was confused about the notion of the same, so the interview dramatized the difference by making chalk-mark pairs on the board, some of the same color, some of different colors. Each member was asked to describe the various pairs.

#### 2. How do you change a line?

The investigator drew a long horizontal line on the board. He then explained that he wanted to change it and asked how that might be accomplished. He demonstrated that he could make the line longer by drawing onto it, and make it shorter by erasing part of it. The children then had a chance to dramatize the two ways you can change a line by holding their hands up, holding an imaginary line between them. Then they were instructed to make the line longer, and make it shorter. Finally, each child was asked to explain how you can change a line.

#### 3. Limiting conditions were introduced

The investigator drew a model on the board, in which the horizontal line is contained between two vertical lines. This is the basic isomorphic form for limiting conditions.



After explaining the arrangement to the group, the investigator demonstrated what happens when you change the horizontal line. He stressed these notions. “If you make it longer, it goes past this line. It sticks out like a diving board. If you make it shorter, it doesn’t even reach the line.” The class repeated these possibilities in unison and then individually.

Then the group played detective. The investigator explained that he would change the line and the group would have to figure out how he changed it. He reminded them of the possibilities. If you make it longer, it will go past the line. If you make it shorter, it won’t reach the line. The investigator presented examples. Each member of the group had a turn. When they gave a correct answer, they were asked, “How do you know?” The only acceptable answers were either, “Because it sticks out past the line,” or “Because it doesn’t reach the line.”

#### 4. Review

The investigator went over the material that had been presented during the session: the same, the ways you can change a line, and how you can tell if a line has changed.

#### **Progress**

*Motivation.* Both groups seemed about equally well motivated. Group II is more blasé in its attitude, but the members seemed eager to have a session.

*Learning.* Group I seems to be able to incorporate phrases every bit as readily as Group II (if the words are quite familiar). But Group I seems to use the words more like song lyrics than a concept signifier. For instance, when the investigator put two marks of the same color on the board, Group I answered the question. “Are they the same?” with the chant. “If they aren’t the same, they must be different.”

They can learn the phrase, but they do not understand the operations required to use it properly. The investigator spent about five minutes explaining these operations. “The first thing you do is ask yourself a question. You ask what you know about those lines. You look at them and say, ‘What do I know?’ You ask yourself, ‘Are they the same?’ And then you answer yourself, ‘Yes, they are the same.’ You ask a question, and you answer the question.” He then presented different examples, showing how to ask the question. “We ask ourselves, ‘Are they the same?’ And what do we answer? ‘No.’ ‘Well, then,’ we say, ‘If they’re not the same, they must be different.’”

At the end of the session, the investigator reminded the group members to ask themselves questions. “That’s the secret of being a big thinker. Ask yourself questions. Talk to yourself.”

At the present writing, the investigator feels that the deficit in the fundamental operations of language is severe in the first group. He realizes that he introduced the “rhythm” notion and thus encouraged the children to associate the phrases with song and other sheer rote material: but he feels that the children show a *definite lacking in the ability to use language as something to examine and think about and a definite deficit in fundamental language operations.*

One boy in Group II has a crippling concept deficit. If it continues in its present direction, he will be severely handicapped (see the report on the various subjects for details). The investigator feels that it would be wise to drop him from the group. The investigator cannot gear the pace of the group to his performance, and he apparently can’t keep up with the group. This boy needs to acquire confidence in his ability to handle concepts. He probably won’t get it in the group, because it is quite evident that he’s behind. The investigator will do what he can to see that the boy gets tutored in fundamental concepts outside of the group.

*Learning speed.* Group II is moving ahead of Group I. At least a part of the reason for this advantage is that they received a smoother presentation. The investigator irons out some of the rough spots on Group I and then gives a better presentation for Group II. A



Wednesday, June 24, 1964

greater part of their advantage, however, stems from their ability to use words as “cognitive objects.” They understand the fundamental operations of “Ask yourself if it’s a dog. If the answer is *yes*, it’s a dog.” Group II is less rigid, far less “rote” and more apt to answer with the correct “because.” In Group I, on at least two occasions, a child answered with the wrong rote phrase. “How do you know that it’s longer?” “Because they’re the same.”

The investigator hopes to correct the nascent deficit in Group I by stressing the notions of how you *use* these phrases.

## Thursday, June 25, 1964

The investigator spent about twenty minutes with each group.

### 1. Review of *same*

Investigator drew pairs of chalk marks on the board. Both marks were the same color in some pairs, different colors in others. Each child was asked whether a pair was the same. If he answered, "No," he was encouraged to say, "If they're not the same, they must be different." After the exercise, the investigator explained that you always start with what you know. "You start out by asking yourself a question. What do I know? I know they're not the same. So I can say, 'If they're not the same, they must be different.'"

### 2. Longer and shorter

The investigator drew two horizontal lines of the same length on the board. He asked the group to tell about the members. He then made one line shorter than the other. "Tell me about this one." If the child answered that it was longer, the investigator then asked him to tell about the other member. "If this one is longer, this one is shorter." The groups worked in unison. Then each member had several turns.

### 3. How can a line change?

The investigator drew a line on the board and asked how to change it. Each member had several turns. The rule that was stressed is that you can change a line either by making it longer or by making it shorter.

### 4. What happened?

The investigator drew the model on the board.



He then concealed his activity from the group and changed the horizontal line. Each member was asked to tell how it changed. They were then asked, "How do you know it's shorter (or longer)?" The correct answers were stressed. The children repeated them, individually, and in unison.

### 5. The word *because*

The investigator explained, "You use it to tell what you know. If somebody asks you 'How do you know that those lines are the same?' You say, '*Because* they begin in the same place and end in the same place.' What do you say?..."

Thursday, June 25, 1964

## 6. Deductions

Finally, the investigator demonstrated some of the practical applications of what the children had learned. “Okay, let’s say that a guy comes up to you, David, and he says, ‘I’ve got two boats. One’s shorter.’ And so you say, ‘The other one must be...’” “Situations of this pattern were given to each member. He was requested to apply what he had learned to figure out the answer. “It’s just like the problem we’ve been doing. If one’s longer, the other one has to be shorter. You can always figure it out.”

### **Progress**

*Motivation.* The difference in motivation at this point seem more explicable not in terms of Group I or Group II, but in terms of the dynamics of the individuals in the group. In the investigator’s opinion, at least two of the children in Group I are more strongly motivated than any member of Group II (except for perhaps Lynn).

*Learning.* The tasks presented today represent basically a review of what has already been studied. There was no significant difference between the groups in ability to handle the concepts. Group I seemed to respond well to the explanation of how one knows when to use the various concepts, how one knows when to say if-then and when not to. “You start out with what you know. You ask yourself, ‘Are they same?’ If the answer is *yes*, you say, “Yes. They’re the same.’ If the answer is *no*, you say, ‘They’re not the same, so they must be different.’ But you always start with what you know. And you can find out what you know by asking questions.” Group II seems a little more flexible in the use of the concept presented so far, but Group I may be more accurate, less sloppy. Too early to tell.

*Learning speed.* About the same for both groups.

## Friday, June 26, 1964

The investigator spent a little longer with each group today bringing the total time to about thirty minutes for each group. There were two reasons for the longer sessions.

1. The session was being recorded on tape, and the investigator wanted to demonstrate the fundamental approaches to the concepts. 2. The investigator felt that since he would not be with the children for two days (until Monday), they would benefit from a quick review.

The concepts studied were

### 1. Review of the same (color)

Pairs of marks were drawn on the board. The investigator asked each member to identify several pairs as either the same or "If they're not the same, they must be different."

### 2. What can I do to change a line?

The children reviewed the notion that you can change a line either by making it longer or by making it shorter. The investigator changed the line and the children were asked to tell what change took place.

### 3. If this one's longer, this one must be shorter

The investigator drew two horizontal lines on the board, one beneath the other. He then proceeded to change the lines, making one shorter in relationship to the other. He would ask different questions, such as "Which one's longer?" or "What about this one? Is it longer or shorter?" Then he would relate the answer to the other line, "If this one's longer, this one must be shorter."

### 4. How did the H model change?

The investigator first showed the various ways that the H model can change. He stressed the idea that you can tell how it changed by relating the horizontal line to the vertical line. "How do you know it's longer? Because it sticks out past the line." He then put a series of 6 H's on the board each showing different changes that had occurred. The children were asked to tell what happened, and tell how they were able to tell that it happened.

### 5. Rule inversion

The investigator gave them explicit instructions in converting propositions from the form, "If A moves, B moves" to "If B moves, A moves." He introduced the game of detective, in which one starts out with a rule, such as, "If you get into the jam, you'll get jam on your hands." Then the rule converts to "If you've got jam on your hands, you got into the jam." The investigator then pretended that one member of the group had jam on his hands. "What do you know? What's our rule? If you get into the jam, you'll get jam on your hands. *And* if you've got jam on your hands, you got into the jam. *He's* got jam on his hands, so..."

Each member had at least one turn with each of the three situations. The class recited the rules in unison.

Friday, June 26, 1964

The investigator closed each session with a pep talk and a statement about how smart his subjects were.

**Progress**

*Motivation.* Group I seems more highly motivated but less capable of a sustained effort. Members seem to “tire” more quickly than in Group II; members are more apt to say, “I get mixed up.”

*Learning.* There are some apparent differences in the approach to concepts. Group I seemed to take to the detective kind of reasoning better than Group II. Perhaps because the type of reasoning seemed more novel to them, while it may have been prosaic for at least some of the Group II members.

*Learning speed.* No great differences apparent. Group I’s deficit is not nearly as noticeable as it was during the second lesson. Members are catching on to the notion of using words as “playthings.”

### Monday, June 29, 1964

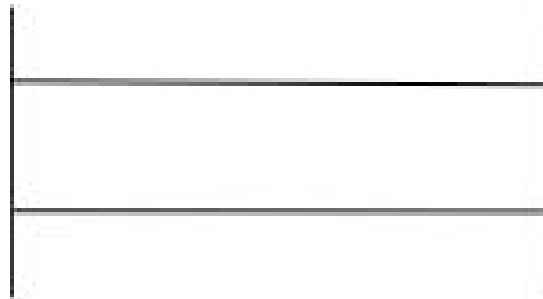
The investigator spent slightly less than twenty minutes with each group, working on the following tasks:

#### 1. If the parts are the same, the whole things are the same

Cookie diagram on the board. One row was changed so that it had either more or less cookies than the others. The children were asked to make the rows the same. (The only way introduced was to add cookies. During the next session, they will learn that you can also take cookies away.) The task was related to the rule: If the parts are the same, the whole things are the same. “What’s the rule?... Are the parts the same? No, so these rows can’t be the same, they must be different.”

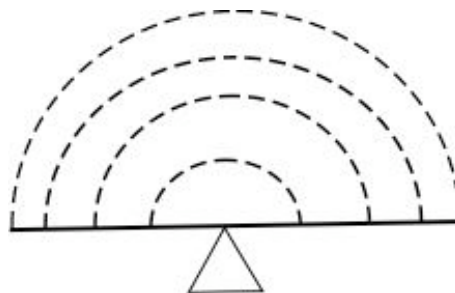
#### 2. The double-H model

The double H model was introduced. The children were asked to describe all of the possible changes (assuming that they are taken one at a time.) “What about the top line? Can it change? Sure...How can it change?... Okay, now everybody gets a turn to tell me all of the ways in which the lines can change.” Next, the investigator concealed his activities from the group and changed one of the members. He then called on group members to tell: (1) which member had changed, (2) the manner in which it changed, and (3) how one can tell that the change occurred. The groups handled the problems with no trouble.



#### 3. The balance board

The investigator drew a diagram of a balance beam on the board.



Monday, June 29, 1964

He explained the notion of center. "The center is the place where the board is the same on both sides. If you cut the board in two right here, and put this part on top of this part, they would be the same." He further relates the notion of sameness to the previous part whole task. "For every part on this side there is a part on the other side." He demonstrated by drawing arcs that intersected the board at approximately the same distance from center. "If the parts are the same, the whole things are the same, so this side must be the same as this side."

#### 4. The arrow

The investigator provided an operational rule for interpreting arrows. "You pretend that the arrow is your finger. Here's the end of your finger. So you just follow your finger and go that way."

#### 5. Rule for the balance board

If one side goes higher, the other side goes lower. After the rule was introduced and the investigator was reasonably certain that the children understood why it held true, the children were each given a chance to apply the rule and explain what would happen, given a certain condition. "If this side goes *up*, what happens to the other side?"

### **Progress**

*Motivation.* The members in Group I are less enamored with the sessions than they were during the first week. One boy wasn't keen on the idea of having a session today. He worked hard, however, once he decided to join us. He's a smart boy, but if he gets too sluggish and petulant, the investigator will drop him from the group. Group II is giggly but tractable, with more attention trouble.

*Learning.* The characteristic difference between the two groups seems to be that Group I is more rigid in the use of the "rules" presented. This rigidity probably reflects their deficit in language games. Group II immediately caught onto the idea that if one side of the balance beam went down the other would go up, but this same point was not equally obvious to Group I. Even after considerable demonstration, the investigator felt that at least one member of the group was still a little hazy on the concept. However, the members of Group I, even the girl who is shy on understanding, learned the rule as quickly and efficiently as the members in Group II. A way to test the relative rigidity of the two groups would be to explain a given rule, teach it, and then present situations in which either the new rule or another rule applies. The investigator feels that members of Group I would have a stronger tendency to use the last rule presented, while those in Group II would pay more attention to the salient cues in the situation. Group I is lacking in the ability to ask questions and generally ask the questions, "What do I know? And how do I know it?"

*Learning speed.* The overall rate of progress (as far as the task has been defined to date) is about the same for both groups.

## Tuesday, June 30, 1964

The investigator spent about twenty minutes with each group. Only three members of Group I were present (Eric, Junior, and Ramona). All of Group II was present.

### 1. How do you make two rows the same?

The investigator drew two rows of cookies on the board, one over the other. He then asked the children whether or not the rows were the same. How did they know that they were not the same? (Because if the parts are the same, the whole things are the same, and one of the row has more parts—cookies—than the other. The children were asked to tell how they could make the lines the same. The rule was demonstrated that you can either take cookies away from one row or add cookies to the other until there are parts in one row for corresponding parts in the other. The rule was then tied in with the notion of the longer and shorter line. “Look, I can either make this one longer; or I can make the other one shorter.” Thus the notion of the two ways to achieve a balance was given another expression. The children had already learned something balancing two lines. They will receive additional exercises with the parallel line system.

### 2. Two ways to move a balance board

The investigator reviewed the basic rule that describes the action of a balance board, “If one side goes down, the other side goes up.” Then he demonstrated the action of a system using an actual board, which he held up against the black board when he made his points. The investigator is not an advocate of demonstrations with the “concrete things” unless the things are capable of communicating basic concepts, which the children could not fully grasp from an abstraction. Such a concept is the notion of rigidity and how it functions in producing changes when the rigid object rotates around a center point. It is not at all obvious to the child that when one side goes down the other goes up. He can recite the rule, but he is not used to dealing with “centered” objects. He knows that a board is basically the same on either end. You can pick either end up, swing the board around by either end, etc. The child has formulated the general rule that any “proposition” you can make about one side applies to the other—the same proposition. Now, the investigator introduces the notion that the same proposition doesn’t apply to both sides of the board. The child can recite the rule, but he can’t understand the logic. And the logic takes a little time to soak in. He’s got to learn that the basic rule about rigid objects is not entirely adequate. It applies only when the object does not pivot around a center.

The investigator demonstrated the rule “if one side goes up, the other goes down.” Then he showed the two ways to achieve a change in the system. He drew a large arrow to show the direction in which he wanted the balance board to move. Then he demonstrated that the change can be achieved either by activating the near side or activating the other in the opposite direction. You can make this side go down either by pushing *down* here, or by pushing up on the other side.

Each child had several turns in describing the ways in which a given change can occur. They have a rather hazy grip on the rule. The investigator plans to go back to the line



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system and start developing the analogy of change. You can achieve a change either by making one line longer or the other one shorter.

### 3. Detective

The children reviewed familiar “rules” of detection. Turn the rule around.

#### **Progress**

*Motivation.* Group I seems more uniformly motivated than Group II. Group I members become engrossed in activities they enjoy (such as detective), but they have a tendency to interpret uninteresting demonstrations in terms of experiences that are more enjoyable. “That’s a bed you drew. That’s just like my brother’s bed. I go on teeter-totter all the time. There’s a bunch of them over at...”

*Learning.* Group II had slightly more trouble with the basic concept of changing the balance board than Group I. Although once the group caught on to the demonstration with the actual board, they had less trouble understanding the diagram than members of Group II. The difference was slight. Both groups balked at the notion that you can change the board by pushing up on the other side.

*Learning speed.* Not any appreciable difference, although the least adept members of Group I were not present today. They will most probably suffer from the lack of practice, which means that the investigator will probably have to spend at least one more session on the material covered today. That may put Group I a session behind Group II.

Wednesday, July 1, 1964

### Wednesday, July 1, 1964

The investigator spent about twenty minutes working with each group. All members of Group II were present. Debby was absent from Group I. These are the tasks that were presented:

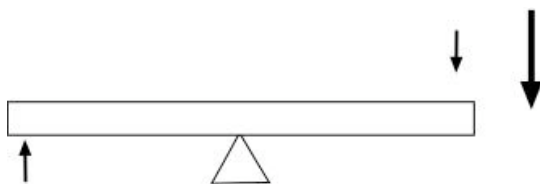
#### 1. Review of higher-lower

“The ceiling is high, and the floor is low.” The investigator put two dots on the board, one higher than the other. He then asked the children to identify each, and he showed the kind of deductions that are possible. “If this one is higher, this one is lower.” The children were given turns at making deductions.

#### 2. Balance board problems

The investigator presented the balance board diagram and reviewed the basic principle of operation. “If this side goes higher, this side must go lower.” The children recited the rule in unison and individually. Then the investigator reviewed the idea that a change in the system can be achieved by acting in a different manner on either member. Group I had trouble handling this notion and so the investigator spent most of the remaining time trying to clarify the point. He used a board and had each child move it first on one side, then on the other, to demonstrate the operation. He asked each how they could achieve a given change.” I want this side to go up.” And they were required to show and tell how the change might be achieved. They were reluctant to tell and they were sometimes confused about the basic principle involved.

Group II went on to further deductions about the balance board (working from a diagram only). The investigator described a change that had happened. He put a large arrow on the board to illustrate the change. He asked the possible ways that change might have taken place. Then he introduced the limiting condition. The side I touch is the side I push on. If I touch here, I push up on this side. If I push down over here, I push down on this side.



He touched the board and then asked, “What must have happened? Use the rule. The side I touch is the side I push on.” The children had no trouble applying the rule.

