#### THE UNIVERSITY OF MANITOBA

# AN EXPERIMENTAL ANALYSIS OF THE ROLE OF EQUILIBRATION IN THE DEVELOPMENT OF CONSERVATION OF CONTINUOUS QUANTITY

by
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A dissertation submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

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#### ABSTRACT

This research sought to test Piaget's postulate that the process of equilibration is of central importance in the development of intelligence. Specifically, the development of conservation of continuous quantity was studied. design used was a single organism design. It incorporated four groups of subjects: a natural conserver and control group and two experimental groups. The last three groups were matched at four pre-operational levels of cognitive competence. One experimental group was given errorless discrimination training in an attempt to gain control over conservation verbal behavior in the absence of disequilibrium. The second experimental group was given disequilibrium induction training in an attempt to gain control over this behavior when disequilibrium was involved. Both methods were successful in this regard. Minimal disequilibrium occurred in the errorless group and a substantial amount occurred in the disequilibrium group. In general all the subjects were trained to criterion. However, on two delayed posttests, at one week, and five to six weeks, the errorless group displayed no conservation understanding while the subjects in the disequilibrium group were diagnosed at the following levels: one was operational, one was a consolidator, and two were borderline transitional. The results are interpreted as giving tentative support to Piaget's postulate.

#### CHAPTER 1

#### THEORETICAL INTRODUCTION

One of the central concepts of Piaget's theory of development is that of self regulation. For him self regulation occurs at all levels of development—genetic through to the intellectual level. He posits that the source of this self-regulation is the organization function which he defines as the general functioning of the organization of all the elements that make up the developing whole at any point in time (Piaget 1971a). The organization function operates upon all the sub-structures that make up the organism, in such a way that it guides the whole process of development along a path which is species-specific.

On the level of intellectual development Piaget usually refers to the organization function as the process of equilibration. Here the influence of the whole of intelligence on its developing parts is such that given the proper social environment, intelligence will follow a developmental path that leads from sensorimotor to formal operational acts of knowing (cf. Crabtree, 1968; Furth, 1969; Gobar, 1968; Piaget, 1960a, 1960b, 1961, 1964, 1967, 1970, 1971a, 1972).

On the intellectual level equilibration can be activated by two different types of disequilibrium: adaptational

<sup>&</sup>lt;sup>1</sup>For a further discussion of equilibration see Appendix 1.

disequilibrium between assimilation and accommodation to the external world and organizational disequilibrium which can occur between the substructures within intelligence or between the whole of intelligence and one or more of its substructures (Brainerd, 1973; Piaget, 1972; Strauss, 1972).

Piaget's theory does not reject the processes of learning such as are described by the principles of operant conditioning (cf. Martin & Pear, 1978). Rather, it qualifies these by saying that their developmental effectiveness will be determined by the intrinsic processes of self-regulation which characterize each stage of development.

Given the centrality of the process of equilibration to Piaget's theory it is important that it should be studied experimentally. Brainerd (1973) has analyzed several methods for creating adaptational disequilibrium experimentally. He has labelled these as: dimensional discrimination, direct feedback, prediction-outcome and conformity training.

One of the areas where Piaget's theory has been put to an extensive experimental examination is the development of the understanding of conservation. Many different types of conservation ability have been examined—such as conservation of area, number, continuous and discontinuous quantity, length, weight, and volume. Take as an example conservation of continuous quantity (CCQ). Here a child is faced with two beakers of identical shape and size and containing the same amounts of liquid. After the child agrees that both contain the same amount of liquid, one of the liquids is poured into

a taller but thinner jar. A conserving child will understand that the amount of liquid is still the same as that in the unpoured jar, because even though it is higher, it is also thinner than the other (the compensation explanation). A nonconserving child will say that the transformed liquid has increased in quantity because it is higher (or in a few cases, decreased because it is thinner).

Appendix 2 present a summary of 71 different attempts to experimentally induce conservation ability. This summary is presented as Table L Several of the results of this review are relevant to the question of whether or not it is necessary to postulate the process of equilibration in explaining the development of conservation ability. First, all of the successful experiments either directly or indirectly utilized disequilibrium induction methods. By directly, I mean that the authors specifically attempted to utilize one of the methods cited by Brainerd and listed above, for creating adaptational disequilibrium experimentally. By indirectly, I mean that if you analyze their procedure you can see that the authors (either knowingly or unknowingly) may have created the possibility that one of Brainera's methods for causing adaptational disequilibrium experimentally, was present. The criteria on the basis of which an experiment was judged successful were: (a) presence of the correct judgement and explanation on the posttest as well as, (b) at least two of the following properties: specific generalizability, non-specific generalizability, resistance to countersuggestion, and

durability. Examples of successful experiments that deliberately used disequilibrium induction methods are: Brainerd (1972a, 1972b, 1974b, 1976), Brison (1966), Curcio, Kattef, Levine, & Robbins (1972), Halford & Fullerton (1970), Hatano & Suga (1969), Inhelder, Sinclair, & Bovet (1974), Lefebre & Pinard (1972), Murray (1972, 1974), and Sheppard (1974). Examples of experiments that indirectly used disequilibrium induction methods are: Bearison (1969), Boesma & Wilton (1974), Cooley & Martin (1972), Gelman (1969), Rosenthal & Zimmerman (1972), Zimmerman & Lanaro (1974), Zimmerman & Rosenthal (1974). Second, if we analyze the unsuccessful experimental groups across these experiments, 40 of these were exposed to disequilibrium induction methods and 18 were Examples of the groups that were exposed to disequilibrium methods and failed to acquire conservation are: Cooley, Braun, & Kerger (1977), Gruen (1965, gp. 2), Sjoberg, Hoyer & Olsson (1970, gp. 1, 2, 4), and Strauss & Langer (1970). Examples of the groups that were not exposed to these methods and did not acquire conservation are: Fleishman, Gilmore, & Ginsburg (1966, exp't. 1, gps. 1, 2; exp't. 2; exp't. 3), Hamel (1971), Overbeck & Schwartz (1970, gps. 3, 4), Strauss & Langer (1970, gps. 3, 4) and Wallach, Wall, & Anderson (1967, gp. 2). Third, all of the groups that were not exposed to disequilibrium induction methods failed to acquire conservation. Fourth, only 6 out of the 71 experiments attempted to assess whether or not disequilibrium was actually induced. Four of these did a qualitative assessment and

judged that there was some evidence for its involvement in cognitive development (Inhelder, Sinclair, & Bovet, 1974a, b, e, f). The remaining two did a quantitative assessment (Smedslund, 1963b; Winer, 1968). In only one of these cases (Smedslund, 1963b) was there any evidence of its involvement. Finally, none of the 71 experiments attempted to gain both a quantifiable measure of and an experimental control over disequilibrium, in such a manner that it would be kept at either a minimum or maximum during induction training.

These results make it almost impossible to make a databased objective judgement about whether or not equilibration is a necessary factor in the development of conservation ability. The evidence for it is weak. Its necessity might be inferred from the fact that all of the successful experiments utilized, either directly or indirectly, a disequilibrium induction method and from the fact that none of the groups were successful in the absence of these methods. However, the fact that so many groups were exposed to disequilibrium induction methods and failed to acquire conservation render this inference weak. Further, the 6 experiments that attempted to objectively assess the presence of disequilibrium provide inconclusive evidence for its involvement in cognitive charge.

The experiment which is reported here attempted to obtain evidence, which was more direct, concerning the process of equilibration. It did this in several ways. First, it defined some overt behaviors that could be taken as indices of the presence of cognitive disequilibrium. Second, it

utilized a sophisticated operant conditioning methodology to design two conservation training methods which might enable the experimental control of disequilibrium. The first method was an errorless training program designed to develop conservation ability while holding disequilibrium at a minimal level. The second method was a disequilibrium induction procedure, based in part on Inhelder, Sinclair, and Bovet (1974a), which was designed to develop conservation ability and induce a significant amount of disequilibrium.

In this way it was hoped that a more objective assessment might be made of the role of disequilibrium, and through it
of the process of equilibration, in the development of liquid
conservation ability.