#### 3. Change in the double-H model

The investigator tried to make the point that the principles of change that apply to the balance board apply to the double-H system. He drew two horizontal lines on the board and asked how he could change those lines so that the top one ended up longer than the

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bottom one. "I can either make the top one longer, or I can make the bottom one shorter." Group I had some trouble with this concept.

*The numbering of tasks shows that the investigator did not present the same tasks to both groups. 2-4 signifies the fourth task presented to group 2.*

#### 2-4. Detective

To round out the lesson with Group II, the investigator played detective. "If you touch the chalk, you'll get chalk on your hands. If you've got chalk on your hands, you touched the chalk. You've got chalk on your hands, so you touched the chalk."

### **Progress**

*Motivation.* Group II is more solidly motivated. Members seem to be developing a sense of esprit de corps, which is lacking in Group I. One reason may have something to do with attendance. Four members of Group I have been absent at least one day, two have been absent two days. No member of Group II has yet been absent.

*Learning.* Group II is definitely ahead of Group I. Members of Group I seem to find it difficult to collect ideas that are separated in space. They can work the double-H problems in which the elements are used in drawing conclusions are physically juxtaposed. Where they are spread out, these children seem to have trouble "Looking at this and telling me what this one over here is doing." They want to look at the object they are considering (*object* to mean any kind of presentational element). When they move from one attention point to another, they want to move their reasoning pattern as a lump. If they are talking about going down on this side, they want to talk about going down on the other. The extended physical distances seems to reveal this difference in conceptualization. Apparently, when the objects are closer together, these children have less difficulty appreciating relative change. When the distances increase, however, a new trick is involved, and this trick is hard for them to handle. They've got to set up their reasoning for one of the objects, and then keep this system running while they mentally run over to the other object and apply the appropriate pattern over there. They seem to lack the ability to leave the first pattern running without bringing it with them. They then find themselves applying the original pattern to the second object.

Group II does not have this problem. They apparently have the ability to keep one line of reasoning going while the other is in neutral. Why, I don't know. I'll have to think about this further and consider the possible basis for developing the skills.

The effect is obvious, however. The members in Group I have trouble attending to the consequence side of the bar if the change is occurring on the other side. "Now, watch what happens over here when I push up on the other side... No, watch over here... No... You watch here, while I push up on the other side."

Perhaps this symptom is an indicator of cultural deprivation. If it is, it should be reasonably easy to test. A simple test could be constructed in which the child is required to perform an act that is cued by an action of the operator. These tasks could vary in

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complexity and could rely on varying degrees of verbal skill. “When I put this block down, you pick your block up. When I say, ‘No goats’, you say ‘Dogs.’” The result of the apparent “independent scanning tracks” of the Group II subjects might be related to the recent findings in other types of scanning.

*Learning speed.* Group II is showing greater speed in learning the new tasks. Members are apparently not hampered by “poor scanning” ability and are, therefore, able to apply the analogous reasoning pattern they learned while working with the double-H model.

## Thursday, July 2, 1964

The investigator spent about twenty minutes working with each group. All members of Group II were present. Debby was absent from Group I. (She's attending some kind of Bible School and will be out for the rest of the week. That hurts.)

### 1. Higher-lower

The investigator reviewed the base notion of high-low. "The ceiling is high and the floor is low." Then he put two dots on the board. "This one's higher, so the other one must be lower." The children recited in unison.

### 2. How can I end up with one line longer?

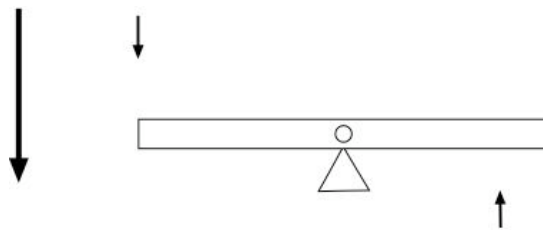
The investigator drew the double line system on the board.



He then asked how he could achieve a given change. "How can I change these lines so that the top one is longer? I can make the top one longer, or make the bottom one *shorter*." Each child had turns with two different examples of change.

### 1-3. Push up on one side or down on the other

The investigator demonstrated the operation of a balance beam by using a bar, which he held up against the chalkboard. He then drew an arrow to show which change he desired. "I want this side to go lower. How can I make this side go lower? I can push down on this side. Or I can push up on the other." He drew smaller arrows to show the location and direction of change.



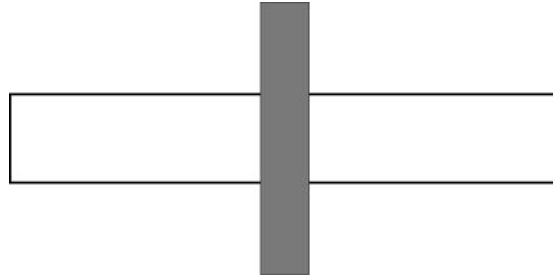
### 2-3. What happened?

The children in Group II worked problems that involved describing what had happened in the system to achieve a given change. The investigator drew a diagram on the board. He then asked one of the children to describe how that change might have been achieved. He drew arrows to indicate the possible changes. Then he reminded them of the limiting condition. "The side I touch is the side I push. If I touch here, [down arrow] that means I

push *down* on this side. If I touch here, [up arrow] that means I push down on this side. If I touch here, that means I push *up* on this side. Watch carefully.” Each child had a chance to work several deductions.

#### 2-4. Bar longer-shorter

Group II learned the fundamental rule that governs the operation of a bar considered as a “center problem.” The investigator drew a bar on the board, with a line running through the center.



He described the diagram as a picture of a bar sticking through the wall. Then, to illustrate the mechanics of the change in the system, he held a long board up to the chalkboard and moved it along the horizontal axis. “See? As this side gets longer, the other side gets shorter.” The children recited the rule in unison and individually. After the investigator pointed out that the rule works both ways, he showed how the longer-shorter relationship would be illustrated on the diagram. A long horizontal arrow would show the direction of the bar.

#### 5. Detective

“If you touch the chalk, you get chalk on your hands. If you’ve got chalk on your hands, you touched the chalk. You’ve got chalk on your hands. Therefore, you must have touched the chalk. The investigator presented different examples. “Debby got chalk on her hands. So what does that tell you?”

#### **Progress**

*Motivation.* Group II seems more uniformly motivated. The rotating bar problem is apparently so taxing for the members of Group I that it has sapped no small part of their enthusiasm. The investigator pointed out that this is the most difficult problem they’ll have to learn and that the subsequent problems will be easier. But the members remained rather impassive.

*Learning.* Group II is pulling slightly ahead of Group I. While Group I learned the fundamental relations of change that are possible with the bar, Group II moved ahead to the bar push-pull problem. The members of Group II (except for Eran) seem to have caught on to the pattern the analogy takes. They learn the basic rule and they seem to know how to relate it to the various tasks that follow. Not so with Group I. They haven’t caught on to the notion that the problems are basically the same.

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*Learning speed.* Group II is at least one lesson ahead, perhaps two. It's possible that Group I is behind only in the understanding of the rotating bar problem, in which case their deficit would not be severe.

### Friday, July 3, 1964

The investigator spent about twenty minutes working with each group. Debby was absent from Group I, and Eran was absent from Group II.

#### 1. Higher-lower

The investigator put two dots on the board and asked which was higher and which was lower. The children then recited the if-then as the investigator moved his hand to indicate the direction of the action. "If this one's higher, this one must be lower."

#### 2. Two-line system

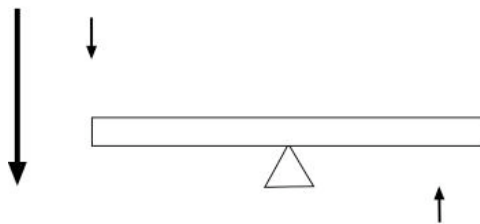
The investigator reviewed the manners in which change are possible in the two line system.



"How can I change these lines so the top one is longer?" Each child had turns at working at least two different examples.

#### 1-3. Balance board problems

The investigator drew a diagram of the balance board on the chalkboard. He indicated the nature and direction of change with a large arrow on one side of the system, He then asked how the change might have been achieved. He indicated the possibilities with smaller arrows over and under the board in the appropriate places.



Then he introduced the rule: "The place I touch is the place I push. If I touch here, it means I push down on this side. If I touch here, it means I push up on this side." After the children recited the basic rule, he touched the bar and individuals were asked to deduce what must have happened.

2-3. The investigator presented problems to Group II members, asking which side of the bar I touched if "this side goes down."



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1-4. *Bar push-pull.*

The investigator held an actual bar up to the chalkboard so that a larger vertical line drawn on the board cut through the approximate center of the bar. Then he moved the bar to either the left or right. “Now watch what happens to this side. This side is getting... longer. And the other side is getting... shorter.” That’s the rule, as one side gets longer, the other side gets shorter.”

2-4. The investigator introduced the notion that change can occur in the bar system either by pushing on one side or pulling on the other. He demonstrated and had the children recite the rule in answer to the question, “How can I make this side longer?... Either by pulling on this side or pushing on the other.”

2-5. *Integrating the notion of a fixed center and types of possible change*

The investigator instructed the children in Group II to make an imaginary bar that went horizontally through their nose. He told them to grab either side and then do what he did. “Hold your nose still.” He moved the bar left and right. “See, as this side gets longer, the other side gets shorter.” Then he rotated it. “See, as this side goes higher, the other side goes lower.” The group spent several minutes making various changes.

**Progress**

*Motivation.* The motivation among members of Group I is rapidly dwindling. They were quite well motivated when they could use the original material they learned, but for them the learning situation (as it is to at least some degree in all cases) is a threat to their personal security. They have learned responses for which they had received rewards. They were happy. Now, however, the rewards for those responses—the same responses that were successful last week—are not forthcoming. Instead, the children are asked to repeat the cycle and learn new responses. The balance to the threat that learning situation poses is the rewards in personal satisfaction it produces. The members of Group II obviously know something about these rewards. They know that even though the present task is difficult, perhaps even frustrating—certainly demanding—they will be well compensated with a sense of personal achievement for their present efforts. Not so with Group I members. They would rather call it quits right now.

*Learning.* Group II members handle the concepts with a great deal of facility. Group I members are still having trouble with the basic operations of the rotating bar. The investigator introduced the diagram today and discovered that the children had less difficulty working with it than with the actual bar. A tentative explanation could be: The members of the diagram are fixed. The child does not have to contend with actual “sensory” change. Instead he can concentrate on the logic behind this change. He can apply the rules and he doesn’t have to work about reconciling his words with what is happening, because *nothing* is happening. What seems to be happening with the actual bar is that the child sees the bar move and he fails to see that the present position is continuous with the original position. He, therefore, becomes confused when he tries to apply the rule. He doesn’t seem to catch into the notion that the rule applies *regardless of the position of the board*. When working with the diagram, on the other hand, the child

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doesn't have to make "feedback" type adjustment every time the bar moves. He can treat change as a hypothetical construct and relate it to a constant.

This ties in perfectly with Frank's experiment.

**It's easier for the child to work with abstractions than it is for him to work with the real thing when change is involved.** It's easier for him to use the fixed rules that are involved in reasoning that it is to work from a base that is constantly changing.

The difference in the effect of presentation could be demonstrated by teaching two groups the same task (a task that involves change). One group could learn from diagrams, the other from the real thing. The criterion would be the ability to explain how various changes might be achieved.

*Learning speed.* Group I is definitely behind Group II—about two lessons behind. They are learning, however. And at least one member of Group I could probably be doing what the Group II members are doing.

## Monday, July 6, 1964

The investigator spent about twenty minutes with each group. All members were present.

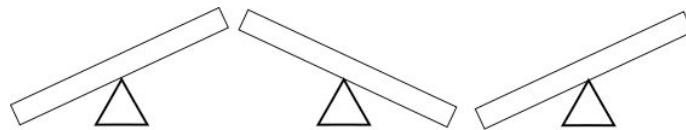
The aim of the session was to demonstrate that similar statements apply to all of the systems studied to date.

### 1. Double line system

“How can I change this system so that the bottom line is longer?” Answer: Make the bottom line longer or make the top line shorter. Each child had at least one turn at specifying the ways in which a change of this type might have been achieved.

### 2. Balance beam

The investigator reviewed the general mechanics of the system. “If this side goes lower, this side goes higher.” Then he drew three tilted beams on the board.



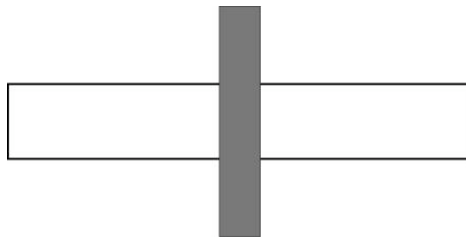
He asked individuals what might have happened to results in a given change. He stressed the notion that you can't be certain because the change could have been the result of two actions—not one.

### 3. Tie in—balance beam and two line system

Above one of the balance means, the investigator drew a small two-line system. He explained the parallel. “Look. You can change this system so that the bottom line is longer either by making the bottom line longer or by making the top line shorter. Two ways. Make the one longer. *Or* make the other one shorter. That's just like the balance board. How can you make this side go down? Well, you can either push down on this side, or you can push up on the other.”

### 4. Bar—push-pull

The investigator demonstrated the same point with the bar-through-the-wall problem.



He drew the above diagram on the board and reviewed the general rule: as one side gets longer, the other side gets shorter. Then he changed the diagram so that one side of the

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bar was now longer than the other. “How could that have happened?” he asked. “I could have pulled this side longer, *or* I could have pushed this side shorter. Two ways. Pull longer, or push shorter.” Each child had at least two turns explaining how a given change in the system might have occurred. Then the investigator drew a small bar beneath the double line system and the balance board. “They’re all the same,” he explained. “They all change the same way. And there’s more than one way to change them. You can always change it one way. And you can always change it *another way*. If somebody tilts a teeter-totter like this and asks you how he did it, what do you say? I don’t know. You could have pushed it down on this side. But you could have also pushed up on this side. I don’t know.” He pointed out the similarities among the three systems and stressed the idea that one approaches problems of this kind with an awareness of the *possibilities*, but one does not speculate on any of these possibilities unless one has some reason to draw a conclusion about what happened.

### **Progress**

*Motivation.* Group II is quietly and efficiently motivated. While the esprit of Group II steadily increases, that of Group I degenerates. The lessons are, to the member of Group I, a chore. They receive little—if any—sense of satisfaction out of them and they are not involved. They tolerate the lessons, and that’s about the extent of their participation.

*Learning.* Sherry in Group I is getting caught up in her inarticulate use of language. The tasks that require precision and a choice of concepts are quite beyond her. To some extent, the other members of the group share some of her problems. Generally, Group I has trouble in any task that requires parlaying information, using a series of rules, splitting attention, working either one of two ways from a given checkpoint. Specifically, they have trouble with the balance beam problem; they have trouble when they have to analyze a system and then base deductions on the *outcome* of the analysis.

Their primary inadequacy can be described as the inability to deal in possibilities. They want to think of concepts as units. If these units have to be linked, they should be linked in such a way that one can, if given the cue and then recites the entire sequence—in such a way that they function as a larger unit. They do not have the general idea of using a hypothetical serial approach in which a course is determined by the outcome at various checkpoints. The more verbal children have a better grasp on the hypothetical approach within Group II, which seems to indicate the relationship between more sophisticated means of expression and the kind of orientation necessary to approach a check point realizing that it is capable of determining more than one course of action.

Group II members, on the other hand, are quite facile in dealing with possibilities.

*Leaning speed.* Group II is maintaining, if not increasing, its lead over Group I. Today’s lesson functions as a reinforcing review of discrete tasks for Group I, while it was an integrating, continuity exercise for Group II. Group I members will require at least several lessons before they see the points of similarity between the various systems. They’re still trying to work with the relations within the system.

## Tuesday, July 7, 1964

The investigator spent about twenty minutes with each group. Ramona was absent from Group I, Audrey from Group II.

The primary emphasis was on the ways in which the double-line system, the balance beam system, and the bar-through-the-wall system are the same.

### 1. Double line system

The double-line system was presented with one member longer than the other.



The investigator explained, “These lines were the same, but I changed them. How did I change them?” The answer is, “I don’t know.” “Why don’t you know? Because there is more than one way I could have changed them. What could I have done to the top line?... Maybe I made it shorter. And what could I have done to the bottom line?... Maybe I made it longer. You just don’t know.” The investigator presented various examples, with the lines horizontal and vertical. Each child received at least two turns.

### 2. Balance beam

The system was diagrammed in a tilted position. The investigator explained. “This is just like the lines. The board is tilted, isn’t it? This side is... And the other side is... Now, somebody asks you how did that happen, and what do you say? I don’t know. Why don’t you know? Because it could have happened in more than one-way. Somebody could have pushed down on this side or pushed up on the other.” Each child had at least two turns analyzing what happened.

### 1-3. Bar push-pull

The investigator went over the fundamental operations of the bar-through-the-wall system with Group I. Then he showed that the statements that applied to the other systems apply to this one as well. He drew that bar so that one side was longer and the other shorter. Then he asked. “How could I have changed the bar so that it looks this way? What’s the answer? I don’t know. You don’t know because what could I have done to the other side? Pulled it and made it longer? He presented the bar in various positions and asked group members to explain how the change could have happened.

### 2-3. Detective with the bar

The investigator integrated several previous tasks and played a game of detective with the bar. He colored one half of the bar and explained that it had been painted with fresh red paint. “What’s the rule? If you touch the red paint, you’ll get red paint on your hands?”

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Then he changed the bar so that one side was longer, and the other shorter. “How could I have changed the bar so that it looks like this?” After the children answered, the investigator said, “Do we know which one really happened? No. But what if we find somebody with red paint on his hands? If you touch the red paint, you get red paint on your hands. And if you get red paint on your hands, it means you touched the red paint. So where did that guy touch the bar? Did he touch it here? ...No, there’s no red paint here. Did he touch it here? Sure. Right in the red paint.” So, if he’s got red paint on his hands, it means he pushed this side to make it shorter. Now. Let’s find out how you boys and girls moved that bar.” The investigator examined the hands of the boys and girls. On the palms of some he made a mark with red chalk. Then he held the hand up for the group to see. He asked the child to explain what he did to move the bar. Each child had two turns, one time with chalk on the hands, the other time with no chalk.

### **Progress**

*Motivation.* Group I showed good motivation today. Members tired hard and apparently enjoyed the game of saying “I don’t know.” When their responses are slow and incorrect, interest in the task soon dwindles. Today, however, the pace was fast and they were able to respond with speed and accuracy. That made for a good lesson—the best in more than a week.

*Learning.* Sherry in Group I is seriously lacking in prerequisite skills that are necessary for the present tasks. She does not understand what the demonstrations mean. Debby in Group I is also lagging. These are the children with the most poorly developed verbal skills. The ones with the best verbal skills are the ones who are doing best on the tasks. In Group I, Eric, Junior, and Ramona have the best verbal skills. They would probably be able to keep up with children in Group II on the present tasks (although they are not as facile at approaching a check point with the understanding that they will take one of several possible courses) Group II is doing very well. They could probably pass the criterion problem now, but I want to acquaint them with more facets of the analogy.

*Learning speed.* Group II is maintaining a lead of about two lessons. Group I, if members continue to perform as they did today, can keep its present relative position. The response level of most members in the group is now high enough to enable the children to get more satisfaction out of the lessons. They can use the relations they learned and receive the reward of self-satisfaction of the efforts they’ve expended.

### Wednesday, July 8, 1964

The investigator spent about twenty minutes with each group. Sherry was absent from Group I; Audrey from Group II. The mother of another member of Group II (Ellen) requested the nursery school teacher to drop Ellen from the group, so she was not present for the session. After the other children had finished their session, the investigator gave Ellen the criterion problem in presence of the nursery school teacher (Ann Reisner). The investigator drew a diagram of a tilted balance board on the chalkboard. He asked the child to describe what happened to the balance board. She answered, “This side is lower, and the other side is up there.” Then he asked her to tell what somebody could have done to change the balance board that way. She answered, “Push down on this side or push up on the other.”

The investigator colored the top of the board with red chalk. “This is fresh, red paint. You know what that means. Now, what if I tell you that the guy who tilted the balance board has red paint on his hands. Can you tell me what happened? Show me.” Ellen pointed to the lower side and said, “He touched it here.”

The investigator asked, “So what did he....”

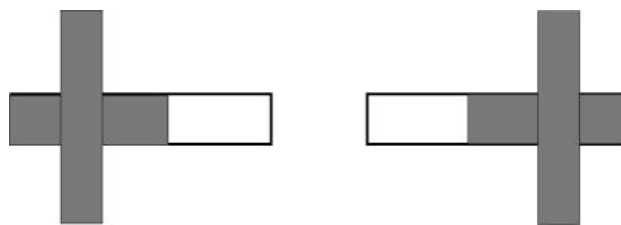
Ellen interrupted, “He pushed down here.”

The investigator shook hands with her and told her that she did a splendid job—which she did. Ellen passed the criterion problem after only seven sessions. The investigator could probably have tested the other members of Group II sooner, but he wanted to be certain that all of the children would pass the criterion problem, and he didn’t want to present it more than once. For this reason there was no pretest. The logic behind it goes something like this. If the children see the problem—even if they are unable to solve it—they may retain some notion about what was asked, about the general nature of the problem. The rules that the children will later learn apply to the problem. If the children see that they apply, the entire course of training will merely function to point the children toward the solution of a problem which they were unable to solve. The pretest, in the investigator’s opinion, would have resulted in a very serious pollution.

Here are the tasks studied by groups one and two:

1. What happened to the painted bar

The investigator drew the bar through-the-wall in various expressions of change. One side of the bar was colored (indicating wet paint).



Individuals in the group were asked to tell what happened to the bar. Then they were asked to describe how somebody might have made the bar change the way it had changed. Finally, they were told something about the hands of the person who changed the bar. Either he had red paint on his hands or he didn't have red paint on his hands. They then drew the conclusion about what had happened. Each child had at least three turns.

## 2. Double-line change

The investigator drew pairs of lines on the board—one of which was longer than the other. He then asked class members to describe the lines. Then they were asked to tell how the change might have taken place.

### **Progress**

*Motivation.* Group I was very poorly motivated again today. Members paid practically no attention to what was going on. The investigator tried concentrating on one child at a time and ignoring what the other members did. Performance was poor, but it was probably a reflection of poor motivation, especially in view of the good performance during the last lesson.

*Learning.* A very interesting pattern was seen today in Group I. Members that clearly had the idea of the two different ways in which a system might change had apparently amalgamated these notions into a kind of unit. No longer was the thought pattern, "He might have changed the system by acting on A, or he might have changed the system by acting on B." It was now, "He might have changed the system by acting on A and acting on B." In one case, the child seemed stunned when the investigator pointed out that he did one or the other. The tendency to amalgamate is consistent with the hypothesis that these children are not very capable of handling choice situations.

*Learning speed.* Group II maintains its lead. While Group I members apparently labor through the problems Group II handles them with increasing ease. The investigator is beginning to drop some of the "rote" details out of the presentation with Group II, because they have obviously internalized the analogy and are able to handle the reasoning change by taking short cuts. The step-by-step presentation is no longer necessary. The investigator will now adopt the policy of moving ahead—jumping ahead—and then noticing any difficulties they might have in following. This approach is more economical (and probably more interesting) than the original, hammer-hammer presentation.

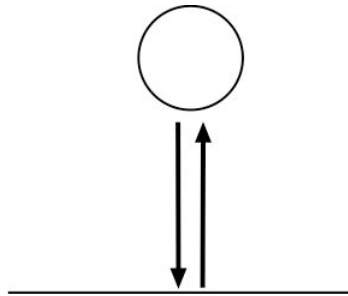


**Thursday, July 9, 1964**

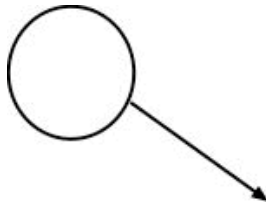
The investigator spent about twenty minutes with each group on a new set of tasks that demonstrated the ability of the group to apply the fundamental approach used in solving the various problems to problems such as motion problems involving a set up that was bilaterally symmetrical. All members of Group I were present. Audrey was absent from Group II.

1. The bouncing ball

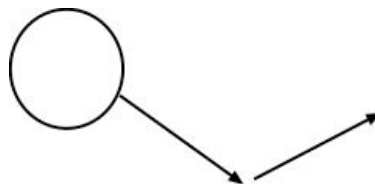
The investigator asked members of the group to pretend that they had a large ball, which they were bouncing on the floor. As the members bounced the ball, the investigator asked if they marked the spot on the floor where the ball must strike each time. This was the basis for the rule, "If the ball bounces straight down, it bounces straight up." The investigator diagrammed the rule on the board.



He pointed out the arrows indicating the path of the ball as it bounces. He then presented other situations and derived different rules. For instance,



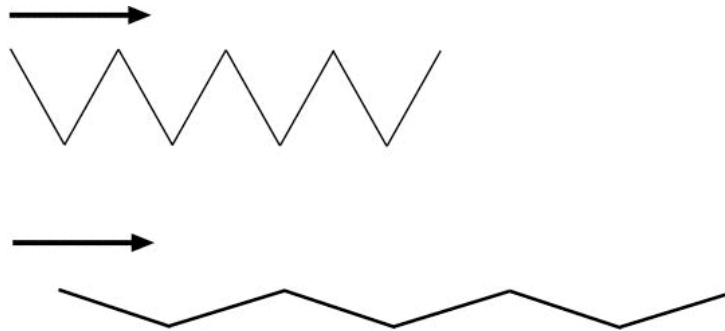
If the path goes down this way,



it will go back up this way.

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He tried introducing the notion that it goes up the same way it comes down, but this notion led to some confusion because the children justifiably thought that the ball should always return to its point of origin. To help clarify the concept, the investigator pointed out that the ball wants to keep on going in the same direction it starts. If it starts out this way, it wants to keep on going this way. Up and down, and up and down, and....” He diagrammed the path of the various balls according to the angle of initiation.



The basic rules that were emphasized are: “If it goes down this way, it bounces back up the same way.” (With the understanding that the ball continues in the direction in which it started. The investigator will explain this basic notion during the next session.) The other rule: If it goes straight down, it bounces straight up.

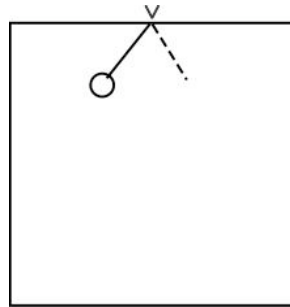
## 2. How to read a map

The investigator demonstrated the fundamental orientation necessary to read maps with the following explanation. ‘Now, here’s what you have to do to understand maps. Watch me. I’m flapping my wings. I’m flying. Come fly with me. Up, up, we go. Now, look down there. Way down. I see a room. And look, inside the room I see Eric, right here, and Junior...and...Okay, now I am going to pick that room up, like this... and put it on the board, ... like this... There. Now, I put Eric here...Keep flying. Remember, we’re looking way down. And here’s Junior....’ He had the children stand in different positions in the room and drew different diagrams.

## 3. Roll the ball against the wall

The investigator demonstrated the law about the angle of incidence and reflection using the map of the room.

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He made a V so that the point touched the top of the wall of the diagram. Then he drew a ball to one side. “You’re standing here with the ball, and you’re going to roll it right at this point, right here. Now, when the ball hits this point, it’s going to bounce. Where will it bounce?... It will go out this way. It goes just like the bouncing ball. If it comes in this way, it bounces out this way.” He explained several other angle problems. Then he introduced an angle and asked members of the group to show which way the ball would roll. Each member had two turns.

2-3. The investigator attempted to see if Group II members would transfer one of the if-thens from the bouncing ball situation to the room situation. He drew a new V on the top wall and asked them to solve a problem that would require them to see the analogy between this situation and the bouncing ball and to turn the basic if-then around (in the manner they have done with they reason about what happened). He asked, “Okay, Lynn, where would I have to stand in this room if I wanted the ball to roll right back to me?” Lynn properly identified the path. The investigator erased the V and placed a V on the right side wall of the room. “Okay David, here’s a different mark. Where would I have to stand if I wanted the ball to hit this mark and then roll right back to me?” David properly identified the path. The investigator put a V on the bottom wall. “Okay, Eran, where would I have to stand if I wanted the ball to roll right back to me?” Eran failed to find the correct path.

### **Progress**

*Motivation.* The dilemma with Group I revolves around the fundamental fact that learning reasoning patterns is more difficult for them and far less pleasurable that it is for Group II members. The only way to motivate them is reduce the session to a game in which they learn about a third as the Group II members. As soon as the elements that require real cerebration are introduced, their motivation drops to practically nothing. This statement does not apply to all members. Ramona is probably bored with some of the proceedings, because the tasks are very easy for her. But generally, as the tasks come closer to the core of the reasoning problem, the motivation of the members drops. Group II members continue to be well motivated.

*Learning.* Since the tasks must be sugar coated for the Group I members, they deal less with the fundamental reasoning patterns and, therefore learn less than the members of Group II. While they covered basically the same content as the Group II members, they did not go into things as thoroughly. There probably isn’t one Group I member that has a

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firm idea about the paths of bouncing balls or rolling balls. The Group I members could not have succeeded in the transference task that Group II handled because Group I members 1) haven't learned the principle that transfers, 2) probably don't see the basis for transfer, 3) don't realize that the *method* of transfer is quite similar to the one used to go from line to balance board and bars.

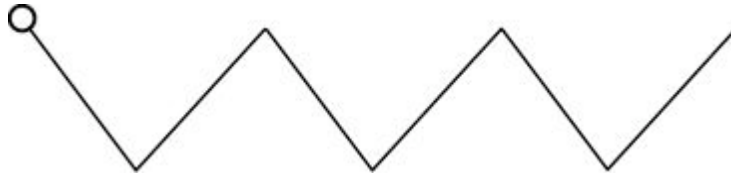
*Learning speed.* None of the members of Group II could correctly predict the path of a bouncing ball when the investigator first introduced it. None understood the laws of motion reflection. None knew how to read maps. Yet, within twenty minutes they learned tasks that are labored by "heuristic" advocates for not hours, but sometimes weeks. They learned about "relative positions." They learned the laws of reflection. And they learned new ways to extend the fundamental reasoning patterns they had applied to the other center problems. The integration of skills enables Group II members to move at a continually accelerated rate. The approach employed by the investigator is no longer rote. The children understand the rote principles and how to apply them. So he does not slow them down by reviewing the obvious. Group II members are progressing considerably faster than Group I. Estimated advantage: About four lessons.

### Friday, July 10, 1964

The investigator spent about fifteen minutes with each group. All members were present in both groups. The sessions were short and involved no new patterns.

#### 1. Bouncing Ball

The investigator reviewed the path a bouncing ball makes. He tried to give an operational understanding of how the path of the ball is in a repeating series.



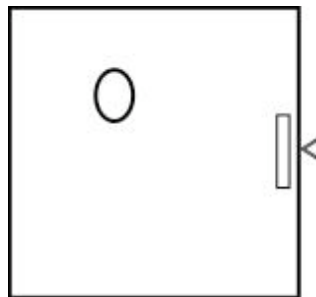
He stressed the basic rule. If the ball goes straight down, it will bounce straight up. During the next session, he plans to draw conclusions from this if-then. If it doesn't go straight down, it doesn't bounce straight up (which if-then might well have come first).

#### 2. Map reading

The investigator oriented the children for map reading again. He told them to pretend they were flying, then to look down at the floor, where they were supposed to be able to see themselves. After the investigator had pointed out the area in which they were supposed to see themselves, he pretended to pick the area up and put it on the blackboard. Then he drew it. "Remember, when you read a map you have to pretend that you're way up in the air, looking down."

#### 3. Rolling ball

The investigator used the map of the room as a basis for demonstrating the action and reaction of rolling balls.



He drew a V against one of the outside walls and a blob that was to represent one of the children. The blob held a ball, which was thrown at the point of V. The children were asked to predict what would happen after the ball reached the wall by drawing the path

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the reflected ball would make. Each child had a turn with the V and the ball in different positions.

#### 4. Double H model review

The double-H model was presented first in its unchanged position and then with one of the members changed. The children were asked a) Which line has been changed, the top or the bottom? b) How has it been changed? Has it been made shorter or has it been made longer? c) How do you know?

### **Progress**

*Motivation.* The sessions were short and reviewed material that the children had already mastered. So motivation was good and the sense of accomplishment was keen. The investigator brought his twin five year boys to the Group I session, which militated against a very long or intense session. Spirits were high in both groups, however.

*Learning.* The review with Group I pointed out that the two members of the group who are shy in verbal skills are not retaining the material as well as those who have a good verbal background. The group is split. Ramona, Junior, and Eric are moving along at a good rate. Debby and Sherry are not. Sherry has improved measurably. She is more articulate in her speech and she talks much more than she did at the beginning of the sessions. She is able to say some phrases and “rules” with reasonable accuracy. However, she still has a serious misconception about the nature of verbal communication. She still tries to talk in lumps, not words. And she’s still not caught into the idea of asking a question, answering it, and proceeding according to the answer. Debby’s status was illustrated by an incident that occurred today. The investigator told the children to study the way balls work over the weekend, to get a ball and watch the way it bounces and rolls when it hits a wall. Said Debby, “My mommy says I can’t roll a ball.” She’s severely inhibited in verbal expression, and apparently in mental expression. She tries hard, but she’s running scared.

The split in abilities makes it difficult to present material that is “interesting” to the entire group. If lessons are geared to Sherry, the others (except perhaps Debby) are bored. If they are geared to Ramona, Eric, and Junior the other two are completely lost. Also, teaching Ramona, Eric, and Junior does not particularly dramatize the difference between the culturally deprived and the culturally privileged. Ramona is nearly as quick as Lynn and David in Group II. Eric and Junior are probably on a par with Eran in Group II. Although the tendencies noted in previous lessons hold for Junior and Eric (and sometimes Ramona) they are not as pronounced or crippling as they are in Debby and Sherry. At this point, I believe that the wisest approach would be to split the group. I would like to present the criterion problem next week to Eric, Junior, and Ramona. I think they will pass it. Then I would like to spend time that is necessary to bring Debby and Sherry up to the conceptual level that the others have achieved. I think I can succeed by the end of the summer, but I will have to work with them alone and begin with the basic rules of language.

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*Learning speed.* Group II is both faster and better at retaining the material. The reason: The material is meaningful to them. They have integrated the analogy. Audrey in Group II had been absent for three days. She exhibited a deficit over the others, both in understanding the new problems (the bouncing ball, the map, and the rolling ball) and in integrating the new material with what she had learned about the bar, the balance beam, and the line system.

## **Monday, July 13, 1964**

The investigator spent about twenty minutes with each group. All members of both groups were present.

### **1. Bouncing ball review**

The investigator introduced the converse of the rule “If it goes straight down, it will bounce straight up.” “If it doesn’t bounce straight down, it won’t bounce straight up.” “If it doesn’t bounce straight down, it won’t bounce straight up.” He presented problems in which the ball went down at an angle. “Does it go straight down? No. Then it won’t go straight up, will it?” Every child had at least one turn at judging the line of reflection of the ball.

### **2. Rolling ball review**

First the children were instructed to fly up high and look down. The investigator then picked up the area of the floor on which attention was focused and put it on the chalkboard. He stressed the orientation that map reading assumes. “Remember, when you read a map, pretend that you’re way up in the air, looking down at the map. Then you can understand it.” He put a series of rolling ball problems on the board, in which he drew in the path of the approaching ball and the children were asked, individually, to draw the line of reflection ball.

### **3. Bar push-pull**

The investigator drew a series of bar-through-the-wall examples on the board and asked each child a) which side is longer, and b) how might it have happened. Then he colored half of the bar and considered the wet paint as a limited condition. “What if you get your hands covered with red paint while you’re moving the bar? How did you move it?” He also briefly reviewed the wet-paint rules. “If you touch the wet paint, you get wet paint on your hands. If you have wet paint on your hands, you touched the wet paint. You have wet paint on your hands, so.... That means you must have touched the bar where the paint is wet. Where’s that?”

## **Progress**

*Motivation.* Group I members, especially the three best performers, are not very well motivated. They don’t pay attention well, and they constantly horse around. The investigator is reluctant to lean on them because of the peculiar nature of the situation. The only way to motivate them adequately is to reward them for trying and actively discourage them from not trying. However, he has to stay on their good side, because unless they “enjoy” the sessions, they can get out of them. Probably the best solution would be to give them the criterion as soon as possible and terminate their participation.

*Learning.* The advantage of Group II is at least partially a function of their greater stress on convert rehearsal. At the Friday session, the investigator advised both groups to think about bouncing balls and rolling balls over the weekend. “Get a ball and bounce it. Watch what it does.”



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Not one member of Group I followed the advice. Four members of Group II did. There is a real difference in capacity between these children and those in Group I. But the big difference is in the amount of time spent on the lessons. With Group I members, the lesson apparently ends when the investigator says, "That's all," while the Group II members continue to rehearse the material.

Sherry in Group I is apparently starting to learn some of the fundamental verbal concepts. Her improvement is striking. She speaks much more coherently and articulately. She is able to handle some of the easier problems.