#### CHAPTER II

#### METHOD

#### Subjects

Sixteen subjects were studied, including 12 who were non-conservers and 4 who were natural conservers at the start of the experiment (the procedures for testing for conservation behaviors are described below).

All the subjects were given two tests to determine that they understood the terms: same, more, and less, and one test for the tallest, shortest, fattest, skinniest, lowest, widest, and The method was to present them with two beakers with narrowest. the relative amounts of colored water in them, that corresponded to the term being tested, and then to ask them to make the appropriate judgement. Children from two kindergarten classes were then given tests for conservation behaviors until 12 nonconservers2 were obtained, following the Baseline Pre-Tests as described below. The four natural conservers were obtained from a grade 2 classroom. The 12 nonconservers ranged in age from 5 years 3 months to 6 years. All were in kindergarten in an elementary school and included seven boys and five girls. All subjects had a middle socio-economic status. The four conservers ranged in age from 7 years 6 months to 8 years 2 months and included two boys and two girls.

<sup>&</sup>lt;sup>2</sup>Unfortunately one of these subjects for the control group was initially misdiagnosed. A later analysis of his data revealed that he emitted some correct judgements on pretest one. However, his data is included because it shows the delayed structural elaboration referred to by Inhelder et. al. (1974).

#### Apparatus

The apparatus for the pretests, post-tests, and the errorless and conflict training procedures are listed in Table 2.

Insert Table 2 about here

#### Experimental Design

The sixteen subjects included four groups of four subjects Two groups were designated experimental groups and were given either the errorless or the cognitive conflict training procedures. Within each experimental group a single organism multiple-baseline-across-subjects design was used (e.g., see Martin and Pear, 1978). With this design baseline data are gathered on the dependent variable(s) across several subjects. The experimental condition is then introduced for one subject while the others remain on baseline. The experimental condition is then extended to include additional subjects, sequentially over time, thus providing a demonstration that the subject's performance does not change until he is included in the experimental treatment. This design was strengthened by the addition of two control groups who remained on baseline conditions throughout. One control group contained nonconservers while the other contained natural operational conservers.

In order to help control for experimenter bias, two

Table 2

Apparatus for Pretest-Posttest, and for Errorless and Conflict Training Procedures

Item				Dimensions (Where Applicable)	Volume (Where Applicable)
Pre-Posttest	Errorless	Conflict	No. Req'd.		
Pre-Posttest  Flexible Wire Flexible Wire Red Poker Chips Blue Poker Chips S.B. S.B. Cylinder Cylinder Sausepan Unique shaped fla		Conflict	No. Req'd.  1 1 7 7 2 2 4 2 1 1 2 3 2 2 3 1 1 1 1 1 1	15 cm. 10 cm. 13 x 9 x 2 in. 12 x $\frac{1}{2}$ in. (approx 5 $\frac{1}{2}$ x 5 $\frac{1}{2}$ x 2 $\frac{1}{2}$ 4 x 4 x 8 $\frac{1}{2}$ 4 x 4 x 7 $\frac{1}{2}$ 4 x 4 x 6 $\frac{1}{2}$ 4 x 4 x 5 $\frac{1}{2}$	1,000 mls. 400 mls. 100 mls. 250 mls. 150 mls.  1,000 mls. 400 mls. 250 mls. 150 mls. 150 mls. 500 mls. 125 mls. 1,000 mls. 500 mls.
	2.5 2.6 2.7 1.1 1.2		1 1 1 1	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O

Table 2 (Continued)

Item				Dimensions (Where Applicable)	Volume (Where Applicable)
Pre-Posttest	Errorless	Conflict No	. Req'd.		
	1.3		1	3 x 3 x 6½	
	1.4		1	$3 \times 3 \times 5^{\frac{1}{2}}$	
	1.5		1	$3 \times 3 \times 4\overline{2}$	
	1.6		1	$3 \times 3 \times 3^{\frac{1}{2}}$	
		$\mathbf{T}\mathbf{B}$	1		1,000 mls.
		TB	4		400 mls.
		$\mathbf{T}\mathbf{B}$	3		250 mls.
		${f TB}$	3		150 mls.
		<b>S</b> B	3		400 mls.
		SB	1		250 mls.
		SB	2		150 mls.
		$\mathbf{E}\mathbf{B}$	1		500 mls.
		$\mathbf{E}\mathbf{B}$	1		125 mls.
		$\mathbf{F}\mathbf{B}\mathbf{F}$	1		1,000 mls.
		$\mathbf{FBF}$	3		500 mls.
		$\mathbf{F}\mathbf{B}\mathbf{F}$	1		250 mls.
		Retort Stand	1		
		Clamps	4		
		Board	1	15 x 8 in.	

<sup>&</sup>lt;sup>3</sup>SB symbolizes standard beaker

FBF symbolizes flat bottomed flask

- 3 symbolizes 3 quart milk carton
- 2 symbolizes 2 quart milk carton
- 1 symbolizes 1 quart milk carton

TB symbolizes tapped beaker

EB symbolizes Erlenmeyer beaker

experimenters were used in such a way that all the subjects were exposed to each experimenter once on the pretests and 50% of the training in each experimental group was performed by each experimenter.

#### Baseline (Pretests)

All the subjects were given two sets of pretests on the conservation concepts. For the two experimental groups the second set was given in a staggered manner in order to provide a multiple baseline across subjects. Within each experimental group, subject 2's second pretest occurred two days after subject 1's, subject 3's occurred eleven days after subject 2's, and subject 4's occurred two days after subject 3's.

#### Baselines for the Conservation Concepts

All the subjects were given two sets of pretests for conservation of continuous quantity (CCQ), conservation of length (CL), and conservation of number (CN). These tests were taken from Inhelder, Sinclair, and Bovet (1974). On each pretest each concept was tested twice on different stimulus configurations. CCQ and CN judgements were countersuggested against four times when the answers were correct or wrong. CL judgements were countersuggested against only twice when right or wrong.

In order to be classified as a conserver, the subject had to give correct conservation judgements and explanations. Conservation explanations were considered adequate if they met one or more of the following criteria (taken from Forsberg, 1973):

- 1. Compensatory relations: the subject states that changes in certain dimensions are compensated for by changes in other dimensions. e.g., "This one is longer, but thinner."
- 2. Reversibility: the subject states that the transformation could be cancelled by an inverse transformation. e.g., "You could pour it back, and it
  would be the same."
- 3. Addition/Subtraction: the subject states that nothing has been added or taken away. e.g., "You didn't add any on or take any off."
- 4. Identical action: the subject states that the standard object could be transformed in a similar manner to the comparison object. e.g., "You could make that ball into a pancake like that."
- 5. Initial equality and/or irrelevant transformation:
  the subject states that the two objects were
  initially equal and/or that the transformation
  makes no difference to the property in question
  (these two explanations generally occurred together).
  e.g., "they were the same before, and you just
  poured them in here."
- 6. Logical necessity: the subject states a general rule.
  e.g., "No matter what shape it is, it will still
  weigh the same."
- 7. Quantitative equivalence based on another property:
  e.g., "It still has the same amount, so it must
  weigh the same."

In order to be classed as a nonconserver on any particular concept a subject could not have made any conservation judgements or explanations on the two pretests for that concept. If on all of the pretests all of a subject's judgements to the main questions following the transformations were nonconservation judgements but the subject changed his/her judgement under countersuggestion, these changed judgements were still rated as nonconservation judgements. Since the subject evidenced no understanding of conservation during the main portions of the pretests, these changed judgements were not taken as indicative of an understanding of conservation.

The twelve nonconservers to be assigned to the two experimental groups and the control group were given a developmental level score which was based upon: (a) percent judgements which were conservation judgements, (b) percent explanations which were conservation explanations, and (c) percent of nonconservation judgements which were changed to conservation judgements under countersuggestion, all taken from pretest one. These were used by the author as indications of developmental level. These percentages were converted to absolute figures and totalled to give the developmental level score. The subjects were then rank ordered and one member of each rank randomly assigned to one of the three groups. Thus, the groups were matched in terms of the rank ordered developmental level of their subjects.