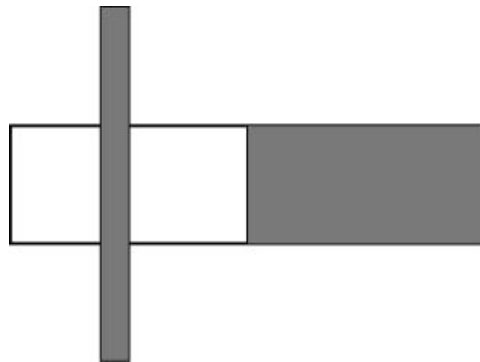
*Learning speed.* Group II is substantially ahead of Group I.

**Tuesday, July 14, 1964**

The investigator spent about twenty minutes with each group. All members of both groups were present.

### 1. Test of Generalization

Today's session was devoted primarily to demonstrate the approach of the two groups to the same problem. The investigator wanted to test a hypothesis about their approach to complex problems. Hypothesis: Since all members of Group I are not adept at approaching check points and proceeding according to the outcome at the checkpoint, they would fare poorly on a problem that hinged on check-point reasoning. To test the hypotheses, the investigator presented a familiar problem (bar with one half freshly painted), but he presented it in a way that required the children to utilize the entire reasoning chain. Any failure to follow the logically necessary steps would result in a possible failure to solve the problem. The investigator drew the bar on the board in a "changed" position.



He then asked a member of the group, "Okay, now the guy who moved that bar came out of the room with red paint on his hands. What happened?" To solve the problem, the child has to go through a chain of reasoning something like this:

"What happened? One side of the bar is longer and the other side is shorter. The side that is painted red is the side that is longer. If he got red paint on his hands, he touched the bar where it is painted red. If he touched it on the side that is red, he made the side longer by pulling it."

The key to the reasoning chain lies in understanding that the person who changed the bar could have changed it by pulling or by pushing but since he touched the bar on the longer side, he must have acted on that side. Just as the child learns to work out deductions from visual perception at a tremendous rate with sufficient practice, so he can learn to work out the details in a reasoning chain at a tremendous rate with sufficient practice. But the steps involved are necessary. They can never be eliminated—merely speeded and perhaps consolidated. The investigator therefore predicted that members of Group I would give bizarre answers to the problem. They did. They (including the three best performers in the group) would point to the shorter side and say, "He made this side longer." Or they

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would say, “I don’t know,” thinking that they were answering a question about the bar when it is not painted (when no limiting conditions are present). Not one person in Group I solved his problem correctly.

Not one person in Group II solved his problem incorrectly. Typically, Group II members would pause for a moment, put their hand on the appropriate side of the bar after they considered the facts, and say, “He made this side longer.” Apparently, they approached the problem by asking themselves first, “Where did he touch the bar if he didn’t get paint on his hands. They would answer this question and then ask, “What did he do to the bar if he touched it here?” Before that question can be answered, another, more basic question must be answered. “What happened to the bar? How did it change?” While the order is changed, the questions are all present and must all be answered.

1-2. After the exercise with the bar, the investigator showed the children how to approach the problem. He presented the stops as a kind of rote approach. “What’s the first thing you ask yourself when you look at the problem? *What happened to the bar?*”

Then you answer. “It’s longer on this side and shorter on this side.” Now you ask yourself, “How did he do that?” And you answer. “*I don’t know.*” Because what could he have done? He could have made this side longer and this side shorter. Now you ask yourself, “Where would he touch the bar if he got red paint on his hands?” He would touch it here. That means he pushed this side shorter. Actually, in view of the way Group II members successfully handled the problem, the investigator should probably have had the Group I members approach the problem this way. “Okay, if he got wet paint on his hands, where did he touch the bar?.... Good. And if he touched the bar here, what did he do?.... Ask yourself, “Is this side longer or is it shorter?” .... So he must have made the bar longer on this side. He must have pulled it here.” Unfortunately, the investigator did not see the way Group II approached the problem before instructing Group I on how to approach the problem. He may try the new approach during tomorrow’s session.

1-3. After the Group I children caught on to the sequence of questions, the investigator put a tilted balance board on the chalkboard and showed that the same pattern of reasoning applied. He encouraged the group to respond in unison. First, I ask myself, ... “*What happened?*” This side is up and this side is down. Next, I asked myself, how could he have done that? “Either pushed down on this side or up on this side.” The board was not painted, so this is as far as the children carried out the analogy.

#### 2-2. Bouncing ball

The investigator drew a ball on the board and indicated the downward path. Each child had two turns at drawing the resulting upward path. All responses were correct.

#### 2-3. Rolling ball

The investigator presented a map of the room. Eran (who is not yet four years old) had some trouble in predicting the reflection path of the ball from the wall, but the other three children were correct on all three attempts. The final attempt required them to point out

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where the man throwing the ball would have to stand if he wanted the ball to strike the V on the wall and return to him.

**Progress**

*Motivation.* Group I members are still more poorly motivated than Group II members. They enjoy themselves enough but they are not trying to understand the principles. Unless they are performing, they pay no attention to what is going on. This poor motivation is reflected in a poor performance. At least three members of the group are capable of handling these problems with almost as much ease as the Group II members. But they don't try and as a result, they don't learn as rapidly or as thoroughly.

*Learning.* Today's lesson rather dramatically demonstrated the difference in approach between the two groups. Group II members use the chain of reasoning they have learned (modified, internalized, and adapted to their individual structures), whereas Group I members treat the patterns as something that is basically extrinsic, to be put on like a coat when the investigator mentions a key word.

*Learning speed.* Group II is constantly increasing its lead. Their increment is to a great extent a reflection of superior motivation and ego involvement.

### Wednesday, July 15, 1964

The investigator spent about twenty minutes with each group. All members of both groups were present.

#### 1-1. Painted Bar

The investigator introduced the approach inferred from the behavior of Group II members. "If he got paint on his hands, where did he touch the bar? Good. And if he touched the bar here, what did he do? Did he pull it longer, or push it shorter?" The response was good. Each member had two turns at working from different bar situations.

#### 1-2. Balance board

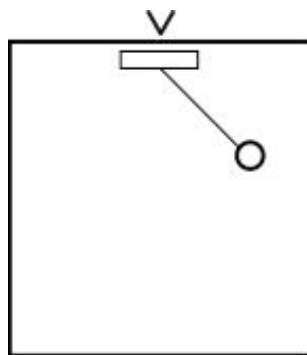
The balance board was reviewed. The investigator drew a tilted board and asked how it got that way. The response was good. Each child had one turn.

#### 1-3. Rolling Ball

The investigator drew a map of the room on the board. He then indicated various members of the group on the board as blobs holding a ball. He drew the path of the ball to the wall and then asked them to indicate the path of the ball as it leaves the wall. The responses were accurate. The investigator then asked individuals to indicate where they would have to stand if they wanted to roll the ball against a V on the wall and have the ball return to them. The three best performers in the group answered correctly.

#### 2-1. Mirror Problem

The investigator introduced a new problem. He drew a map of the room and indicated a mirror against one wall. He asked the children if they could predict the path of their vision if they stood off to one side and looked into the mirror. He indicated the path of vision from the diagrammed child to the mirror; they were asked to indicate the reflected path.



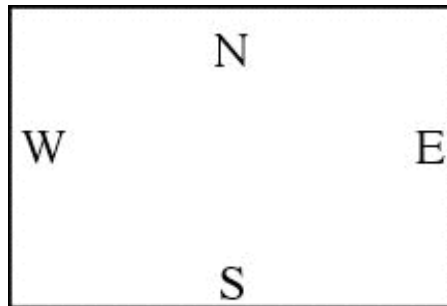
They could not. The investigator indicated the reflected path. He did not tie the problem in with the familiar rules about rolling balls. Instead, he wanted to see how long it would take for members to see the analogy. He presented another problem and asked those who thought they knew the answer to raise their hands. All members raised their hands. The one called on to indicate the reflected path indicated it correctly. The investigator asked

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the other members to indicate where they would have to stand in relation to different mirrors if they wanted to see themselves. All but one answered correctly.

## 2-2. Map reading

The investigator decided to introduce some non-center problems which involve some of the same deductive elements used in the center problems, (since it's quite obvious that the members of this group will be able to pass criterion problem with no difficulty). He introduced map reading (without making any reference to directions apart from the map). The investigator drew a map on the board and indicated the four directions with letters, N, S, E, W.



He then taught the names as pairs (since much of what the children have done is associated with the notion of pairs and since the problems that will be introduced in connection with map reading assume a knowledge of the direction as pairs). “North is always at the top and south is at the bottom. Let’s say that...” One member of the group, David, has a severe lisp and was unable to pronounce the word *South*, so the investigator took a few moments to point out the operation to use in sounding the word. “First take a big bite, like this. Now don’t open your mouth. Just say ‘Sssssss’... Good. Now say the rest of it. Remember, always start with a big bite like this...” Within no more than a minute, David was able to pronounce the word (probably the first Sss word he’s ever pronounced correctly). He seemed quite pleased with his newfound skill and kept repeating the word again and again.

Prediction: By the end of the summer session, David will have his lisp under good control.

To introduce east and west, the investigator capitalized on knowledge the children have already acquired. The investigator has shaken hands with the children as the close of each session. As a result, they know which hand to shake hands with. “Look, you stand in front of a map and put out the hand you shake hands with. That’s *east*. And the other is *west*. Always start with the hand you shake hands with. That’s *east*.”

By the end of the session, all members could say, “North at the top and south at the bottom. East on this side and west on this side.”

### **Progress**

*Motivation.* Apparently Group I members are confused about how to react to the investigator. He encourages them to do things that are normally taboo in their homes. He encourages them to talk in a loud voice, to do things that are against the rules (such as roll a ball in the building). Also, the investigator doesn't act like a typical adult. He engages in far more histrionics, etc. As a result, they have apparently concluded that lesson-time is goof-off time. They can't seem to find the appropriate role because the investigator apparently doesn't fill any ready-made image. This point was dramatized this morning. The children were seated, listening to a lousy presentation of a lousy story. They were bored stiff. But they did not talk and act up. Instead they sat quietly until the fiasco was over. As soon as they were inside the lesson room, however, they sprang to life. They talked and moved around the room. They didn't listen too well, although they performed well. Their behavior was probably a partial result of the preceding boring activity, but it's probably also a partial result of the investigator's failure to define a role that is conducive to the job of learning the skills being considered. Group II continues to be exceptionally motivated.

*Learning.* Group II has perfected a learning approach. They have learned that they will use the fundamental rules that are presented at the beginning of each task. They therefore make an attempt to learn the new rules, with an eye to future applications. They mentally classify them so that they are accessible and tied in with rules associated with familiar patterns.

*Learning speed.* Group I is improving. Members (including the best performers) are probably a full week behind the members of Group II.

## Thursday, July 16, 1964

The investigator spent about twenty minutes with each group. All members were present.

### 1-1. Review

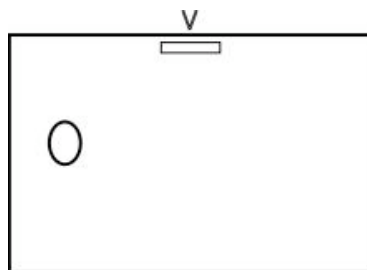
The investigator informed the members that he would present the criterion problem to three of the members on the following day—Ramona, Eric, and Junior. Then he stressed two points: (1) There is more than one way to change a system; and (2) you don't have to see something happen; you can figure it out.

To demonstrate point 1, the investigator presented the unpainted bar, the two line system (without the limiting vertical line) and the balance beam. He presented each system in a condition of change and asked individual members of the class to tell how that change might have happened. In each instance, two possible actions would have resulted in the change. The group responded very well. Each member worked at least two examples with each system, and there were no mistakes.

To demonstrate point 2, the investigator played detective, this time with the emphasis on the fact that you don't have to see something happen to infer it. He introduced basic rules, such as "If you walk in the mud, you get mud on your feet." Then he pretended that all the class members' shoes were placed on a counter. He pretended to examine each pair, finding one pair with mud on them. "What does this mean?" The group answered correctly, identifying the person to whom the shoes belonged and accusing him of walking in the mud. The investigator made the point, "Did we see him walk in the mud? No. Well, how did we know it happened?... We figured it out, didn't we?" Then he concluded. "You can figure it out if you just remember the rules. You don't have to see it happen." The group played the game starting from various rules, such as "If you eat the whole pie, you won't be hungry at supper time." The basic assumptions of deduction were stressed after each example. The class responded well to the game and members exhibited more flexibility in their verbal patterns than ever before.

### 2-1. Mirror Problems

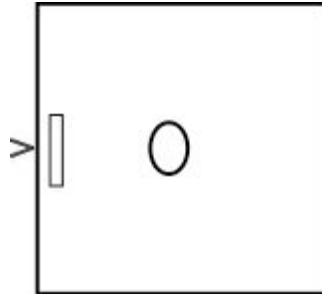
The investigator did not review the Group II. Instead he continued with the various mirror problems. Today, he introduced some very difficult problems that require a firm understanding of the principles of reflection. He drew a room on the board and placed a mirror in it, marked with a V. Then he indicated one of the children with a blob to one side of the mirror.





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“That’s you, Lynn. Now, think big. Where would I have to stand if I wanted to see you in the mirror?” Lynn, David, and Audrey answered correctly with the mirrors in different positions in the room. They also responded well to this problem.

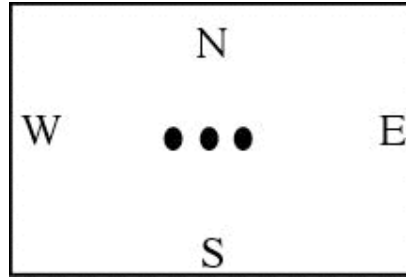


“Okay, there you are. Now where would I have to stand to see you in the mirror?” Lynn indicated that the investigator should stand right in front of the mirror (which constitutes a correct answer). The investigator then pointed out that he was much taller than Lynn and could therefore see over her. “Where also could I stand then?” She indicated a spot behind the blob on the board. David and Audrey answered correctly on similar problems (with the mirror in different positions in the room). Eran didn’t catch on. Apparently he doesn’t quite get the idea that the line on the board represents a path of light or a line of visions (or the path of a rolling ball, for that matter). The investigator is proceeding despite Eran’s deficit.

## 2-2. Map problems

The investigator reviewed the directions on the map. All children remembered the names north, south, east, and west. All could repeat the rule, “North on the top and south on the bottom. East on this side and west on that side.” The investigator proceeded to set them up for the next task, understanding relative directions on the map. The middle point is east of the left point and west of the right point. To orient understanding for relative direction, the investigator began distinguishing between the name of the nominal direction of a given point and the name of the direction one must travel (or must assume) if he is to reach that point from another point. The first part of this presentation involves understanding that points have names according to their position and according to the actions associated with them.

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The investigator drew three points (above) in the middle of the map. He then asked individual members of the group to tell which point is east, which is west. Then he presented the first of a series of “relative situations.” “Let’s all pretend that we’re in the middle dot. Okay, now we want to go to this dot over here...[draws arrow to indicate the direction of travel] Which direction do we have to go?...Now let’s go back to the middle dot. This time we want to go to the other dot. In which direction do we have to go?... Good.” He repeated the exercise with the dots lined up in a north-south direction and in different positions on the map (to militate against the children associating the problem with spurious set cues).

### **Progress**

*Motivation.* Both groups were well motivated today. Group I was impressed by the idea that they were going to solve important problems tomorrow. Group II members were a little more restless today than they normally are, but their performance was excellent and they were reasonably interested in what was going on.

*Learning.* The members in Group II, Lynn, David, and Audrey, are progressing at a remarkable rate. Within a few months, I could teach them virtually every non-mathematical formal operational problem Piaget ever used. Many of these they would pick up by sheer analogy, once the characteristics of the system were demonstrated.

*Learning speed.* Group I is not lagging further behind. Members have finally caught onto the pattern of reasoning that is prerequisite to deductive thinking. They have finally internalized the checkpoint procedure. Perhaps the various approaches presented to the same problems jarred them out of the idea that one has to hang onto a single verbatim recital. (Two members of the Group I have not caught on yet, Debby and Sherry.)

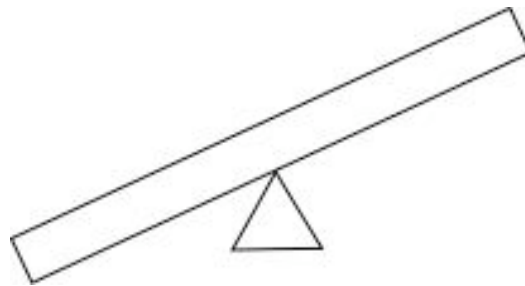
### Friday, July 17, 1964

The investigator gave the criterion problem to three members of Group II. He did not think that two members of Group I (Sherry and Debby) were ready for the problem; David was absent from Group II. Of the six who tried the problem, five solved it.

#### Procedure

The tests were recorded and a secretary from the Institute (Kay Case) was present to take notes whenever the investigator deviated from the standard procedure.

The investigator called the children into the test area one at a time. The item used for the test had never been presented in any session. It required a combination of what the children had learned about the bar push-pull problems, what they know about the fresh paint rule, and an understanding that the balance beam problem is the same as the bar push-pull problems in logical ways. The investigator explained, "I'm going to give you a hard problem. Think big and figure it out. He drew a tilted balance board on the chalkboard.



He explained, "Take a good look at this balance board and tell me how somebody moved it to make it look this way."

The correct answer: "Push down on this side [left], or push up on this side [right]. The investigator then chalked a colored line across the top of the balance board. "This is fresh red [or blue] paint. You know what that means. Now, if I tell you that the guy who moved the board got paint in his hands, show me how he moved it. ...Tell me. What did he do?..."

The correct answer: "He pushed down on this side, [Right]."

#### Subjects

##### Group I

*Ramona.* Solved the problem with almost amazing speed (as most of the others did). She did not hesitate. As soon as she learned the condition, she ran to the board and indicated the direction of the action. She verbalized the response correctly.

*Junior.* Junior gave an amalgamated response when asked to tell how the unpainted board might have moved to achieved the attitude shown in the diagram, He said, "Push down

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on this side *and* push up on this side.” Since the response was amalgamated, the investigator asked, “Do you know which one he did?” Junior answered, “Yes,” and indicated that the somebody must have pushed up on the right side. The investigator asked again, if that’s how he moved the board. Junior said, “*He probably* pushed up on this side.” The investigator asked, “How do you know?” Junior grinned and shrugged. The investigator asked, “Do you know?” He answered, “No.” The investigator feels that he understood the basic choices involved in the problem. He had never used the word probably before, and assuming he knows what it means, he was simply trying to defend his original statement that he knew how the change was achieved. This interpretation is consistent with Junior’s general pattern of behavior. He doesn’t like to be wrong.

When the investigator introduced the limiting conditions, Junior quickly solved the problem and verbalized the solution properly.

*Eric.* The children had studied paint primarily in relationship with painted bars. The action of the bar is push-pull. Therefore it seemed to the investigator that the greatest danger of failure would lie in the total transference of the bar response to the balance board, which would result in the child touching the painted area and saying either “He pushed in on this side,” or “He pushed out on this side.”

Eric gave the investigator a scare. He answered the question about the unpainted board correctly, but when he started to answer the question about the painted balance board, he began moving his hand *in* toward the board, the same motion the same motion the investigator had taught the children to use when working with the painted bar. The movement goes with the response, “Push in on this side.” However, as Eric started to talk, he noticed that the movement of his hand did not correspond to the pattern of movement of the balance board. For a moment he was uncertain, then he smiled and said, “Push *down* on this side!” The investigator sighed.

## Group II

*Lynn.* Lynn’s performance was perfect. She was confident and correct.

*Audrey.* Audrey performed about as well as Lynn and Ramona.

*Eran.* Eran failed to pass the problem. The investigator believes that under normal conditions he would have passed it; however, he tried the problem immediately after giving a long (at least 10 minute) recitation in the other room. He was not attentive when the problem was presented and he did not actually try to figure the problem out. Instead he did what Eric almost did, and what Junior did. He amalgamated his response about how the somebody might have moved the board; and he transferred the painted bar response to the painted board. “You push in on this side,” he said. The investigator tried to get Eran to reconsider the problem, but he could not solve it.

The investigator will give the problem to David sometime during the next week.

## Monday, July 20, 1964

The investigator spent twenty minutes with two children from Group I and all members of Group II. For the remaining sessions, Group I will consist of only Debby and Sherry, the two members who are lacking in prerequisite skills.

### 1-1. Same

The investigator introduced precise operations for determining whether or not two things are the same.

- A) Same color. Ask yourself: Do they look the same?
- B) Same shape. Ask yourself: Do they look the same? Are the parts the same?
- C) Same size. Ask yourself: Do they begin in the same place and end in the same place?

The two children had no trouble with A or B, but they didn't quite understand C. The investigator had them repeat the general rule—and ask themselves the appropriate questions—at least six times (until it seemed apparent that they were becoming saturated).

### 1-2. Longer

In the original analysis, the investigator skimmed over the difference between the word *longer* as a designation of relative size and the work *longer* as part of an action that considers a different aspect of relative size. When we say that one of two lines gets longer, *we say that becomes longer than when it was regardless of its relationship to the other line*. The investigator tried to clarify the difference between a longer line and making a line longer by (A) drawing two lines that different dramatically length.



He asked which line was longer, and demonstrated that it's possible to make the longer line shorter by erasing part of it. After he made the line shorter, it was still longer than the other line. (B) Introducing a mnemonic type rule to help the children remember longer and shorter. He instructed them to hold their hands out in front of themselves about a foot apart. "Pretend there's a line between your hands. Here's the rule. When you make that line shorter, you'll end up clapping your hands together. When you make that line longer, you'll end up stretching your arms out to the side as far as they'll go." The investigator worked on the rule until the children seemed saturated.

### 1-3. Review

The investigator went over same, longer, shorter, reminding the children of the various rules. He placed strong emphasis on the notion that you approach a problem by asking yourself questions. "Don't guess. Figure it out."

2-1. Relative direction

Piaget maintains that relative direction is one of the most difficult concepts for a child to learn. Actually it is not too difficult if one assumes the proper viewpoint—just as nothing is actually difficult if it's properly translated and expressed in terms of prerequisite concepts in the child's repertoire. Within 15 minutes, the investigator had taught three children in the group how to solve problems of relative direction.

Here are the steps he followed:

A) He introduced a more precise rule for determining whether a town on a map was east, west, north or south. He indicated the four directions on the black board and placed three towns in a row.



He pointed to the left town. "If we want to know the direction of this town we ask ourselves, 'How do we get there?' Let's see. If we're at this town [middle dot] how do we get there? We have to go this way. We have to go west."



He pointed to the right town. "And if we're in this town, how do we get there? We have to travel..."



....west.

So we say that this town is west of [middle] this town and west of [right] this town.

B) He demonstrated how the basic rule applied to dots in both east-west, and north-south orientations. Each child had several turns at working these basic problems.

C) He applied the same rule to the middle town.



“Is the middle town east or west? We don’t know until we know where we’re starting out from. What’s our rule? If we want to know the direction of this town, we have to know how do we get there? Well, that depends on where we are. And unless we know where we are, we don’t know how to get there. If we start out in this town [left], we have to go...



...east. So the middle town is east of this town. But if we’re in this other town, we have to go...



west. So the middle town is west of this town.” To keep the children from getting confused, the investigator kept on finger pointing to the middle town throughout the discussion, so the children would have a point of reference to remind them where they were supposed to be going.

At the end of the 15-minute session, three of the children in the group could solve problems of this type—and understand what they were doing.

### Progress

*Motivation.* The smaller group works better in the Group I situation. Attention is much keener, and the children have more of a tendency to listen while the other responds because they understand that the investigator may call on them next.

*Learning.* Three of the members in Group II are doing an excellent job. The two girls in Group I have a very weak grip on the basic assumptions and logic of language. I talked to Debby’s older brother today (7 1/3). He read to me from a book and I gave him a part of a test I am developing for determining specific conceptual deficits. He read extremely well; he scored extremely well on the test; and he indicated in response to a question about the smartest boy in his room that he was the one. I believe it. His performance rather thoroughly snuffs out the hypothesis that I’m working with a group that can be characterized as “culturally deprived.” Ramona’s mother is a schoolteacher of

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exceptional ability. Junior's mother obviously cares about him. Debby comes from a home in which middle-classed values are stressed—yeah hammered. Eric is quite intelligent. The parents of all of these children are concerned enough about the intellectual development of their children to send them to a nursery school.

I knew nothing about these children when I selected them for the group. I selected on the basis of verbal skills. Only one of the children exhibited knowledge of colors (although I don't believe I tested Ramona).

However, there are differences between the members of this group and those in Group II. Even the more proficient members of the group make amalgamated responses and hasty conclusions that seem to indicate some language deficits. I can't explain why these differences should be so pronounced.

*Learning speed.* Group I members are learning the tasks very slowly. They don't have the mental framework necessary to hook the present concepts. These concepts will have to be drilled home and firmly implanted and defined in terms of the questions that relate, which will take time. There is no short cut.



## Tuesday, July 21, 1964

The investigator spent about twenty minutes with Group I and about twenty-five minutes with Group II. Group II was visited by Dr. Samuel Kirk, so the investigator demonstrated some of the concepts the members had mastered.

### 1-1. Longer-shorter

For the first time, the investigator got through to Sherry that the words he was using were related to words that she knows. She had consistently failed to understand concepts such as long. One time she would answer correctly, the next time, incorrectly, indicating to the investigator that she was using spurious cues to try to find the concept. The investigator tried operationally defining the terms with only moderate success. He had also tried to relate it to words which he supposed were in her vocabulary, again with only moderate success. Today, however, he tried capitalizing on words and observations that *she made*. The investigator had assumed that she understood that there are different ways to express the same concept. This assumption was dead wrong. She was at a very primitive, concrete level of reasoning, and she had no idea that there are such words as synonyms. Today, when the investigator was demonstrating a small line, Sherry observed, "That's a biddy baby line."

"That's right," the investigator said. "And we have a name for biddy baby lines. We call them short." Sherry smiled broadly, and the investigator sensed that for first time, he reached her. *He had communicated the fundamental idea that a word or a phrase can have a name just as a thing can have a name.* "Just remember, we call biddy baby lines *short lines*."

When the investigator demonstrated a long line Sherry observed, "That's a great *big* line." The investigator agreed and pointed out that we call great big lines long lines. He tried to emphasize the fact that they can be called both great big and long. Sherry apparently got the point.

### 1-2. Balance board

The investigator drew a diagram of a tilted balance board and had the children repeat the basic rule they had learned about it. "If one side is up the other side is down." He then made up a game in which the children had to use the rule. He had them pretend that they were on either side of a balance board, and he instructed one of them to stand up while the other one squatted down. Then he had the one who was squatting stand up and the one who was standing squat down.

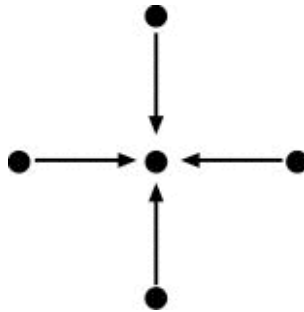
After they played the game, the investigator again presented diagram problems, referring to the sides of the balance board in terms of the game that had just been completed "Okay, this is Debby's side, and it's up. When Debby's side is up, Sherry's side is...."

### 2-1. NSEW

The investigator reviewed the locations on the map and the orientation necessary to determine whether a place is east, west, north, or south. He placed one dot in the middle of the board (which had been lettered NSE and W). Then he asked the children whether

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the dot was north, south, east, or west. He said, “The answer is... I don’t know. You can’t know unless you know where you’re coming from.” He drew another dot to the left of the first one. Then, pointing to the first one, he again asked. “Now is the dot north, south, east, or west of this dot? Ask yourself: How do I get to this dot? He went to the other dot and drew a line to the middle dot. How do I get to this dot? I go west.” He repeated the original demonstration from various directions until the diagram formed the pattern.



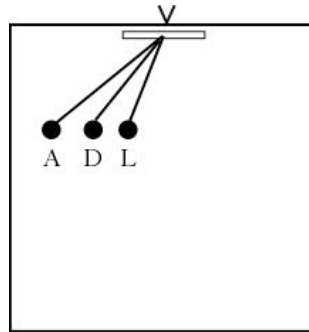
He then erased the pattern and replaced it with five dots (one in the center and four around the periphery). He called the center dot Playtime Nursery School. The dot to the left he called one of the children’s homes. “This is your home Lynn. Now, is Playtime School east of your home, west of your home...” Lynn drew a line from her home to the school, saying, “It’s east, because I have to go east.” The other children (with the exception of Eran), correctly identified the relative direction of playtime from their houses.

#### 2-2. Visitor-review

Dr. Kirk came in the classroom at this time so the investigator demonstrated some of the skills the children had mastered.

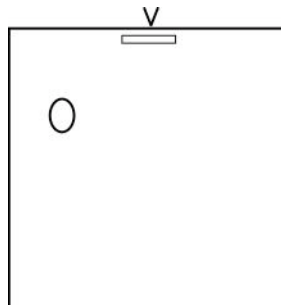
- A) NSEW. Each of the children correctly answered a question about relative distance with the 5-point diagram.
- B) Double-H model changes. Each of the children correctly answered a question about how the double-H model had changed.
- C) Bar push-pull. Each of the children correctly answered a question about a painted bar.
- D) Rolling ball problem. David, Lynn, and Audrey correctly answered questions about the rolling ball.

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Each correctly indicated the line of reflection.

E) Mirror problem: David, Audrey, and Lynn correctly answered a very difficult set of questions about mirrors. The problem was diagrammed this way.



The blob was explained to be one of the boys or girls. “That’s you David. Now where would I have to stand to see you in the mirror (V)?” David, Lynn, and Audrey answered different problems correctly, Eran didn’t.

### **Progress**

*Motivation.* Both groups were well motivated. I believe that the difference in motivation of Group I, now that the group is reduced to two members, will be reflected in better performance. Group II members liked the change to show off their visitor and they did an impressive job. Out of about 30 responses, there was only one error.

*Learning.* On the basis of what the investigator learned today in dealing with Sherry, there is no quick remedy for the child who has not learned that it’s possible to use words that describe words and to use words that have about the same meaning as other words. The secret, apparently, is to tie the new concept to what the child knows. Unless this is done, the new system never really takes root; it remains a kind of foreign body that has no real meaning in terms of the child’s other verbal skills. The investigator should have first found out how Sherry would have described the lines; then forged a link between her description and the words would use in the experiment—in much the same way he did

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today. The problem associated with this approach is that Sherry is just now beginning to describe these marks in her own words. Her standard approach until recently has been to find a familiar word in the statement and use it as a point of reference for a tangential discussion (and she hadn't employed this approach for the first two weeks of the schooling sessions). If, for instance, the investigator was talking about bouncing balls and the rules that describe their fundamental actions, Sherry would begin talking about her ball, etc.

*Learning speed.* Group I showed some real progress today. Group II, of course, made the investigator look pretty good today.

### Wednesday, July 22, 1964

The investigator spent about twenty minutes with each group. Both members of Group II were present. Eran was not present in Group II. Eran did not want to come into the session. He cried and objected. Actually, this reaction seems to illustrate the effect of failure on his attitude toward the learning situation. During the past several weeks, the investigator has been pacing his presentation according to the reception by Lynn, Audrey, and David; all of whom are virtually equal in performance. The only time the investigator exhibited any disappointment in Eran's performance was when he tried and failed the criterion problem. However, Eran has apparently experienced an increasing sense of failure. During the first few weeks of the session, he showed more alacrity than any of the other Group II members. Yet the experience of seeing his classmates solve problems that he knows are beyond him has apparently turned the learning situation from a fun-time activity to probably the worst kind of torture, the systematic erosion of the self image. Although the investigator hadn't scolded or reprimanded him, Eran increasingly became reluctant to solve problems, even those that are well within his grasp. Eran wants to deny any basis for comparing himself with his classmates. If he acknowledges a basis for comparison on problems that he can handle, he has to acknowledge the basis for comparison on those problems that he can't handle. This is very painful for him.

**The Eran phenomenon could become the basis for an interesting series of demonstrations and experiments in which one member of a group is made to identify himself positively with a group, and then is forced to either abandon identification or acknowledge that he is a failure in terms of the group standards of performance. These demonstrations could help clarify the indirect effects of accomplishment and comparison with group members on self-image, interest, expectations, and performance.**

#### 1-1. Synonyms

The investigator believed that if the children in Group I had actually caught onto the idea of synonyms, they could demonstrate it with analogous tasks.

He drew two vertical lines on the board, a thin one and a thick one about the same length. He asked Sherry which one of the lines was the fat line. She indicated the thick line. He then made the other line considerably shorter. Again he asked which was the fat line. She again indicated the thick line. "And which line is the *long* line?" he asked. She identified the thick line. "What's this other line?" he asked.

"It's *shorter*," she replied.

"Is it fat?"

"No. It's *skinny*."

The investigator repeated the demonstration with other objects that could be described by two dimensions in the children's repertoire—color and fatness of a line (after he pointed out that the color of the chalk was red), bigness and redness of square, etc.

1-2. Or

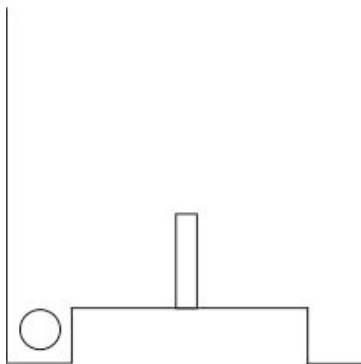
The investigator put a diagram of the balance board on the chalkboard and asked the children to describe what somebody might have done to make it look the way it looks. Both children knew that action could take place on either member, but both made the same mistake of amalgamating the response. “Push down on this side *and* push up on this side.” The investigator tried to give a series of demonstrations that would show the difference between the concepts *and* and *or*. First he said, “Sherry, I’m going to touch you, *and* Debby, I’m going to touch you.” He touched both the girls. Then he said, “Now listen carefully, Sherry. I’m going to touch you, *or* Debby I’m going to touch you.” He touched Sherry. “See? I don’t touch you and Debby. I touch you or I touch Debby. After he repeated the demonstration several times, he sat down and had each of the girls act according to the statement he made. “Debby, touch me or touch Sherry...Debby touch me and touch Sherry.” Next, he demonstrated or with different actions. “Debby pick up this piece of chalk or this piece of chalk...Sherry, pick up this piece of chalk *and* this piece of chalk.” Quite clearly, if a child cannot hear a word or tends to change a word into another word, he does not understand the original word. The children made no real progress in understanding the concept *or*.

2-1. NSEW problems

The investigator presented a series of problems in which members of the group were required to figure out whether a given point was north, east, south, or west of another point. They performed perfectly. There is no question about their ability to understand the orientation necessary for perceiving directions.

2-2. Deductive chain problem with more than one limiting condition and more than one action

To see how much the children had learned about applying the basic principles of deductive reasoning to various problems, the investigator introduced a new kind of problem. He drew a room with a depression at either end and a glass in the middle, suspended a slight distance from the floor, and a ball in the left depression.

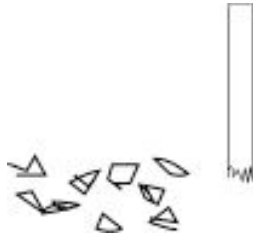


He explained the basic rules that would be used in deductions. “When a ball goes through the glass, the broken glass goes with the ball. If a ball goes this way, the broken glass goes this way and lands here. If a ball goes the other way, the glass goes the other way and lands here.” He did not present any of the deductions that were possible from the

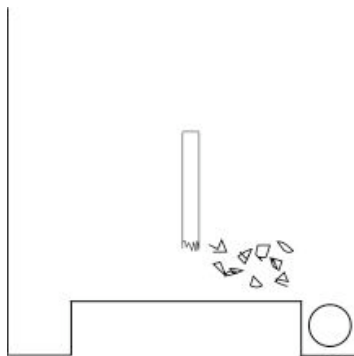
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rule. He merely had them repeat the rules until they had what we felt was a firm grasp of it. Then he presented the problem.

What if you saw a piece of glass that looked like this with the pieces of broken glass over here? Could you tell me what happened? Which way did the ball go through the glass?"



All members answered variations of this question correctly. Next, the investigator explained that in the room problem, the ball can get from one side of the room to the other either by going through the glass, or by rolling under the glass. "Now, you leave the ball over here (left side) and go out of the room. When you come back, the ball isn't over here, it's over here on the other side and look at this...broken glass here on the floor. Tell me how the ball got here."



Problems of this order (in which the glass either was or was not broken) were presented to the children. All answered correctly.

Next, the investigator indicated that the floor of the room was painted with fresh blue paint. He did not explain what that meant in terms of deductions. He simply introduced a series of problems in which the ball was somehow moved from the left to the right side and the ball was either covered with paint (no glass on the floor) or the pieces of broken glass were on the right side of the glass (no paint on the ball).

Finally, the investigator introduced a series of problems in which the ball was back in the left pocket of the room, the ball was either covered with paint or was not covered with paint and there was either no broken glass, broken glass on one side of the glass or

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broken glass on both sides of the glass (in which case the ball was not covered with paint). The children were asked to figure out what happened in these problems. While they had a little difficulty separating the steps necessary to arrive at the appropriate conclusion, they were correctly solving the problems within a few minutes.