The operational conservers were subjects who scored 100% correct on judgements and explanations which were generalizable

and resistant to countersuggestion.

#### Easeline for Behaviors Used as Indices of Cognitive Conflict

As indicated in the introduction one of the goals of this research was to directly measure behaviors that could be used as indicators of the presence of cognitive conflict in order to better judge the presence or absence of adaptational disequilibrium during the experimental procedures for inducing conservation behavior. The following behaviors were recorded as indicating cognitive conflict when they were emitted while the subject was attending to the possible conflict inducing stimuli. That is when the subject emitted these responses while not attending to the conflict producing stimuli these responses were not recorded as indicating conflict. This restricting condition on the definition was necessary because many of these responses were emitted in the errorless training when the subject was acquiring the echoic behavior and not attending to the conflict producing stimuli. In this situation they were considered to be not indicative of conflict but of difficulties in recall.

The occurrence of any one of the following five types of behavior were scored as indicating conflict:

- 1. Humming and ahing. Here each hum or ah was scored as an instance. In addition each repetition of words was also recorded as conflict. For example "I think--I think" would count as one instance.
- 2. Change of judgement. This was scored only if the change was spontaneous and unprompted by the

- experimenter. For example, "There's more lemonade in N because it's thinner, and there (b) it's fatter,"

  . . . then immediately afterward: "No, it's the same"--"How do you know?"--"Because I can see it"-"How can you see it?"--"I just know" (Inhelder, et. al., 1974, p. 55).
- 3. Facial expressions. Here frowns and puckering of the lips were scored if they were obvious enough to create no doubt in the observer as to their occurrence.
- 4. Pauses. Pauses, following a question by the experimenter, which were four seconds or longer and which were uninterrupted by the experimenter, were scored.

  A pause was considered terminated when either the experimenter or subject spoke.
- occurred where the subject recognized problems with his judgements or pouring actions. For example, when beakers A and A' had the same amounts and the subject was asked to pour equal amounts into beakers B and B' where B' is narrower than B, and the subject makes the levels of B and B' equal. When in this situation the subject might have said, "Hey why is there still some up there (i.e., A')." This was scored as indicative of conflict (cf. Figure 4 on page 28.

On all pre and posttests and during training for both experimental groups all the sessions were tape recorded. In addition naive trained observers recorded the behavior indicators of cognitive conflict throughout all the pretests and the training of the conflict group. The observers were not informed about the purpose of the experiments, about the function of the two training methods, or about the author's predictions. In addition, they were asked not to discuss the experiment among themselves. After the experiment was over they were questioned as to whether they had figured out what was being tested. Although they knew at this time that the experiment was a study of the difficulties in learning conservation and about methods for such learning, none of them had figured out exactly what variables were being examined or what the author's predictions were. The behavior of the errorless group was recorded by the experimenter himself, since this program was much easier to manage. The posttest data on conflict was also recorded by the experimenter himself since these data were taken after the end of the university term and the student observers had left for summer employment. The posttest data on judgements and explanations was recorded only by the tape recorder.

Baseline for cognitive conflict in a non-conflict and non-training situation. A non-conflict situation was defined as one where the subject was being asked neutral questions during the pretests or being asked to echo the experimenter's prompts in the errorless training situation,

where there was no transformation of the test stimuli and where none of the conflict induction procedures were being used. The baseline for the non-conflict non-training situation was taken from the responses on the relational terms tests and from the neutral portions of each of the CCQ pre and posttests where the subjects were asked to make judgements about the test stimuli prior to their being transformed. This provided a total of twenty situations where the frequency of these behaviors could be measured in the absence of both conflict and training.

This baseline was necessary in order to determine the frequency of these behaviors when the child was not being exposed to the training and the stimuli that may have the potential to induce conflict.

Easeline for cognitive conflict in a conflict and nontraining situation. For this baseline the indices of cognitive conflict were measured on the parts of the pretests where the subjects were exposed to the transformations, questioned, and had their answers countersuggested against.

Baseline for cognitive conflict in a non-conflict and errorless training situation. Training programs one, two, three, five, and six involved the errorless training of verbal rules in the absence of any transformations of the dimensions of the stimuli and in the absence of conflict induction procedures. Therefore, these programs were used as baseline measures of conflict behaviors in an echoic training but non-

conflict situation.

#### General Procedures

The eight subjects in the two experimental groups were given one half hour training each, Monday through Friday until they met criterion performance. The training took place in an elementary school.<sup>4</sup> Two rooms were used. The subject was seated at an apparatus stand which contained a token (poker chips) dispenser on his/her right, the training apparatus in the center, and a display of the backup reinforcers on the left. The experimenter sat at the subject's right and the observer sat behind and to the right of the experimenter. The training materials were outlined in Table 2.

#### Specific Training Procedures

## The Errorless Program to Teach Conservation of Continuous Quantity

The purpose of this procedure was to develop appropriate CCQ judgements and explanations which would be generalizable and resistant to countersuggestion, without inducing cognitive conflict. In this way the hypothesized process of equilibration would be controlled. The method of experimental control of equilibration was an errorless discrimination procedure which utilized prompting, shaping, fading, and programing of generalization and resistance to countersuggestion. (For a description of these principles, see Martin and Pear,

<sup>4</sup> Victor Mager School in the city of St. Vital.

1978).

The training program to teach conservation of continuous quantity consisted of variations of a basic three\_step sequence. This sequence can be seen in Figure 1.

Insert Figure 1 about here

The major part of the training program consisted in teaching the subjects the appropriate answers to the questions and the appropriate verbal rules that go along with the correct answers, depending upon the verbal stimuli that were presented to the subject in Part B and C of Figure 1.

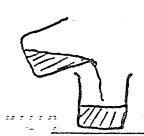
The answers to the questions (and the corresponding containers and their fluids) were taught using a positive reinforcement system and a prompting and questioning system, along with the behavioral principle of fading.

The reinforcement system and the experimental setting. A token reinforcer system (e.g., Kazdin, 1977) was used in which the immediate reinforcers were poker chips and the backup reinforcers ranged from toys valued at one cent to a hot wheels racing car. The one cent toys cost the subject one chip and the car cost 35 chips.

The child was token trained simultaneously with the conservation training. After every correct response the subject was told statements like, "good boy," "that's right," "boy are you ever smart," and given a chip. If he answered

(A) Two identical containers contained identical amounts of fluid. The subject is told, "Your container contains the same amount as mine."

(B) Something is then done to the fluid in the subject's container. Fluid is either added, or taken away, or poured into a completely new container, and the experimenter always described what he was doing, such as, "Now I am adding some water to your container."





(C) The subject is shown the final pair of containers of fluids and asked two questions:

#### QUESTION

# 1. "Do you have more than I have, or do you have the same amount as I have, or do you have less than I have?"

#### 2. "Why?"

#### ANSWER

Subject has to give appropriate answer, which is either "the same," "more," or "less."

Subject then has to give the appropriate verbal rule. appropriate verbal rule consisted of such things as "Because they were the same to begin with and you just poured mine into this jar. Now it's higher but it's skinnier than yours, so they're the same" or "I have more, because they were the same to start with but you added some to mine," or "I have less, because they were the same to start with. but you poured some of mine away."

Figure 1: Basic 3-Step sequence for teaching conservation of continuous quantity.

wrong the experimenter said, "Oh, you just missed a chip but you will have lots more chances." This type of feedback was used in order to reduce to a minimum the probability of cognitive conflict occurring in error trials.

The prompting and questioning system. The sequence of prompt and question trials for each answer and verbal rule was similar to that used in other operant conditioning experiments (e.g., Cooley and Martin, 1972; Martin, 1975). The sequence used was as follows. The example used is taken from the teaching of the verbal rule for the concept of the conservation of unequal continuous quantity (see program 5 of Figure 2). The prompt trial on the new concept, i.e., Pn,

Insert Figure 2 about here

involved the following statement, "Iam pouring your water into this jar. Now do you have the same, more, or less than me? The experimenter immediately gave the answer, "more," then asked, "why?" He again provided the answer, "because mine had more to begin with and you just poured mine into this jar."