They learned an extremely difficult pattern of deduction – and learned it rather thoroughly—in probably no more than ten or fifteen minutes. And the nature of the problem involved was every bit as sophisticated as those that are bandied about by the “heuristic” method for hours with only meager pedagogical success.

### **Progress**

*Motivation.* Motivation of both groups was good.

*Learning.* The inference I have drawn from the progress (or lack of progress) of Group I members in learning basic semantic rules is to rig the learning situation so the child is forced to see that various concepts coterminate in one object. I didn't do this when presenting the fundamental concepts to Group I. But I firmly believe that the best way to stimulate the child into formulating the notions a) that two or more words can mean the same thing, b) that two or more words that do not mean the same thing can apply to the same object, and c) that there may be words that talk about other words is to start with the fundamental notion that a given object can have more than one dimension. To make this point, the instructor should find out which concepts are in the child's repertoire. When he finds two that can coterminate in a given object, he should preset the object and hammer home the idea that it conveys both concepts. If the child understands the concept *big-little* and *skinny-fat*, the instructor should draw balls and long skinny ovals, then point out that each one is either both skinny or fat and big or little. Once the child accepts this fundamental notion of *coincidence*, he can begin to understand that there are different channels of attention for the different dimensions that may be exemplified by a given object. This, I think, is logically the first step in educating the culturally deprived.

*Learning speed.* Group II is progressing at a gratifying rate. Group I is grappling with fundamental concepts for which there is no analogy. The progress of Debby and Sherry is therefore slow. There is no happy mnemonic that can help them.



## Thursday, July 23, 1964

The investigator spent about twenty minutes with each group. All members (including Eran, who insisted on joining the group) were present.

The investigator gave the criterion problem to David. He passed it without any difficulty.

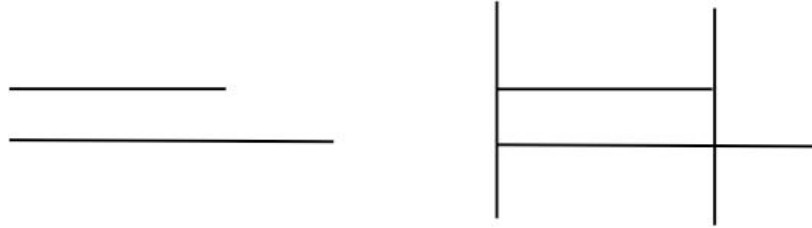
After he answered the question about the nature of the change if the guy that moved the board got orange paint on his hands, the investigator asked David ‘What if I told you that the guy came out of the room where the board was with no paint on his hands at all. How did he move it then?’ David pointed to the right side of the board, and said, ‘He pushed up on this side.’

### 1-1. Or

The investigator tried to get across the idea of *or* again to Group I members. Debby had caught on to the concept, Sherry hadn’t. The investigator started with a task of taking chalk from his hand, according to his instructions. ‘‘Take this one and this one,’’ or ‘‘Take this one *or* this one.’’ He used two pieces of chalk, but he soon changed to four pieces because Sherry did exactly what Debby did on the preceding turn. If Debby picked up the tan chalk, Sherry picked up the tan chalk, regardless of the instructions. So, the investigator gave different instructions using *or*. He would tell Debby, ‘‘Pick up this piece of chalk, or this piece of chalk, or this piece of chalk.’’ If she selected the tan piece, the investigator would exclude it from the three *or* choices presented to Sherry. He repeated the demonstration referring to different combinations of chalk and using either *or*-instructions or *and*-instructions. Sherry made some progress, but the concept is still fairly shaky.

### 1-2. Longer shorter in the double-H model

The investigator introduced the double-H model. Sherry was unable to apply the concept longer-shorter to it. She would apparently guess, but not out of boredom. She apparently thinks that the solution to problems of this kind are arrived at through guessing. The investigator tried to investigate why she was unable to relate the now fairly well learned concepts of long-short to the double-H model. One reason (discussed in the learning section of today’s report) is that the initial concept in a series of analogous applications should always be the least stable and the slowest learned; the other is that Sherry apparently doesn’t see the analogy. She knows that the statement about the longer lines transfers to other situations in which she’s confronted with a single line or two horizontal lines, one over the other, but she doesn’t know that when these lines become components in a more complex figure they are still longer. (A test of cognitive maturity might well incorporate a test in which the child is asked to integrate a simple dimension or judgment into a more complex form. Specifically, the test could ask him to identify which of two lines is the longer and then ask which of the same lines is longer when incorporated in the double-H model.)



Sherry apparently didn't see that the bottom line (or the one that extended past the vertical line) was continuous. So the investigator pointed out that it begins where the other line begins and extends past where the other line ends. Sherry mentioned that the double-H model looks like a bed. The investigator capitalized on her comment to point out that the changed double-H model looks like a bed with something sticking out or with something missing. Sherry got a charge out of this way of looking at the problem and seemed to make some progress in understanding.

### 1-3. Bar push-pull

The investigator introduced the bar problem. Debby could tell the two ways in which a given change could be achieved. Sherry couldn't. She had trouble with the words. She couldn't say "or," and she apparently tried to repeat the words used to describe the phrase as a rote statement, with no apparent meaning. She couldn't seem to use the word "in" to describe the direction in which the bar was moved when it approached the center. The investigator used a bar to test her understanding. He held it in the middle and instructed her to push the bar in. She did. He told her to pull it out here. She did. He then pointed out that the operations she had just performed were the ones used in the problem. "See? Push it in here. Pull it out here." Sherry smiled and for the first time, she seemed to approach the task with some understanding.

Her basic problem, in the investigator's opinion, is not in understanding the abstraction on the board but more fundamentally in understanding that two grossly different situations can be described with the same set of words. She thinks that the words are a part of the situation and tools for describing a class of situations. She does not understand the basic substitution rules of the language.

### 2-1. Deduction with the ball-in-room problem

The investigator gave Group II members a series of problems that involved deductions with the ball-in-room set up. The children solved these problems with no difficulty.

### 2-2. NSEW

The investigator introduced the most difficult NSEW problem the children have yet had. He drew three dots on the board (in either a vertical or horizontal orientation). He asked individual members of the group to "Tell me about the middle dot. Which one of these other dots is it east of and which one is it west of? The first child to try the problem was stymied, so the investigator reminded her of the fundamental rule. "Ask yourself how you get there." Lynn protested. "But I don't know where my house is." The investigator replied. "Well, pretend that your house is here and then over here. You'll get two answers

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then and they'll both be right." Lynn did and successfully solved the problem. So did the other children. They each had three turns. Occasionally, they would become confused about which dot they were talking about. "The one you're going to is the one you're talking about. You're going to the middle dot so that's the one you're talking about."

### **Progress**

*Motivation.* Good for both groups.

*Learning.* **The first of a series of analogical skills should always be the slowest learned and the least stable (until it is reinforced and buttressed with oblique rules and experiences). The first learned is the one that represents the greatest amount of experimentation and error. It wears the engrams of each error.** It is never clearly defined. The phenomena can be rather simply demonstrated by teaching a preschooler (age: 3 1/2) a complicated classification system, such as the classification of dinosaurs, starting with sauriscian and onithiscian and proceeding to the names of members of the theropods, sauropods, etc. The child will learn it very slowly and he'll have trouble hanging onto it. Teach him three or four other complicated series that are roughly the same as the first in that they involve unfamiliar words and classes within classes. He will learn the fourth series a) substantially faster than a child of his age and verbal ability can learn it, b) substantially faster than he learned the first series. And his retention of the names and relationships will be better. A year later he'll remember far more of the last series than of the first (although in actual time, he may have as much as three times invested in the first). A series of experiments defining the relationship between the initial learning in an analogy series and subsequent learning should be initiated. It would greatly broaden understanding of the dynamic of learning.

*Learning speed.* Debby is progressing considerably faster than Sherry. I would guess that by the end of next week, Debby will be ready for the criterion problem. Sherry, on the other hand, is in some respects at the concept level of a three year old, using an approach to problems that violently interferes with the conventions we have stipulated as necessary for the solution.

## Friday, July 24, 1964

The investigator spent about twenty minutes with each group. All members were present. Today was the final session with Group II. They will be tested on conversation next week and the investigator will try to arrange a meeting with the parents to explain the nature of the program, its outcome, and implications.

1-1. The investigator hypothesized on the basis of Sherry's performance that she does not transfer words in the manner we normally expect from children younger than she.

To test this hypothesis, the investigator presented static state positional concepts and movement concepts that involve the same position. For instance, "Hold the box over the wagon," and "Move the box over the wagon." The investigator presented the following static state positional words and movement positional words. The three objects involved in the demonstration were a small chalk box, a wagon, and a rocking horse. For the push-in and pull-out demonstrations, the investigator used a table leg.

- in – put the box in the wagon
- on – put it on the horse (or wagon)
- over – put it over the wagon
- between – put it between the horse and the wagon
- behind – put it behind the wagon (or the horse)
- under – put it under the horse
- over – make the box go over the wagon
- past – make it go past the wagon (or horse)
- between – make it go between the horse and wagon
- under – make it go under the horse
- pull out – pull the bar out
- push in – push the bar in

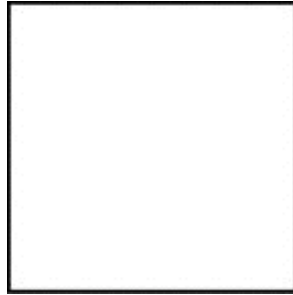
The concepts underlined are the ones Sherry failed on.

She failed to relate the action to the familiar concepts, especially in the case of under and over, which she correctly demonstrated with the static state instruction but which she failed to grasp in the moving state—even after the investigator demonstrated the static state *between* until Sherry could successfully handle the concepts. Sherry does not use words the way the culturally privileged children do. She does not understand the basic assumptions of our language and as a result, she is not able to "generalize" words. I am writing an analysis on the nature of the culturally deprived child and the remedy, so far as school is concerned.

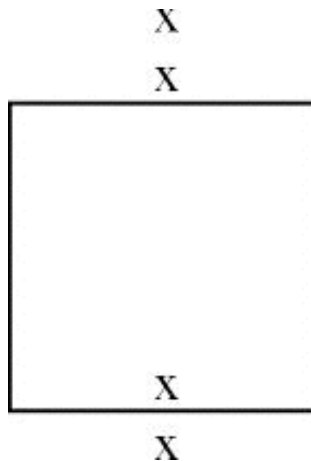
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## 1-2. Prepositions

The investigator tried to relate what Sherry knew about prepositions to the kind of diagram he had been using. The idea was that he wanted to demonstrate that she could use familiar words to work the problems that the investigator presented. He drew a picture of a box on the board.



He demonstrated how you put something in (into) the box. He also demonstrated how you take something out of the box. Both girls were successful in pretending to put objects into the box and take them out. Thus the continuity between the concepts the children had just been dealing with in the investigator's black board presentation was established. Next, the investigator indicated how the various position words are related to the box with a series of X's.



He then asked each of the girls to indicate the positions he mentioned. "Show me where *in* the box is"; "Show me where *over* the box is"; etc. Sherry answered correctly on several occasions and then began to make bizarre responses. The investigator admonished her, "Sherry, think. Think of what you're saying. The words are important. They help you figure things out. Now look at the diagram and think. Where is *under* the box? *Under*." She pointed to the appropriate X. The investigator asked her about the other positions.

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She correctly identified each. She actually seemed to be attending to the words and she seemed pleased with the idea that she could figure out the problem.

1-3. Or

The investigator again introduced the tilted balance board and asked the girls how somebody might have moved it to make it look this way. Sherry could not say the word *or*, and did not understand that she was talking about two possibilities. So the investigator played a game of *or* with her and Debby, using different objects (eraser and box of chalk). “Pick up the eraser *or* the box of chalk.” “Pick up the eraser *and* the box of chalk.” Sherry did not mock Debby’s actions, and she appeared to understand what the word told her to do. She simply couldn’t relate it to a situation removed from the game.

2-1. The investigator reviewed a series of concepts with Group II members

There were several delays in setting up the recorder. As a result, motivation and performance of the group were substantially poorer than they normally are. Here are the problems presented:

Problem with the double-H model

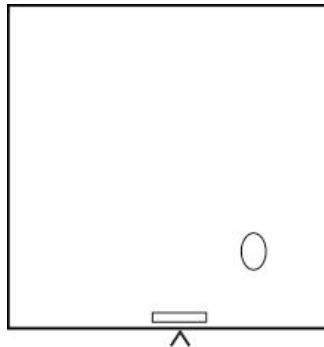
A bar push-pull problem (with limiting condition)

A balance board (with limiting condition)

A bouncing ball problem

A reflected ball problem

*A new problem with the reflected ball.* The children had never seen this problem. The principle is identical to that used in the reflected light problem, but the fact that they were able to transfer the principle showed that they understand the nature of the analogy (since they were able to transfer the appropriate propositions necessary to arrive at a solution). The problem was presented this way:



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“Okay, David, that’s me. Now, you want to throw the ball so that it will bounce off the wall at this point and come to me. Where will you have to stand?” David answered the question correctly. Audrey answered another one with the receiver in a different position. Lynn had some trouble with all of the reflection problems (which is unusual).

A reflected light problem.

Problems involving deductions with the glass-in-the-room problem.

In all, the children preformed well.

### **Progress**

*Motivation.* Good for Group I; fair for Group II.

*Learning.* Group II members have mastered the general deductive approach used in figuring out what happened. In addition, they have learned the specific rules of action that apply to various mechanical and social systems. They have learned something about the application of analogy—an extension of what they have already known about the words, namely that there is a class of substitution instances for a given concept. On the present level they learned that there is a class of substitution instances for a given *rule*, and a class of substitution instances for a pattern of rules or an *analogy*.

*Learning speed.* Debby is moving much faster than Sherry. Sherry not only has to learn a host of concepts; she has to learn that the concepts apply to a variety of situations.

Next week they will be tested on their ability to conserve quantity.

## Monday, July 27, 1964

The investigator spent about twenty minutes with Group I. Both members were present. The following tasks were presented:

### 1. Prepositions

The investigator reviewed the notion of prepositions, referring to the rocking horse. Then he played the game with the two pieces of chalk, in which he gives the instructions to either “Pick up this piece and this piece,” or “Pick up this piece or this piece.” Both Debby and Sherry performed without a mistake. The investigator then allowed each of the girls to be teacher and present the chalk task. Sherry had some trouble saying the *or* direction. In her obvious concern over the word, she began saying it at the beginning of the sentence, “Or pick up this one, or pick up this one.” The investigator told her how to handle the word. “Tell me what to do, then say *or* then tell me what else I might do.” Sherry manager several correct instructions.

### 2. Balance Beam

Sherry still had trouble with the balance beam problem. Specifically she had trouble working the *or* into her explanation. She finally did, however, and was able to correctly indicate the two ways in which a change might have been achieved in the system.

### 3. Bar push-pull

Sherry had troubles with her prepositions again. She would approach the bar and indicate the proper motions but say something like this, “Push out on another side [indicating that she is pushing in] and push out on another side” [indicating a pull-out motion on the other side]. The investigator took her through the steps very carefully and slowly, requiring her to repeat each statement after he said it. After a few trials, she was able to say the statement properly—in a way that indicated she understood what she was saying.

### 4. Word games

The investigator introduced some word-game exercises designed to strengthen the girls’ weakness in language. He would say sentences like, “The man wears a hat.” Then he would require the girls to repeat it. Finally, he would ask a series of questions, pointing out that the answer is in the original statement. “Who wears a hat on his head? The man.” “What does the man wear on his head? A hat. What does the man do with the hat?....” The girls were not able to work the simplest statements, but they caught on quickly once the rules of the game were spelled out. “Just listen to what you say. It’s got all the answers.” This exercise was probably the most productive the investigator has yet introduced. For the first time, the girls seemed to grasp the idea that the answers to many of the questions the investigator asked were contained in the “rule” they had learned. For the first time, they seemed to be catching on to the basic notion of using the rule as a rule. Sherry had some trouble answering questions about propositions that involve *and* and *if*. But her performance indicated that she was really catching on.

## Progress

*Motivation.* The motivation has steadily improved since the group was cut down. Today was probably the best to date. The girls were really interested in the tasks, and they



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seemed to have confidence in their ability to figure out the answers if they tired hard enough.

*Learning.* At the present rate of progress, I would judge that Debby should be ready for the criterion problem by the end of this week. Sherry will not be ready at that time, but she is showing definite improvement. In fact, she probably shows more improvement than any other member of either group. Some of the facts she learns however, are in the repertoire of the average three year old child.

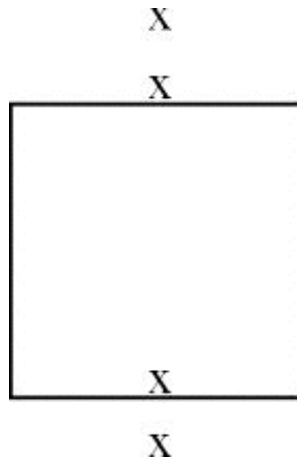
*Learning speed.* The patterns of language that Sherry is learning now are not meaningful to her. They are, in many cases, so many words, because she is unable to relate the semantic patterns from one situation to another. But as she learns a fundamental pattern of expression such as “if this happens, this happen” she learns new patterns of the same pattern in about one tenth the number of trials required for the first pattern, For instance, she learned to derive deductions from the statement, “If you drop the chalk, it will fall,” with only a moderate amount of prompting, whereas it had taken her probably fifty trials to learn the similar statement, “If you get into the jam, you’ll get jam on your hands.”

## Tuesday, July 28, 1964

The investigator spent about twenty minutes with Group I. Both members were present, and the following tasks were presented:

### 1. In the box

The investigator drew a box on the board and reviewed the names of positions, over, on, in, and under.



He drew an X in any of the above positions and the children were instructed to identify the X with a statement such as “In the box,” “On the box,” etc. Each girl had four turns with the entire series.

Sherry performed perfectly at the beginning of the exercise but began to saturate and make mistakes near the end. The investigator wanted to conclude the session with the girls understanding the concepts involved, so he went over the positions several times and had the girls repeat the proper designations after he said them.

### 2. Balance board

The investigator introduced the balance board in a tilted position and asked each of the girls how somebody might have moved the board to achieve the change. Both girls answered correctly. Sherry used the word *or* properly.

### 3. Bar push-pull

The investigator presented the bar with one side painted. He reminded the girls of the rule about touching wet paint. Then he asked them to indicate where the man must have touched the bar if he got wet paint on his hands. Both girls answered correctly. Sherry seemed quite pleased with herself.