The question trail on the new concept, i.e., Qn, was identical except the experimenter did not provide the answer or the verbal rule. The Qn was repeated until the subject got three answers right, consecutively. Throughout all trials care was taken to insure that the subject was attending to the relevant stimuli.

		SCHEMATIC OF AFTER THE TRA		ANSWER TO		KNOWN CONCEPT ALTERNATED WITH TEST CONCEPT
TRANSFORMATIONS	TYPE OF CONTAINERS	E's Container	S's Container	QUESTION 1 FROM FIGURY 1	VERBAL RULE (ANSWER TO QUESTION 2 FROM FIGURE 1)	i.e., THE QK.
1. S's fluid completely transferred to another container	Three 600 ml. beakers			Same	Because they were the same to begin with and you just poured mine into this jar.	
2. S's fluid completely transferred to another container	Three 500 ml. Erlenmeyer beakers			Same	Same as above	
3. S's fluid completely transferred to another container.	Three 500 ml. flat-bottom- ed flasks			Same	Same as above	
4. S's fluid completely transferred to a container of different dimensions	2 5-quart	partially fille aid judgment of	sion created by d container to same	Same	Because they were the same to begin with and you just poured mine into this jar. Now it's high but it's skinnier than yours. So they're the same.	1
5. Fluid added to S's container	Three 600 ml. beakers			More	Because mine had more to begin with and you just poured mine into this jar.	4
6. Some fluid poured out of S's container	Three 600 ml. beakers			Less	Because mine had less to begin with and you just poured mine into this jar.	5

Figure 2: The answers and verbal rules that were taught in the first five programs in the errorless training.

Next followed a prompt trial on a known concept, i.e., Pk, in this case the concept of conservation of equal continuous quantity based upon program 4 of Figure 2. The training of this concept was taught in the same manner. Then followed a question trial on the known concept, i.e., Qk. If the subject answered the Qk correctly, then one more Qn was given. If this was answered right then a new program was begun. If either this last Qn or the Qk were answered incorrectly then they were reviewed to a criteria of three times correct. This was followed by one trial on Qk or Qn, whichever was appropriate. Then one more trial was given for which ever question was being reviewed. If these were completed correctly a new program was begun. At the start of each session the concepts that involved either new rules or new types of containers which were previously learned were tested. When the subject responded correctly to a concept at the start of three sessions in a row, it was considered learned. If not the concept was reviewed and the three-test-correct criterion for learning was started again. All of the programs were designed in a similar manner.

The specific training program to teach appropriate judgements and verbal rules. The training strategy included 29 individual training programs. The answers and verbal rules that were taught in the first five programs are summarized in Figure 2.<sup>5</sup> The training strategy was designed to teach the

 $<sup>^{5}</sup>$ See Appendix 3 for all the errorless programs.

concept of conservation of continuous quantity and to firmly establish in the subject's repertoire the compensation verbal rule that explains the judgement.

The principle of fading refers to the gradual change of stimuli that govern a response until that response eventually occurs to a completely or partially different set of stimuli (for a more detailed discussion of fading, see Martin and Pear, This was involved in programs 11 to 16, where the milk carton containers were cut down little by little until the subjects were making a clear cut continuous quantity conservation without the aid of the perceptual illusion. (When the subject looks down into a tall carton it is difficult to discriminate the actual height of the liquid). was further involved in programs 17 to 22, where the conservation of continuous quantity was maintained, but made more difficult by using a skinnier carton, i.e., a l quart instead of a 2 quart carton. Programs 24 through 27 were designed to bring about generalization of conservation of continuous quantity, so that the conservation of continuous quantity would increase in probability when the subjects were exposed to different sized items with appearance much different from that of the milk cartons.

Programs 28 and 29 were designed to enable the subject to resist countersuggestion. They used the same apparatus as program 27. Concerning program 28, following the transformation the Pn was given. "Now would you say . . . etc? Why?" The subject's response was identical to program 27.

Then the Pn continued. "Now you know that the right answer is that they are the same because they were the same to begin with and you just poured mine into this jar. Now it's high but it's skinnier than yours. So they are the same. However, look at how high it is here (the 500 ml. flask). Don't you think that actually makes it more? This is what I want you to tell me." The experimenter then prompts the answer, "No, because . . . etc." The Qn after the transformation was, "Look at how high it is. Don't you think that actually makes it more?" Program 29 followed the same format except it used the following countersuggestion, "Someone else told me that there's more in here because it's taller than there . . . Do you think he's right or wrong (Inhelder et. al. 1974, p. 278)?" Programs 28 and 29 were alternated.

## Adaptational Disequilibrium Program to Teach Conservation of Continuous Quantity

The method used in this program was based upon Piaget's conclusion that the laws of learning are subordinate to the laws of development. This implies that the principles of operant conditioning will be effective in inducing CCQ only to the extent that they create disequilibrium within the optimal zone of interest, thereby activating the basic process of intellectual development—equilibration. The contingencies of reinforcement were integrated into two conflict induction methods: prediction—outcome, and dimensional discrimination training.

The program utilized an apparatus adopted from Inhelder et. al. (1974a, p. 42). The program consisted of six phases, each with several subcycles of pouring the liquid through the three levels of the apparatus. For each subcycle different parts of the apparatus were changed in an attempt to systematically create conflict through prediction-outcome and dimensional discrimination. Some of these phases are outlined in Figure 3.

Insert Figure 3 about here

Figure 4 gives as an example the details of a part of phase 5

Insert Figure 4 about here

cycle 4.

The conflict training program utilized a token reinforcement system similar to that used for the errorless training. The contingencies of reinforcement were used to accomplish three things. First, to provide an extrinsic source of motivation to keep the subject operating on the apparatus over the weeks that the training lasted. Second, they were used to facilitate conflict in prediction outcome and dimensional discrimination situations. The subject was told that when he answered like an older boy he would earn red chips, but when he answered like a younger boy he missed getting a chip.

See Appendix 4 for all the conflict phases and cycles.

PHASE NO.	PHASE PURPOSE	CYCLE NO.	APPARATUS	TRANSFORMATION
1	1. Adaptation of S to equipment. 2. Focus S's attention on the closed cycle of the liquid flow. 3. Teach active search for contradictory judgements.	1	A <sub>3</sub> A' <sub>3</sub> B <sub>3</sub> B' <sub>3</sub> C <sub>6</sub> C' <sub>6</sub> F <sub>6</sub> @ 400 ml.	
1	Same as phase 1, cycle 1.	2	A <sub>3</sub> A' <sub>3</sub> B <sub>3</sub> B' <sub>3</sub> C <sub>6</sub> C' <sub>6</sub> F <sub>6</sub> @ 400 ml.	
2	l. Focus S attention on the fact that equal amts. rise to same level in A and A' and in C and C' but to different levels in B and B'.  2. To facilitate	1	A <sub>3</sub> A' <sub>3</sub> B <sub>4</sub> B' <sub>3</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 400 m1.	
2	CCQ by: (a) approximating Piaget's 4 stages of the equilibration process and (b) prediction outcome conflict.  Same as phase 2, cycle 1.		A <sub>3</sub> A' <sub>3</sub> B <sub>4</sub> B' <sub>2</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 250 ml.	
2	Same as phase 2, cycle 1.	3	A <sub>3</sub> A' <sub>3</sub> B <sub>4</sub> B' <sub>1</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 150 ml.	

'igure 3: Some phases and cycles of the conflict training program.