### 4. Or game

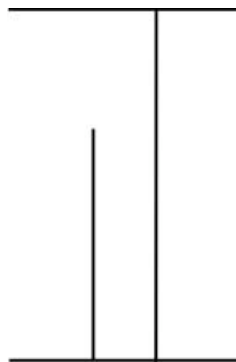
The investigator reviewed the game of Or, in which he holds several objects and gives instructions about picking up both objects or one. Today, he used two pieces of chalk,

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and instead of referring to them as “This one” and “This one” as he had in the past, he referred to them as the “blue one” and the “white one.” Both girls performed flawlessly. Again Sherry seemed pleased with her performance.

#### 5. Double-H model

The investigator introduced the double-H model in various changed attitudes. Sherry had some trouble, but after a rather thorough review of how to approach the model, what questions to ask, and how to *find* the answer in the model, not in the investigator’s face. Then, the investigator introduced a task that involved a certain amount of flexibility with the familiar rules. He drew a vertical version of the double-H model, with one line changed.



To help Sherry visualize what had happened, he used a metaphor Sherry had introduced to describe the double-H model. She had referred to it as a bed. “See? The bed is standing up on end. It was standing like this... [indicates headboard and footboard by holding up hands vertically]... and now it’s tipped over like this.” Sherry could not see that the model was tipped. When asked to tell which line had been changed, she indicated the upper (now) horizontal line of the model. The investigator explained and demonstrated how the model had been tipped, but Sherry apparently didn’t catch on.

#### **Progress**

*Motivation.* Motivation remains very good. During almost all of the lesson, the girls are interested in the proceedings and pay attention, even when the other girl is performing.

*Learning.* Sherry is definitely learning the concepts. She seems to know what to listen for in the investigator’s presentation. She is becoming quite conscious of words. And she is showed another real sign of progress today. She introduced a synonymous expression and seemed quite proud. Instead of saying, “On the box,” as she had said on several previous times, and as the investigator and Debby had said, she said, “On *top* of the box.” For Sherry, this is quite a big step forward. Her confidence is improving and her certainty with the concepts is also improving. She seems to be learning which cues are important and which aren’t, although she still has a tendency to make a wild guess if she gets confused.

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Her performance is different from that of Debby's in three respects. I think these are important because they could well represent the difference between very slight cultural deprivation and more severe cultural deprivation. Sherry saturates more quickly; she fixates on incorrect responses with greater tenacity; and she exhibits a lack of transfer.

The first two of these differences are, I think, a reflection of unfamiliarity with the type of learning task and the material. It is the same kind of learning pattern younger children exhibit when they are exposed to new verbal-learning tasks. They have not worked out feedback rules for determining the difference in "feel" between a response that was wrong and one that was correct, so they try to select the response that has the "heaviest" feel, the one that seems to have the greatest investment in response. This is the last one they produced. As a result, they find themselves making the same mistake, over and over, regardless of the amount of correction.

The remedy for this kind of mistake is practice, practice, and practice, until the child learns to distinguish between a response that feels heavy because it's incorrect, and one that feels heavy because it's correct.

Quick saturation is the other side of the same coin. The correct response is like a piece of clay. Unless it's the right weight the child can't handle it; unless it's the proper shape he can't recognize it. Too much handling pushes the clay out of shape and soon, the child can't recognize it.

The remedy for quick saturation is again practice. With time, the clay hardens. With practice, the child is able to handle a new response more skillfully. He can isolate it more readily, separate it from the language pattern in which it is contained (which pattern becomes increasingly "hardened"). In short with practice new responses become easier because they require less learning.

Lack of transfer, however, does not merely reflect a lack of familiarity with the tasks. It indicates that the child has learned maladaptive rules for interpreting the language. He has learned *not to transfer*, because the fundamental assumptions of the language have never been presented to him in a way that makes the notion of transfer tenable.

The remedy for lack of transfer in the culturally deprived is an overhaul of the language system. The deprived child must be brought back to the fundamentals of language and then guided down the path of conventional associations, from object identification through relations and properties to deductions, etc.

*Learning speed.* The pace of both girls is definitely improving. Debby may be ready for the criterion problem now. I'm not sure.

## Wednesday, July 29, 1964

The investigator spent about twenty minutes with Group I. Both members were present.

### 1. Over-in-on-under the box

The investigator presented the box and the X's. He spent about ten minutes going over the designations with Sherry. Sherry made a number of bad guesses. Typically, she would move to the next X when she was told that her answer was incorrect. When she indicated that the "on the box" X was under the box and the investigator told her she was wrong, she merely moved down to the "in the box" X. The investigator stressed the notion that you can't guess, that you have to figure out the answer. He demonstrated. "If this is in the box, it can't be under the box. If this other one is on the box, it can't be under the box. If this one up here is over the box, it can't be under the box." Some progress was made. On at least two occasions, Sherry seemed to figure out the correct answer.

### 2. Double-H model

Sherry had grown attached to the response, "You made it longer." She uses it even when she knows that the line is actually shorter. She can properly identify the longer line and the shorter line. She can tell which line is changed. But she cannot answer the question, "Did I make it longer or shorter?" She will always answer, "You made it longer," whether or not the line is actually longer. Of the 20 trials on this problem, she answered the first two questions accurately every time. But she failed on the third one every time the line that was changed had been made shorter. The investigator stressed the relationship between the questions. "Here's what you say to yourself. 'Is this the one he changed? Yes, this is the one he changed. Did he make it shorter? Yes, he made it shorter.'" After working about six minutes on the approach to the task, Sherry had made some progress.

## Progress

*Motivation.* Motivation seemed adequate. Understandably, Sherry was getting a little tired of the investigator's badgering. And she seemed sometimes to revert to her old guessing behavior. But her motivation was adequate.

*Learning.* The type of the learning deficit Sherry exhibits can be seen quite clearly in the two tasks studied today. Her approach is identical. She does not use the statements she has learned to answer questions or formulate contradictions. She doesn't seem to grasp the idea that if she knows that a given X is called "under the box" that it can't also be called "over the box." Perhaps, this is a sign of progress. Before, she had trouble using two designations to indicate the same object or concept. Now she seemed to learn that two designations are compatible. If this represents an antithetical stage, it represents progress—a movement toward the synthesis of the knowledge that things can have the same name under some circumstances and cannot have the same name under other circumstances. However, I think that the guessing is independent of the inability to use synonyms. I think that she has not grasped the basic polar assumption of the language. Since she hasn't grasped it, her notion of using synonyms is nebulous. The basic polar assumption is a general rule that if something is A it cannot be non-A. There is a set of polar words and a set of synonym words for every concept. The synonym words can be

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used interchangeable with the word. The polar words can never be used with the word because they contradict the word. For instance the term “In the box” contradicts the phrase “over the box.” A given position cannot be both in the box and over the box. On the other hand a given position can be “in the box,” “inside the box,” “down at the bottom of the box,” etc. These are synonym structures. With the double-H system, the same type of classification is possible. The polar words for the term longer are shorter, smaller, etc. Therefore, it’s contradictory to say that something is longer and shorter. The words longer, bigger, greater, taller, etc., are synonyms, so the structures, “It is longer” ; “It is bigger” ; “It is greater” ; etc., are all compatible.

Sherry’s primary deficit then is in understanding the fundamental assumptions of polar structures and compatible structures. Apparently my attempts are not striking at the heart of her deficit. I will have to give the matter some thought and try to work out a remedy that makes sense in terms of the present formulation.

*Learning speed.* Debby is progressing, both in performance and in confidence. Sherry, on the other hand, experiences severe regressions. Today’s was one of the worst, but something came out of it—I hope. I believe she started to see that her statements have to be linked together if they are to provide an intelligible pattern of reasoning.

**Thursday, July 30, 1964**

Conservation Test for Members of Group II

David Brison tested the members of Group II on conservation of liquid. His equipment consisted of two identical glasses, one tall thin glass, one taller thinner glass, and one very wide glass. After the subject was seated, Mr. Brison would present the two identical glasses to the subject, both glasses filled to the same level (approximately  $\frac{2}{3}$  full). He then asked, "What do you know about these glasses?" 1) After he had established that the subject could tell that the glasses "were the same" and could verbalize some kind of reason for drawing the conclusions, Mr. Brison poured the contents of one glass into the taller thin glass. He then pointed to that glass and asked, "Now, does this glass have more water to drink than this glass? Does it have the same water to drink? Or does it have less water to drink?" After the subject answered, Mr. Brison returned the liquid to the original container and once more established the fact that the subjects could tell that the two identical glasses again contained the same amount of liquid. 2) Mr. Brison then transferred the contents of one glass into the wide container and again asked, "Does this glass have more water to drink than this glass? Does it have the same water to drink? Or does it have less water to drink?" 3) The procedure was repeated with the medium-thin glass.

On the basis of their answers, subjects were judged conservers or non-conservers. All but one of the five subjects were non-conservers. David F. was the single exception.

Here are their responses to tasks 1, 2, and 3 (above). Subjects are presented in order of presentation.

Lynn:

1. The thin glass has more. Reason: Because it almost reaches the top.
2. The wide glass has less. Reason: Because it almost reaches the bottom.
3. The thin glass has more. Reason: Because it almost reaches the top.

David:

1. The thin glass has the same amount of water. Reason: Because the glasses started out the same.
2. The wide glass has the same amount of water. Reason: Because they started the same.
3. Did not administer.

Ellen:

1. This thin glass has more. Reason: Because the other one has less than this one.
2. The identical glass has more than the wide glass. Reason: Because this one don't (have more).
3. The thin glass has more. Reason: Because (the other one) don't.

Eran:

1. The thin glass has more. Reason: Because it's taller.

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2. The wide glass has less. Reason: Because this glass is bigger, shorter (shorter water).
3. The thin glass has more. Reason: Because it's taller (the water is taller).

Audrey:

1. The thin glass has more. Reason: It's taller.
2. The wide glass has less. Reason: Because it's wider.
3. The thin glass has more. Reason: It's thinner.

The responses all seemed well integrated. A post-test session, during which Mr. Brison demonstrated the contradiction involved in thinking that the water was taller when it came from a thinner vessel, seemed to produce only a moderate degree of understanding. It seemed that the children were employing fairly consistent analogies that implied specific information about the properties of water. If this is the case, they must learn specific facts about the nature of water (namely that it is not compressible, not elastic) before they can appreciate the contradiction that is implied by their behavior.

The investigator spent about fifteen minutes with Group I. Both members were present. The following tasks were presented:

#### 1. Over-on-in-under the box

The investigator repeated the box demonstration. He also used the prepositions in connection with a drawing of a car and a drawing of a rocking horse. He presented the words in a fixed order, proceeding either from over to under or under to over. The reason for this presentation was so that Sherry would learn certain set cues. Since the object referred to in connection with the preposition changed from trial to trial, it was felt that the set cues were not spurious. Both Debby and Sherry had a slight tendency to make statements like, "Over the *box*" when they were actually working with a drawing of a horse, not a box. However, neither girl persisted in this kind of response. Sherry had trouble distinguishing between on and over. The investigator kept going over the entire sequence, reminding her to listen to the words. After about five minutes of review, she seemed to be able to use the words properly. The number of guesses she made today was far less than the number she made during the previous session.

#### 2. Double-H model

The investigator, in an attempt to reduce the possibility of Sherry making the same kind of mistakes she had made during the previous sessions, asked the following questions about the double-H model. "Now which line is changed?... Is it longer or shorter?... Yes. And if it's shorter, he must have made it \_\_\_\_\_."

Sherry did not make a mistake. She had five tries, with different changes and she was correct on every one. She seemed quite pleased with her performance.

The investigator terminated the session after about fifteen minutes because he had an appointment to give Group II members the conservation of liquid test.



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**Progress**

*Motivation.* Motivation was good. Sherry seemed to get apprehensive when she realized that she was not performing well on the over-on-in-under task, but she seemed to keep on trying, and when she finally managed to identify the various positions, she smiled broadly.

*Learning.* I am in the process of teaching Sherry some of the fundamental assumptions involved in learning an “incompatible series” (one in which the various terms excluded the other terms.) In trying to comprehend the basic ground rules and relate herself to the task, she will make a lot of mistakes. Therefore, her performance on the present series (over, on, in, and under) will probably always be somewhat scarred and rough. However, in learning how to cope with the words, she will have learned a great deal about assumptions of language. Therefore, subsequent tasks that are similar will come much more readily. I think that the lessons she learns from making mistakes on the present task are necessary. They function as rather dramatic indicators of the deficiencies in the set of rules she uses to deal with words and they also function as the direct indicators of the kind of remedy needed to correct these deficiencies. Through these mistakes, she can see where she is weak, and she can learn what it takes to correct the weakness.

*Learning speed.* Improving. Sherry had apparently mastered the deductions that go with the double-H model.

### Friday, July 31, 1964

The investigator spent about twenty minutes with Group I. Both members were present. The following tasks were presented:

#### 1. Over-on-in-under

The investigator went over the box diagram. Sherry still had some trouble with the designation *on* and *over*. On her third trial, however, she successfully identified the locations. The investigator then played a kind of game that required the girls to use their knowledge of prepositions. He gave each a turn at positioning an eraser in relationship to a rocking horse, according to the instructions he gave. "Put the eraser in the horse." (Since the bottom of the horse was hollowed out, it was possible to put something "in" it). Sherry still showed some signs of confusing *on* and *over*, so the investigator tried to create a rather dramatic mnemonic. He reminded the girls that "on the horse" was the position one assumed when riding a horse. "Look. When you ride a horse you're on the horse." The investigator then asked Sherry if she could "'Put a Sherry on the horse.'" Sherry sat down on the horse and smiled. After each of the girls had several turns at putting themselves on the horse, the eraser task was again introduced, and Sherry performed perfectly.

#### 2. Double-H model

The investigator gave each of the girls four turns at figuring out which line in the double-H model had changed and how it had changed. Sherry answered correctly on each occasion and seemed quite confident about her answers.

#### 3. Bar push-pull

The investigator reviewed the basic principles of the bar through the wall and associated the nature of the bar with the lines in the double-H model. He first introduced the bar in a position of change.



He then asked one of the girls to indicate which side was longer and which side was shorter. He gave each girl four turns, with different diagrams. Both girls performed without a mistake. Next, the investigator "painted" one side of the bar and asked the girls to indicate which end of the bar someone would have to touch if he got paint on his hands or if he didn't get paint on his hands. Again the girls performed flawlessly.

#### 4. Word games

The investigator introduced statements such as “A man wears a hat on his head.” Then he asked the girls various questions, such as “Who wears a hat on his head? Where does a man wear a hat? What does a man do with a hat?” They were able to answer all questions—the questions of which were directly related to the original phrase. This represented quite a step forward, especially for Sherry, who answered with confidence and apparent understanding. However, questions that were based on *implied* rather than stated relationship were a little too much for the girls. For instance, they could not answer this question in relation to the rule: Ponies are smaller than horses. “If a guy gave you a horse and pony and asked you which one was the pony, what would you tell him?” (The shorter one.) The investigator reviewed some of the rules that had been presented in the past, in an attempt to demonstrate the continuity of the previous tasks with the present ones.

#### **Progress**

*Motivation.* Motivation was very good. The girls seemed to look forward to their session and had a certain sense of *esprit*. As the other children were going out to play, they joined hands and walked to the session area with an apparent air of pride. They performed very well. Sherry has obviously been thinking about what she learns in the lessons. Her motivation is, in my opinion, reflected in a greatly improved performance.

*Learning.* Sherry is definitely catching on to the function of words in reasoning. She is far more articulate in her speech and she is able to draw inferences that were quite beyond her only a few days ago. She has worked out some of the fundamental rules about substituting words and listening to words, and she is therefore able to direct her efforts to more productive channels. As she approached one of the double-H model problems, today, she seemed to have the blank abstracted expression she has when she is about to make a wild guess. So the instructor admonished her to think big and try to figure out the right answer. She furrowed her brow and stared intensely at the diagram—not at the investigator—as he talked, and promptly answered the question, punctuating it with a smile.

*Learning speed.* Sherry is over her first hurdle. Her learning speed should begin increasing considerably on tasks that require direct teaching, attention to words, specific rules, and a verbal subject matter. This does not mean that she would necessarily perform well on a task such as arithmetic that requires, in addition to an understanding of the verbal rules, an understanding of many conventions that are not obvious in the tasks Sherry has encountered to date. But she would learn to master arithmetic tasks much faster than she could have a month ago, because she now understands the fundamental assumptions of language. *She would be able to relate herself and her repertoire of skills to virtually any task that is grounded in verbal assumptions.*

### **Monday, August 3, 1964**

The investigator spent about twenty minutes with Group I. Both members were present. The following tasks were presented.

#### 1. Grouping I, II, and VII in Piaget's classification

Piaget's theory is unable to account for the fact that children can perform a variety of classificatory operations with language. Specifically, he cannot account for the fact that the pre-operational child can handle hypotheticals. In addition, he assumes that the preoperational child is not capable of classifying or "grouping" data in any self-consistent, coherent fashion. The investigator created tasks that require a knowledge of the various groupings. Today he presented 2 tasks. The first requires knowledge of Grouping I skills and Grouping II skills. The other requires knowledge of Grouping VII. These tasks are important because successful performance with them implies concrete operational thought. In this respect the Grouping VII task is particularly important, since it implies that the child is able to perform an operation that is logically equivalent to those defined as conservation of liquids. Both require the child to seriate non-symmetrical series of things and classify them accordingly. The Grouping I and II task requires the child to see the relationship between members and non-members of a class.

*a) Grouping I and II tasks.* "The investigator posed the task as a hypothetical situation presented to each girl individually. "Let's get all of the ice cream there is in the world and fill this whole church with it. We're going to get it all—but wait a minute. If we're going to get it all, we've got to know what kinds there are. What kinds are there?"

Subjects answered, "Chocolate, white, and strawberry (some prompting on strawberry)."

"Okay, now let's pretend. Suppose we've already got all of the strawberry ice cream there is in the world. We've got all there is. We've got this whole bottom part of the church filled with strawberry. Now, think big. What kinds of ice cream do we have to get?"

Both subjects answered, "White and chocolate."

The second task on Grouping I and II involved another hypothetical. "What kinds of children are there in the world?... Are there boy children?"

"Yes."

"What other kind of children are there?"

"Girls."

"Good. Now, what if all the boys in the world were taken away. What kind of children would be left?"

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The subjects had some trouble with this hypothetical. After several repetitions of the question, “What kinds of children are there in the world?” and reminders to listen to the words because they tell the answer, Debby answers correctly, “Girls.” Sherry did not answer correctly.