Pour A  Pour A  Pour A  Pour A  Same	-3→B <sub>2</sub>	Cg E = Expl R = Red W = Wait  Question  amount?	Legend anation ( Chip e Chip		C = C e H = H F = F 1	Start Stop T: Reel ict Syminange of explanat: umming acial expooking a	ools ju	Sid dgem	ent of first control of the control	r rown,
Pour A  Pour A  Pour A  Pour A  Same	Ruestion Answer Gement ( or K)  E's Request or  in A <sub>3</sub> and A' <sub>3</sub> and A' <sub>3</sub> have same  B <sub>2</sub> and A' <sub>3</sub> b' <sub>1</sub> B' <sub>1</sub> have same amount  (RR)	Cg E = Expl R = Red W = Wait  Question  amount?	Legend anation ( Chip e Chip	√or X) S's Resp	C = C e H = H F = F 1	Stop T: Reel	ools ju	Sid dgem	ent of first control of the control	r rown, hips
Pour A  Pour A  Pour A  Pour A  Same	Ruestion Answer Gement ( or K)  E's Request or  in A <sub>3</sub> and A' <sub>3</sub> and A' <sub>3</sub> have same  B <sub>2</sub> and A' <sub>3</sub> b' <sub>1</sub> B' <sub>1</sub> have same amount  (RR)	Cg E = Expl R = Red W = Wait  Question  amount?	Legend anation ( Chip e Chip	√or X) S's Resp	C = C e H = H F = F 1	ict Symi hange of xplanat: umming acial ex ooking a	ools ju ion opre	dgem	ent o: ns (f: .F. CI	rown,
Pour A  Pour A  Pour A  Pour A  Same	Ruestion Answer Gement ( or K)  E's Request or  in A <sub>3</sub> and A' <sub>3</sub> and A' <sub>3</sub> have same  B <sub>2</sub> and A' <sub>3</sub> b' <sub>1</sub> B' <sub>1</sub> have same amount  (RR)	Cg E = Expl R = Red W = Wait  Question  amount?	Legend anation ( Chip e Chip	√or X) S's Resp	C = C e H = H F = F 1	ict Symi hange of xplanat: umming acial ex ooking a	ools ju ion opre	dgem	ent o: ns (f: .F. CI	rown,
Pour I Do A <sub>3</sub> If A <sub>3</sub> B <sub>2</sub> and Why?  Pour A Same	E's Request or  in A <sub>3</sub> and A' <sub>3</sub> and A' <sub>3</sub> have same  B <sub>2</sub> and A' <sub>3</sub> B' <sub>1</sub> B' <sub>1</sub> have same am  (RR)	E = Expl R = Red W = Wnit  Question  amount?	Legend anation ( Chip e Chip	S's Resp	C = C e H = H F = F 1	hange of xplanat: umming acial en ooking a	ju Lon opre	ssio	ns (f:	rown,
Pour I Do A <sub>3</sub> If A <sub>3</sub> B <sub>2</sub> and Why?  Pour A Same	E's Request or  in A <sub>3</sub> and A' <sub>3</sub> and A' <sub>3</sub> have same  B <sub>2</sub> and A' <sub>3</sub> B' <sub>1</sub> B' <sub>1</sub> have same am  (RR)	Question amount?		S's Resp	F ≈ F 1 onse	xplanat: umming acial ex ooking a	on cpre way	ssio /C.H Con	ns (f:	rown,
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Pour I Do A <sub>3</sub> If A <sub>3</sub> B <sub>2</sub> and Why?  Pour A Same	E's Request or  in A <sub>3</sub> and A' <sub>3</sub> and A' <sub>3</sub> have same  B <sub>2</sub> and A' <sub>3</sub> B' <sub>1</sub> B' <sub>1</sub> have same am  (RR)	Question amount?		S's Resp	F ≈ F 1 onse	ooking a	way X X	) /C.H Con	.F. CI	hips , R
Pour I Do A <sub>3</sub> If A <sub>3</sub> - B <sub>2</sub> and Why?  Pour I Same	in A <sub>3</sub> and A' <sub>3</sub> and A' <sub>3</sub> have same  B <sub>2</sub> and A' <sub>3</sub> B' <sub>1</sub> B' <sub>1</sub> have same am  (RR)	amount?	Answer		onse		X Z	C.H Con	- W	, R
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Do A <sub>3</sub> If A <sub>3</sub> B <sub>2</sub> and Why?  Pour A Same	and A' <sub>3</sub> have same $\overrightarrow{B}_2$ and A' <sub>3</sub> $\overrightarrow{\rightarrow}$ B' <sub>1</sub> B' <sub>1</sub> have same amount (RR)	will			·			1	- 1	
Do A <sub>3</sub> If A <sub>3</sub> B <sub>2</sub> and Why?  Pour A Same	and A' <sub>3</sub> have same $\overrightarrow{B}_2$ and A' <sub>3</sub> $\overrightarrow{\rightarrow}$ B' <sub>1</sub> B' <sub>1</sub> have same amount (RR)	will							1	
If A <sub>3</sub> -B <sub>2</sub> and Why?  Pour A Same	$\partial_2$ and $A'_3 \rightarrow B'_1$ $B'_1$ have same and (RR)	will						1		
B <sub>2</sub> and Why?  Pour A  Pour A	$B'_1$ have same amount (RR)							-		
B <sub>2</sub> and Why?  Pour A  Pour A	$B'_1$ have same amount (RR)									
Pour A	$(RR)$ $-3 \rightarrow B_2$	1								
Pour A	-3→B <sub>2</sub>	1								
Pour A	·3→B <sub>2</sub>	1						Ì		
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3	What a You le B' 1 up = B2 C S says Can yo proble a chir about B2 and When a have c How mu (W) T If A3 only s	What about the juice up You left some of the ju B'1 up here. Does B'1 = B2 or is it less? [( S says no]  Can you tell me what th problem is? Why did yo a chip when you were de about how much would be B2 and B'1? (W)  When in A3 and A'3 how have drink? (W) How much did you re (W)  The A3 = A'3 and all A3 only some A'3 B'1 how B2 = B'1?	Can you tell me what the problem is? Why did you miss a chip when you were deciding about how much would be in $B_2$ and $B_1$ ? (W)  When in $A_3$ and $A_3$ how - did - have drink? (W)  How much did you re $A_3 \rightarrow B_2$ (W)  How much did you re $A_3 \rightarrow B_1$ ? (W)  If $A_3 = A_3$ and all $A_3 \rightarrow B_2$ and only some $A_3 \rightarrow B_1$ how can $A_2 \rightarrow B_2$ and $A_3 \rightarrow B_3$ how can $A_3 \rightarrow B_2$ and only some $A_3 \rightarrow B_3$ how can	What about the juice up here? You left some of the juice for B'1 up here. Does B'1 really = B2 or is it less? [(W) if S says no] Can you tell me what the problem is? Why did you miss a chip when you were deciding about how much would be in B2 and B'1? (W) When in A3 and A'3 how - did - have drink? (W) How much did you re A3 > B 2 (W) How much did you re A'3 > B'1? (W) If A3 = A'3 and all A3 > B2 and only some A'3 > B'1 how can	What about the juice up here? You left some of the juice for B'1 up here. Does B'1 really = B2 or is it less? [(W) if S says no] Can you tell me what the problem is? Why did you miss a chip when you were deciding about how much would be in B2 and B'1? (W) When in A3 and A'3 how - did - have drink? (W) How much did you re A3 > B (W) How much did you re A'3 > B'1? (W) Tf A3 = A'3 and all A3 > B2 and only some A'3 > B'1 how can	What about the juice up here? You left some of the juice for B' <sub>1</sub> up here. Does B' <sub>1</sub> really = B <sub>2</sub> or is it less? [(W) if S says no]  Can you tell me what the problem is? Why did you miss a chip when you were deciding about how much would be in B <sub>2</sub> and B' <sub>1</sub> ? (W)  When in A <sub>3</sub> and A' <sub>3</sub> how - did - have drink? (W)  How much did you re A <sub>3</sub> > B' <sub>2</sub> (W)  How much did you re A' <sub>3</sub> > B' <sub>1</sub> ? (W)  Tf A <sub>3</sub> = A' <sub>3</sub> and all A <sub>3</sub> > B <sub>2</sub> and only some A' <sub>3</sub> > B' <sub>1</sub> how can	What about the juice up here? You left some of the juice for B' <sub>1</sub> up here. Does B' <sub>1</sub> really = B <sub>2</sub> or is it less? [(W) if S says no]  Can you tell me what the problem is? Why did you miss a chip when you were deciding about how much would be in B <sub>2</sub> and B' <sub>1</sub> ? (W)  When in A <sub>3</sub> and A' <sub>3</sub> how - did - have drink? (W)  How much did you re A <sub>3</sub> > B  (W)  How much did you re A' <sub>3</sub> > B' <sub>1</sub> ?  (W)  Tf A <sub>3</sub> = A' <sub>3</sub> and all A <sub>3</sub> > B <sub>2</sub> and only some A' <sub>3</sub> > B' <sub>1</sub> how can	What about the juice up here? You left some of the juice for B'1 up here. Does B'1 really  = B2 or is it less? [(W) if S says no]  Can you tell me what the problem is? Why did you miss a chip when you were deciding about how much would be in  B2 and B'1? (W)  When in A3 and A'3 how - did - have drink? (W)  How much did you re A3 > B  (W)  How much did you re A'3 > B'1?  (W)  If A3 = A'3 and all A3 > B2 and only some A'3 > B'1 how can	What about the juice up here? You left some of the juice for B'1 up here. Does B'1 really = B2 or is it less? [(W) if S says no]  Can you tell me what the problem is? Why did you miss a chip when you were deciding about how much would be in B2 and B'1? (W)  When in A3 and A'3 how - did - have drink? (W)  How much did you re A3 > B 2  (W)  How much did you re A'3 > B'1?  (W)  If A3 = A'3 and all A3 > B2 and only some A'3 > B'1 how can	What about the juice up here? You left some of the juice for B'1 up here. Does B'1 really = B2 or is it less? [(W) if S says no]  Can you tell me what the problem is? Why did you miss a chip when you were deciding about how much would be in B2 and B'1? (W)  When in A3 and A'3 how - did - have drink? (W)  How much did you re A3 \rightarrow B How much did you re A'3 \rightarrow B'1?  (W)  If A3 = A'3 and all A3 \rightarrow B2 and only some A'3 \rightarrow B'1 how can B2 = B'1?