*b) Grouping VII task.* The investigator presented a hypothetical that’s logically analogous to Piaget’s task in which he presents subjects with a non-systematical series of sticks (if arranged properly, each stick is longer than the stick next to it on one side but shorter than the stick next to it on the other side) and a corresponding series of dolls. Subjects were instructed to give each doll the appropriate walking stick. In the present task, the investigator posed this situation: “Let’s pretend again. This time let’s say there is a great big guy—this big [indicates], and there’s another guy this big [indicates smaller] and there’s a little biddy guy this big [indicates near floor]. Then he repeated the entire situation to make sure that the subjects were familiar with the details. “Now, these guys go out and buy new suits. Which one buys the biggest suit?...Which one buys the next biggest suit”....Which one buys the next biggest suit?...Which one buys the *smallest* suit?” The correct answer to all of these questions implies an understanding of operations involved in arranging the dolls and the sticks. If the doll-and-stick problem relies on the ability to handle Bi-Univocal Multiplication of Relations, then the present task relies on Bi-Univocal Multiplication of Relations.

*Both subjects answered all questions correctly.* The parsimony or accuracy of Piaget’s Grouping is therefore in serious doubt. Sherry is obviously lacking in cognitive skills.

## 2. Combination of prepositions and conjunctions

The investigator combined several tasks which the girls had handled independently. The purpose of this combination was to create new “substitution instances” and strengthen their hold on the notion that a given concept remains the same in different situations. The investigator used chalk, tinker-toy components, a table, a box and a chair. He then gave a variety of instructions for the girls to carry out. For instance, he might say, “Put this one [chalk] and this one [tinker-toy piece] over the table”; or “Sherry, put the Sherry under the table or put her on the chair”; or “Pick up this one and this one, and put them in the box”; etc.

The girls performed without a single mistake.

## 3. Change

The investigator tried to present a more detailed set of questions in relationship to the change of the balance board and the bar through the wall. The primary aims of the new questions were to (1) prevent the children from developing fixed, set cues, (2) clarify the reasoning pattern implied by a given change.

He presented the bar through the wall painted and in a state of change. He then asked the following questions, but not in a fixed order.

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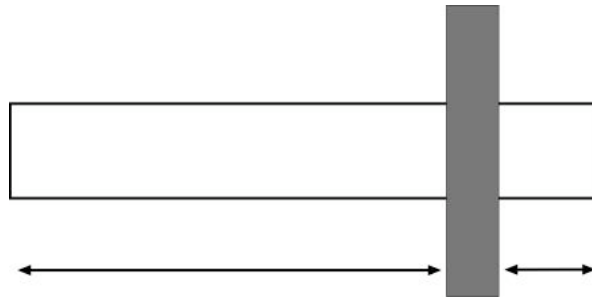
“Where did the guy touch the bar if he got paint on his hands?... Is this side longer or shorter?”

“How did the guy change the bar? Did he push it or pull it?”

“Which side is longer?”

“How did he make it longer?”

“How can you tell which side is longer?” The investigator showed how to tell the longer side by measuring from the center line.



He asked which of the arrows was longer, and the girls had no trouble answering.

The investigator asked a series of similar questions about a non-painted balance board in a tilted position. The girls performed remarkably well on these questions. When asked how the guys might have moved the board to make it look the way it does, Sherry pointed to the appropriate sides and said, “He pushed down on this side *or* he pushed up on the other.” The investigator assured her that she was doing a very good job.

### **Progress**

*Motivation.* Motivation remains very good. The children are obviously rehearsing the material presented during the lessons.

*Learning.* The fundamental task of listening to the words in the investigator’s statements and asking questions about them is beginning to take. When Sherry had trouble with one of the grouping problems, the investigator reminded her to listen to the words because they will tell you all the answers. Sherry put on a determined expression (with clenched fists) and listened as the investigator repeated the problem, she then smiled broadly and answered it correctly. She definitely has discovered the language road. Obviously, she has a lot of unlearning and relearning to do before her deficit will be eradicated, but at least she knows what she’s supposed to do – how she’s to go about it correcting her mistakes. I wish I could work with Sherry longer. I would like to demonstrate how a deficit of this kind can be completely wiped out and how the capacity of the relatively deprived can be modified.

*Learning speed.* Learning new tasks will be increasingly more rapid for both girls because they have learned a great deal about the fundamental ground rules of the game.

**Tuesday, August 4, 1964**

Conservation Test to Members of Group I

David Brison tested four members of Group I. Junior was absent. The conservation test (in view of the results with the other children) will not be administered to him. Mr. Brison presented three different conservation situations.

1. Water is transferred from one of two identical glasses to a tall thin glass.  
“Does this one [the tall glass] have more water to drink as this one, the same amount of water to drink as this one, or less water to drink than this one?”
2. Water is transferred from one of two identical glasses to a wide glass.  
The same question as in 1 is asked.
3. Water is transferred from one of two identical glasses to a medium-tall, thin glass.  
The same question is asked.

None of the children conserved, although two of those who received the test solved the criterion problem. (The other two have not taken it but will take it sometime this week. The investigator believes that Debby will pass but that Sherry won't.) Here are the responses to the three questions:

Names appear in order of presentation.

Ramona:

1. The thin glass has more. Reason: because it does have more.
2. The wide glass has a little bit in it (and more in the other). Reason: because you put a little bit in it.
3. The thin glass has more. Because it does.

Eric:

1. The thin glass has less. Reason: because it has more water. [Dave Brison interpreted this response as an indication that Eric was looking for some kind of trick. This explanation may be correct. It seems to the investigator, however, that Eric was referring to the air space at the top of the glass. It has less when the water is more. Eric seemed to think (because of the way the original question was framed) that the question referred not to the water but to the air space in the glass.]
2. The wide glass has more. Reason: It's fuller.
3. The thin glass has less. Reason: 'cause it's fuller.

Debby:

1. The thin glass has more. Reason: Because this one [thin one] is up to the top.
2. The wide one has less. Reason: Because this one is down to here [wide glass] and this one [other glass] is up to here.
3. The thin glass has more. Reason: This one is all the way up to the top.

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Sherry:

1. The thin glass has more. Reason: Because.
2. The wide one has less. It don't got no more.
3. The thin glass has more. Because.

Mr. Brison noted that the responses of the subjects were far better integrated and coherent than black children of school age he had tested at the Hays School.

The present demonstration seems to indicate that the formal operational-type thinking is not logically, conceptually, or developmentally dependent on the knowledge of conservation or the grouping which Piaget calls Bi Univocal Multiplication of Relations. The implications for education are profound.

The investigator spent twenty minutes with Group I. Both members were present. The following tasks were presented:

1. Double-H model—horizontal and vertical

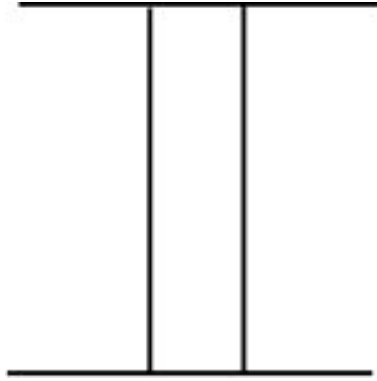
The investigator presented the double-H model first in the usual horizontal position. The girls answered all questions accurately. Then the investigator drew two parallel vertical orientations.



He had the girls describe the line, after which he changed it so that one of the lines was longer than the other. Again he asked questions. The girls answered them correctly. The investigator added the limiting lines to both ends of the model, and took some time to explain to Sherry that the “bed” was now standing up on one end. “Look at this, what would happen if you were in this bed? You’d fall out on the floor.”



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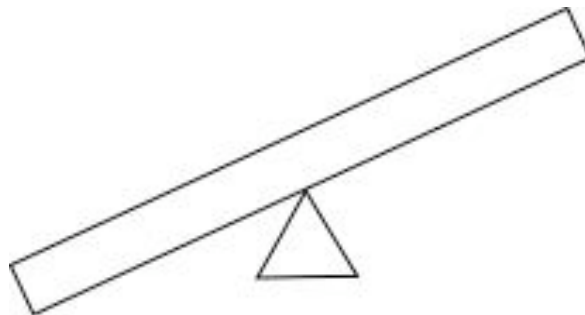
The investigator then introduced the vertical double-H model with one of the lines made either longer or shorter than the other (base line). Sherry made only one mistake in four trials. The investigator informed her that she had made a mistake and told her to look at the model carefully and figure it out. She looked and came up with the correct answer.

## 2. Bar push-pull

The investigator presented a series of unpainted bars and asked the girls to describe how the change might have taken place. The girls answered correctly in all cases (each girl had about five or six turns) and Sherry emphasized the word *or* in each case. “He could have pushed in on this side *or* pushed out on this side.”

## 3. Balance Board

The investigator introduced a new hypothetical question that required the girls to make a deduction about some of the basic rules that had not been discussed during the training session. The question referred to a balance board that was in a position of change.



“Okay, now if I told you that there was a boy sitting on this balance board could you figure out where he has to be sitting?” Debby answered the question correctly. Sherry apparently thought that since it was a hypothetical question it should have an undetermined answer. She said, “He could have sat *down* on this side or sat up on the other side.” The investigator pointed out that when you sat you always sat down and that if you sat down on something like a balance board, it would go down too. After the brief explanation, the investigator asked the same question about a balance board in a different

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position. Sherry answered correctly. She started moving her finger down and then went to the side of the board that was down and placed her finger there.

**Progress**

*Motivation.* Motivation remained good. The girls were less active and talkative today, perhaps because of the weather. But they attended well and seemed interested in the proceedings.

*Learning.* Learning is improving. The girls seem to know which of the details in the presentation are important. Debby is becoming quite confident and quite accurate. She has no trouble with the balance beam problem, which required quite a logical jump from anything she'd previously had. She had to take the concept that heavy things go down and only down, and link to her rules about the balance board;

1. The side you touch is the side you act on.
2. If you push down the board will go down.

I'm sure she will pass the criterion problem. (Actually the present problem is logically equivalent to the criterion problem.)

*Learning speed.* Speed continues to improve as the girls become more confident about their foundation in language and about their ability to figure things out from the original statement or situation presented.

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### Wednesday, August 5, 1964

The investigator spent about twenty minutes with Group I. Both members were present. The following tasks were presented:

#### 1. Word games

The investigator presented three word problems, the solution of which depended on an understanding of the situation presented;

a) There are three kinds of ice cream in the world, chocolate, white, and strawberry. We want to get all of the ice cream there is—and we already have all of the chocolate and vanilla...[or] We already have all of the vanilla and strawberry...etc.

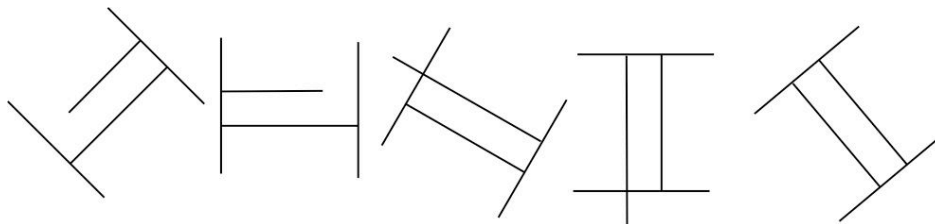
b) Rule: When you play hard with a ball it will get hot. Now pretend that I have a bunch of balls and I tell you that I just got through playing with one of them. How would you go about figuring out which one?... What do you know about the balls? What happens when you play with them?...

c) There are three kinds of dogs, brown dogs, black dogs, and spotted dogs. If we wanted to get all of the dogs in the world what kinds of dogs would we have to get?.... If we had all of the brown dogs, what kinds would we have to get?..... If we had all of the white dogs and black dogs, what kinds would we have to get?.....

The girls performed fairly well.

#### 2. Double-H model

The investigator presented the double-H model in various attitudes and asked a full range of questions about the nature of the lines, how one can tell that the change took place, etc.



The girls had no trouble with the problems.

#### 3. Bar push-pull

The girls have developed the habit of pushing in on the side of the bar that has the “paint” on it so that they can get paint on their hands. This has led them to some confusion about whether the painted side of the bar moves in or out. They find themselves pushing in on the bar whether or not the side is longer. They have learned that their words should be

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consistent with their actions, so they want to say “He pushed in on this side,” even when they know that the side has been made longer. The investigator tried to correct this situation by preventing them from pushing in on the bar. Instead, he instructed them to touch the appropriate side of the bar without pushing or pulling until they can figure out whether the side has been made longer or shorter. The girls responded fairly well, but they do not seem eminently well prepared for the criterion problem, which will be given tomorrow.

### **Progress**

*Motivation.* Motivation was only fair today. Sherry reverted to guessing and saying words that didn't fit the situation. Attention was not too good.

*Learning.* The set of rules the girls use in “deductive” reasoning is pretty fragile. They will have a great deal of justifiable uncertainty about the use of language. They are reluctant to speak with confidence unless they are absolutely sure about the cue words. Transference is still poor because the girls do not have a broad enough foundation to see the basis for forming analogy. It *would* come in time, but the summer term will be finished tomorrow. Time has run out, and I'm not sure what to predict about the girls. I was impressed by the apparent regression of the other members of the group who received the conservation test yesterday. Both Eric and Ramona seemed to have lost quite a bit of their hold on language. When asked for reasons to justify their conclusion about the glasses, both children seemed far more inarticulate than they were at the end of the training session. Short-term sessions of this kind will probably most benefit children like Sherry, who can learn some of the basic fundamentals of language that will prevent her from developing cognitive structures that are completely antipathetic to verbal learning. The others may pick up a few tricks and facts, but they will probably not integrate them with what they already know.

*Learning speed.* Slow and not too steady.

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#### Thursday, August 6, 1964

The investigator gave the criterion problem to both of the remaining members of Group 1. Neither girl passed. The session was recorded, and Kay Case was present.

##### Debby

Debby correctly noted the possible ways in which they system might have been changed. "He could have pushed down on this side or pushed up on this side." However, Debby was unable to *verbalize* the answer to the problem when the limiting condition (the painted top) was introduced. She touched the painted area in the proper place (to the left of the center and on top of the board) but she could not put into words the action that was associated with this position. The investigator indicated that she was showing the correct action and asked her to verbalize the action. "Okay, so what did he do?"

Debby assumed that the investigator was asking a hypothetical answer, because she started to give a two-possibility answer. The investigator pointed out that when she pushed up on the other side, however, she was not touching the painted area so she wouldn't get wet paint on her hands. Debby then went to the other side and said, "He pushed down on this side." The generalization of the rule that had been relatively easy for the other members of the group was extremely difficult for Debby. She could not relate the balance board to the analogy pattern she had learned with the bar push-pull.

##### Sherry

Sherry correctly noted the possible ways in which the system might have changed, but she could not seem to grasp the idea that the wet paint functioned as a condition that limited the possibilities. After the board was painted, she indicated that the guy who moved the bar could either have pushed down on the left side or pushed up on the other side. The investigator asked if he would get paint on his hands if he pushed up on the other side. Sherry didn't seem to get the point of the question at first, but after a few repetitions, she realized that he could paint on his hands only if he touched the left-top of the board. She interestingly touched the *end* of the board and not the top when she indicated the proper side. This is a response she had learned in connection with the bar push and pull. She could not transfer the principle from painted area to painted area. She transferred it from the more concrete end-of-the-bar to end-of-the-board.

## Conclusion

The changes in the children's performance during this study revealed a lot of useful information about working with advantaged and disadvantaged preschoolers.

1. If the children understand both something about the words and strategies of applying the language the teacher uses, they learn fast and what they learn is well integrated. If children don't understand details of the language or aspects of the strategies, the instruction will falter and progress will be slow. The strategies involve using information presented by the teacher and applying it to concrete examples. Clearly, the investigator in this study did not start Group I in the proper place until near the end of the experiment. At that time, the girl's learning became both faster and steadier. All but one child in Group II were properly placed. Their rate of learning increased as they progressed through the more difficult concepts. In other words, the more difficult material became increasingly easy for them.
2. If the children have a more solid grasp of language and the use of rules, they not only learn faster, but they don't need instruction that is as careful or that teaches them to such a high degree of mastery at each step. The instruction may be sloppy, but they learn. On several occasions Group II children did not have a good grasp of a concept at the end of a session but had a good grasp at the beginning of the next session. This trend was observed less frequently with Group I. In general, things had to be taught to high level of mastery for Group I children.
3. The children's self images were shaped by evidence of their performance. The children in Group 2 were blasé at first, but as they solved challenging problems, they became more highly motivated. The study unintentionally demonstrates the cruelty of lower performers placed in heterogeneous groups dominated by higher performers (Eran in Group II). The lower performers receive ongoing demonstrations of how inept they are. When both the instruction and the other members of the group are at their level, they receive far more information about their competence than about their incompetence. They therefore enjoy the sessions more and have stronger motivation to learn the material.
4. Children's developmental patterns of cognitive growth may be greatly altered through effective instruction. The children in Group II were developmentally enigmatic at the end of the training. Only one child passed the test of conservation of substance, which placed them at a "preoperational stage" according to Piaget's developmental timetable. This scheme suggested that they would have to learn about concrete operations and then slowly, much later, they would learn formal operations. Not until the age of 10 or 11 would they be able to understand relative direction (that A is north of B but south of C). Nor would they be able to figure out problems that required "propositions about propositions." In other words, they would not be able to solve the criterion problem presented in the training, and they would not be able to learn much of the content presented because the items involving the double H model, the bar that goes through the wall, the room with the broken glass, and the teeter-totter required children to construct the equivalent of propositions based on information presented in the problem. They would also have to use relevant information to form propositions that rule out at least one possibility. The preschoolers in the study contradicted all of these limitations.

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Furthermore, their rate of learning new operations was very impressive (less than a total of one hour to learn relative direction). Their failure of the test of conservation of substance confirms the irrelevance of this test in predicting what children are or are not able to learn. It also shows that there are serious problems with Piaget's interpretations of the relationship between learning and development.

*In the fall of 1964, following this study, the Bereiter-Engelmann preschool for disadvantaged children began operation. It was strongly influenced by this study. In addition to a daily math period and reading period, there was a daily language period, which focused on the language of instruction. The content of the language period was strongly influenced by the operations and vocabulary that some of the children in Group I did not know—prepositions, conjunctions (particularly or), if-then statements, and rule applications. Only now, 40 years later, are investigators beginning to recognize that the performance deficit of at-risk students is largely a function of their language deficiency.*

*The study also led to the development of the Basic Language Test, which was simple but provided a high degree of predictive validity for identifying children who lacked important language skills, and indicated the kind of items and skills children needed to learn.*

*Finally, the study illustrates the four basic premises that have guided the development of Direct Instruction programs and practices.*

- 1. The information that governs the development and revision of programs does not come in the form of research summaries about learning or motivation but from direct observations of children's specific responses as they are being taught.*
- 2. If the teaching is adequate, children are able to learn highly sophisticated content.*
- 3. If the children fail to learn, the problem lies not with the children but with technical details of the instruction that led to the failure.*
- 4. If children fail, the reason is never amorphous, but precise, and the remedy is never general but keyed precisely to specific kinds of mistakes the children made.*