However, if he was able to figure out why he lost the chip and then how the older boy would have done it, he would receive white chips. This presumably facilitated the discrimination between the right answer situation and the problem solving situation. Responses that moved in the direction of solving the problem were reinforced with one white chip and responses which solved it received two white chips. Correct judgements were reinforced with one red chip and correct explanations with two.

Prompting, where the experimenter specified the correct answer was not used in this program. However, a great deal of probing was used, where the experimenter asked Socratic type questions to facilitate the recognition of incompatible judgements and dimensional discrimination inconsistencies.

The third function of the reinforcement contingency was to provide an external source of confirmation which would reinforce any movement in the direction of internal equilibrium.

The contingencies were explicitly designed to facilitate the development of the compensation explanation. However, when other valid explanations occurred they were also reinforced.

All the subjects in the conflict group were taken through all the phases of the program. The only requirement for moving to a new phase was completion of the last, irregardless of whether it was done right or wrong. With the exception of subject 4 all the subjects were alternated on phase 6 cycle 1 and phase 5 cycle 7 until they completed both correctly three

consecutive times. These two cycles were designed to facilitate the discrimination between conservation of equal and unequal continuous quantity. At this point subject 4 lost interest in the training and it had to be discontinued. He said he was tired of the game and didn't want to play it any more. However, he did complete these two cycles several times, though not without a few errors, prior to the termination of his training.

### Posttests

All the subjects with the exception of one from the control group who moved away and received only one posttest, received two sets of posttests. The first set was given one week after training was completed, and the second was given approximately five to six weeks after training. All the posttests followed the same format as the pretests. The tests for CL and CN were identical to the pretests. Seven tests for CCQ were given on each posttest. The transformations involved were: (a) from a 1,000 ml. standard beaker to 250 ml. cylinder, (b) the reverse of (a), (c) from a 250 ml. cylinder to four 100 ml. standard beakers,

- (d) from a 250 ml. cylinder to a 13 x 9 x 2 in. saucepan,
- (e) from a 1,000 ml. standard beaker to a 15 x l in. squiggley shaped glass tube made by the university glass blower,
- (f) a preference test where the subject's favourite soft drink was poured from a 1,000 ml. standard beaker into a 150 ml. cylinder and he/she was then told he/she could have his/her

pick to drink, and (g) a compensation judgement probe where the subject was presented with a 400 ml. standard beaker containing 250 mls. of liquid and an empty 250 ml. cylinder and told to pour the same amount into the cylinder.

## Interobserver Reliability

## Pretraining Reliability

Each of the four observers were given approximately fifteen hours pretraining. Each of them was rated with each of the other three observers on their observations of the practice subject's judgements and explanations on the tests for CCQ, CL, CN. They were rated in the same way on their observations of conflict responses across CCQ, CL, CN tests. Also their observations of judgements, explanations and conflict responses on programs and cycles from the errorless and conflict training were rated. Agreements and disagreements were based upon both the presence and absence of whichever of the above behaviors was being rated. The formula used

# $\frac{\text{agreements}}{\text{agreements}} + \frac{\text{disagreements}}{\text{disagreements}} \times 100$

Interobserver reliability checks were taken on both experimenters once a week through the pretesting and training conditions. The same methods of calculation were used except that during training, reliability was calculated for two observers for the conflict group and for the experimenter and one observer for the errorless group. Scores were calculated on the basis of all the measures combined (judgements, explanations, and conflict) and on conflict only for both

errorless and conflict training groups. Agreements and disagreements were calculated on the basis of both the presence and absence of the behavior being recorded.

## Interrater Reliability

Interrater reliability checks were taken by a naive rater on this taped data. Random samplings were taken of the pretests, posttests and training for both experimental groups. For the pretests and posttests all of the data on one subject randomly chosen from each experimental group was rated. For the training two of the errorless programs and two of the cycles for each subject in each group were randomly selected and rated. This constituted a rating of approximately five per cent of all the training programs and cycles.

The reliability checks were taken from the pretests, posttests, and training data for the two experimental groups on hmms, changes of judgements, pauses, and conservation judgements and explanations. It was necessary to break the rating down in this way because important theoretical conclusions were drawn from each of these categories, the data for which, was taken off of the tapes.

The method of calculation was the same as that described for the inter observer reliabilities.

#### CHAPTER III

#### RESULTS

### Interobserver Reliability

## Pretraining Reliability

The calculations of the reliabilities on the various pretraining observations resulted in 35 reliability scores. The range of these scores was 83% - 100% and the mean was 96%. The scores for the errorless and conflict procedures were 100%. The scores for total conflict were: 6 at 100% and 1 at 98%.

## Pretest and Training Reliability

Scores were calculated on the basis of all the measures combined (judgements, explanations, and conflict) and on conflict only for both errorless and conflict training groups. As can be seen from Table 3 all the scores remained above 81% agreement.

Insert Table 3 about here

### Interrater Reliabilities

As can be seen from Table 4 all of the ratings, except the hmms for the errorless group, are satisfactory.

Insert Table 4 about here

Table 3

Interobserver Reliability Ratings for Pretest and Training Conditions

Type of Measure and Training Condition

	0 1		-	
	All Meas	ures <sup>a</sup>	Conflict Measu	re Only
Pretest On C.C.Q., C.L., C.N.	9 Errorless	8% Conflict	99% Errorless	Conflict
Training Check #1	$94^{c.}_{\it lo}$	90%	94%	85.4%
Training Check #2	84%	91%	81%	99.4%
Training Check #3	95%	84 <sup>G</sup>	95%	94.1%
Training Cneck #4	90%	93%	86.2%	100%
Training Check #5	100%	88%	100%	94%

<sup>&</sup>lt;sup>a</sup>All measures include judgments, explanations, and conflict behaviors.

Table 4

Interrater Reliability Ratings for Pretests, Posttests, Conflict, and Errorless Training

Condition Type of Measures

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	llnms	Changes of Judgments	Pauses	Judgments	Explanations
Pretests 1 & 2	86.7%	100%	100%	100%	100%
Posttests 1 & 2	81.5%	98.1%	96.3%	90.6%	83.7%
Conflict Training	92.6%	97.5%	98.8%	95.7%	99.4%
Errorless Training	79%	90.9%	96.4%		100% <sup>a</sup>

<sup>&</sup>lt;sup>a</sup>Percentage based upon combined judgments and explanations.

The rating for the hmms for the errorless group is a little low in comparison to the convention of 80% (cf. Kazdin, 1975) as a minimal acceptable reliability score. However, given the complexity of the data here, this rating might be considered quite high. On all measures agreements were calculated on the basis of an agreement on the total number of hmms and repetitions for a training trial. These behaviors were often very difficult to discriminate. Thus, if one rater scored five hmms and the other four it would count as a disagreement for that trial. As can be seen all of the reliabilities which were below 100% would have been higher if agreement had been based upon individual responses. In the above example four agreements and one disagreement would have been recorded.

## Subject Data

The summary of the developmental data on the subjects can be seen in Table 5. As can be seen the experimental and

Insert Table 5 about here

control groups were closely matched in their developmental level scores.

Table 5
Age and Developmental Level Scores of Subjects

nge and be	voiopmental bever beeres	or susjects
Group	Age	Developmental Scor
Errorless trainin	ag	
Subject l	5(6)	96.3
Subject 2	6(0)	54.1
Subject 3	5(3)	37.3
Subject 4	5(11)	30.0
Conflict training	3	
Subject l	5(4)	82.8
Subject 2	5(7)	53.1
Subject 3	5(3)	41.5
Subject 4	6(0)	31.4
Control		
Subject 1	5(7)	86.5
Subject 2	5(6)	72.3
Subject 3	5(3)	42.7
Subject 4	ō(ō)	24.5
Comparison		
Subject 1	7(11)	N/A
Subject 2	7(6)	N/A
Subject 3	8(1)	N/A
Subject 4	8(2)	N/A

## Pre and Posttest Conservation Abilities

CCQ on the pretests, last training program for the experimental groups, and posttests. Figure 5 shows the per cent of the correct judgements and explanations of the subjects at five points in the experiment. All the subjects

Insert Figure 5 about here

in the errorless and conflict groups and three of the subjects in the nonconserving control group scored zero on both pretests. The fourth subject in the control group scored 8.3% and 14.3% of his judgements correct on the first and second pretests, respectively.

In the conflict and errorless groups three of the subjects scored 100% on the last training program. In the conflict group one subject had two judgements wrong and in the errorless group one subject had one explanation wrong.

In general then, three of the subjects in each experimental group were trained to criterion and one subject in each group was very near to criterion performance.

In the conflict group on the last posttest subject 1 had 100% correct judgements and explanations, subject 2 scored 82.1% and 72.4% respectively, subject 3, 33.3% and 30.4%, and subject 4, 22% and 44%. Using Flavell and Wohlwill's (1969) classification, subject 1 would be an operational conserver, subject 2 a consolidator, and subject 3

SEQUENTIAL TESTS OF C.C.Q. Percent of C.C.Q. judgments and explanations correct Figure 5. on pretests, last training program and posttests, for the four groups.

25

Ü

2

1

2

Subjects developmental level on pretests. One line means identical judgment and explanations

Ù

and subject 4 would be borderline transitional conservers. In the errorless group on the same test, subject 1 scored 3.3% and 0%, and subject 2, subject 3, and subject 5 scored 0% on judgements and explanations. In the control group subject 1, who was misdiagnosed on the pretests, scored 84.2% and 80%, subject 2, 23% and 0%, subject 3 was unavailable, and subject 4 scored 0% on both judgements and explanations. In the comparison group all subjects scored 100% in their judgements and explanations.

CL, CN on the pre and posttests. Figure 6 shows the per cent correct of the combined judgements and explanations on CCQ, CL, and CN, on the pre and posttests for the experimental and control groups. As can be seen there was no consistent generalization between the trained and untrained

Insert Figure 6 about here

concepts. The only fairly consistant trend is for those concepts that were increasing on the pretests to continue to increase on the posttests. All the comparison group scored 100% on the pre and posttests for CL and CN.

<sup>&</sup>lt;sup>7</sup>As mentioned, an error was made on the data analysis of this subject, on the first pretest, which was not picked up until the tapes were reanalyzed.

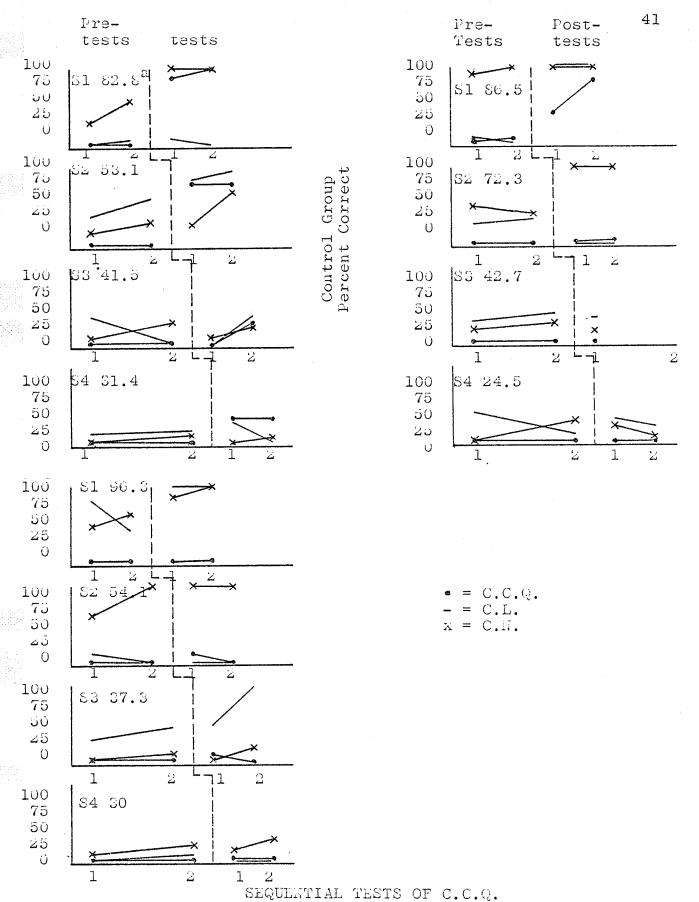


Figure 6. Percent of combined judgments and explanations correct for C.C.Q., C.L., and C.N. on the pretests and post-tests for the conflict, errorless, and control groups. Subjects developmental level on pretests.

Resistance to countersuggestion of the CCQ ability. On the two posttests for CCQ the errorless group resisted 4% of the total countersuggestions and these all occurred on the first posttest. The conflict group resisted 49% of the total countersuggestions. For this group on the last posttest subject 1 resisted 100%, subject 2 resisted 88.2%, subject 3 resisted 37.5%, and subject 4 resisted 22.2%. On the combined posttests the nonconserving control group resisted 12% of the total number of countersuggestions. Subject 1 accounted for 8.3% of these.

The comparison group resisted 100% of the counter-suggestions on both the pre and posttests.

Also of interest, because of its relevance for the issue as to whether natural conservers can resist countersuggestion, is the fact that on the first pretest eight subjects, including the four in the comparison group, were tested who had all their judgements and explanations correct. All of these resisted all of the countersuggestions. Since these were conserving subjects only 4 of them could be used in the experiment.

Types of explanations used on the pre and posttests.

Table 6 shows the total number and the percentage of each type of explanation, on the CCQ tests, used by each group.

Insert Table 6 about here

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Table 6

Total Number of CCQ Explanations and Percent of Each Type of Explanation for Each Group on the Pretests and Posttests

	Number o	f Expla	nations	and Perce	ent of E	ach Type
	N	%E1	%E2	%E3	%E4	%E5
Comparison	306	32	8	13	4	43
Control	25	60	0	0	0	40
Conflict	117	37	3	0	0	60
Errorless	5	0	0	0	0	100

The definition of each of these types of explanations was given in the methods chapter p. 12. The only group to emit correct explanations on the pretest was the comparison group. For the remaining three groups all these explanations were emitted on the posttests.

The figures for the experimental and control groups are all derived from the posttests. As can be seen the profile of the conflict group comes the closest to that of the natural conservers.

### Conflict Data

Frequency of behavior used to indicate conflict as recorded directly by the observers. Figure 7 shows the frequency of these behaviors for each group across conditions as recorded by the observers. Minimal amounts of these behaviors were recorded for the control and comparison

Insert Figure 7 about here

groups across conditions. Concerning the errorless and conflict groups, only the training in the presence of the transformations produced significant amounts of these behaviors. Over 400% more of these behaviors were recorded for the conflict group than the errorless group.

The data show ABA design experimental control of these behaviors. Further, even though some conflict did occur for the errorless group, the procedures have clearly maintained control over these behaviors keeping them low in the errorless group and maximizing them in the conflict group.

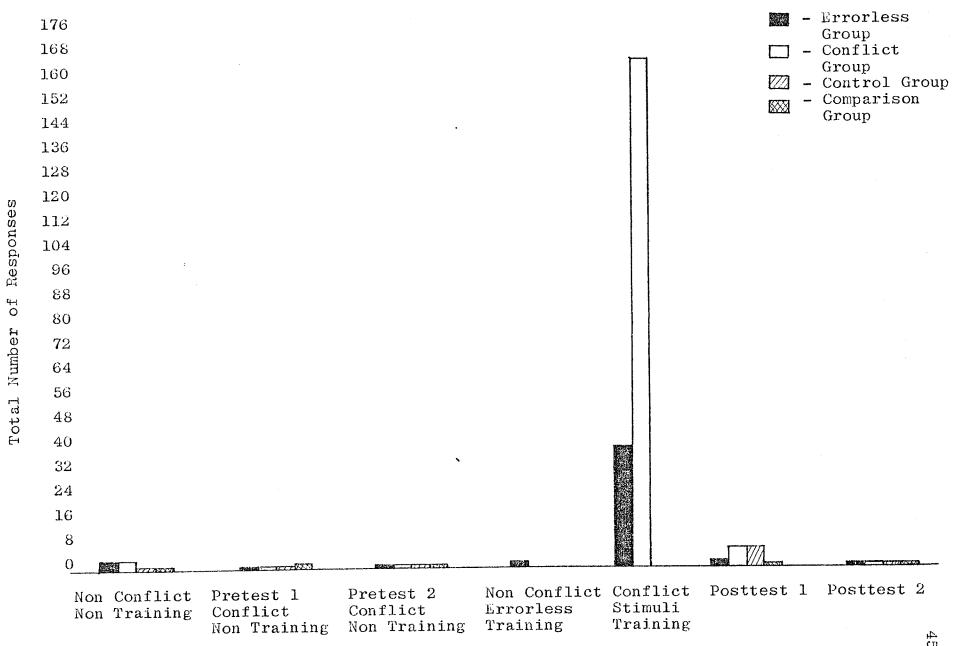


Figure 7. Total frequency of conflict for the errorless, conflict, control, and comparison groups across conditions as recorded by observers.

Frequency of behavior used to indicate conflict as recorded by the tape recorder. Table 7 gives the mean number of these responses per test and training program across conditions as taken from the tape recordings. Concerning the

Insert Table 7 about here

errorless group these data on Table 5 indicate that these subjects experienced some conflict on the conflict inducing part of the pretests. All the subjects increased their frequencies in the errorless training condition without transformation of the liquid, relative to the non-conflict nontraining condition. In the training condition, where they were exposed to the transformation stimuli which were gradually faded in, only subject 1 and subject 3 show a noticeable increase over the errorless training without the transformation, and this increase is only about an average of one response per program. This indicates that the transformation variable which might have induced conflict appears not to have done so to any significant extent. This complements the data recorded by the observers which indicated that conflict for this group was low. Therefore, these responses under the control of the errorless training variables appear to be indicative of difficulties in acquiring the echoic behavior and not of conflict since there was not a significant increase in their frequency between the training without and with the transformation of the liquid. It is this transformation that

Table 7

Mean Number of Behaviors Indicative of Conflict Per Test or Training Program

Across Conditions for the Experimental Groups Based on Tape Recordings

Non Conflict Non Training Condition	Conflict Non Training Pretests	Errorless Train- ing Without Transformation	Errorless Train- ing With Transformation	Conflict Training	Conflict Non Training Posttests
Errorless Group					
Sub. 1 0.35	1.25	0.91	1.97		1.21
Sub. 2 0.33	1.00	4.20	3.42		1.50
Sub. 3 0.19	2.00	1.25	2.25		1.86
Sub. 4 1.00	2.75	6.56	6.89	•	7.64
Conflict Group					
Sub. 1 0.10	1.25			7.00	1.60
Sub. 2 0.85	0.75			9.00	1.10
Sub. 3 0.00	0.50			5.14	1.60
Sub. 4 0.67	0.25			3.30	0.29

might have induced the conflict. With the exception of subject 4 the posttest response rate is about the same as the conflict nontraining pretest rate.

Concerning subject 1 and subject 3 of the conflict group, the pretests were conflict inducing. All the subjects showed a pronounced increase in these responses when they were exposed to the conflict induction treatment. This complements the data obtained by the observers. Once again these subjects, with perhaps the exception of subject 3, do not find the posttests to induce more conflict than the pretests.

Correlation between percentages of types of conflict behaviors and developmental level scores. An examination of Table 8 reveals an interesting fact. If all of the percentages of each type of behavior used to indicate conflict

Insert Table 8 about here

are rank ordered only pauses rank order in a manner which comes close to the rank order of the developmental scores, and also to the results of the training on conservation ability. In general within each group the percentages of pauses correlate well with the rank of the developmental score. Also there is a significant decrease, in the percentage of subject 1 of the errorless group, from that of the lowest percent in the conflict group, i.e., there is a

Table 8 Percentage of Conflict Constituted by Each Type of Conflict Related to the  $\underline{S}$ 's Developmental Level Score

	lopmental core	Change of Judgments	Hums	Facial Expressions	Recognition of Conflict Stimuli	Pauses	Conserver Status on Last Posttest
Conflict	Group						
Sub. 1	82.8	5.08	66.5	2.50	0.00	25.9	Operational
Sub. 2	53.1	6.17	46.8	13.31	3.30	30.5	Consolidator
Sub. 3	41.5	12.43	68.0	7.69	0.00	11.83	Transitional
Sub. 4	31.4	14.30	73.2	2.70	0.00	9,83	Transitional
Errorles	s Group						
Sub. 1	96.3	29.9	66.0	1.02	0.00	3.03	Nonconserver
Sub. 2	54.1	7.28	<b>87.8</b>	1.45	0.00	3.49	Nonconserver
Sub. 3	37.3	30.1	68.8	0.90	0.00	2.00	Nonconserver
Sub. 4	30.0	4.91	94.2	0.12	0.00	0.74	Nonconserver

significant difference between the percentages of pauses of a transitional conserver and a non-conserver. Furthermore, the percentages of pauses of the operational conserver and consolidater are significantly higher than those of the two transitional conservers.

# Data on the Acquisition of Judgements and Explanations During Training

Number of each type of reinforced explanations. Table 9 shows the number of each type of explanation that was emitted

Insert Table 9 about here

by each subject and reinforced during training. It also shows the percentage of the total number of explanations, emitted by each group, made up of each type. As can be seen for the errorless group 100% were Els. However, for the conflict group only 56% were Els, while 4% were E3s and 40% were E5s. Also a total of 56l explanations were reinforced in the conflict group as compared to 1,068 in the errorless group. Nevertheless, on the two posttests the errorless group emitted only 5 correct explanations and the conflict group emitted 117 correct explanations. Furthermore, on these two posttests the errorless group only resisted 4% of the countersuggestions while the conflict group resisted 49%.

Table 9

Number of Reinforced Explanations of Each Type

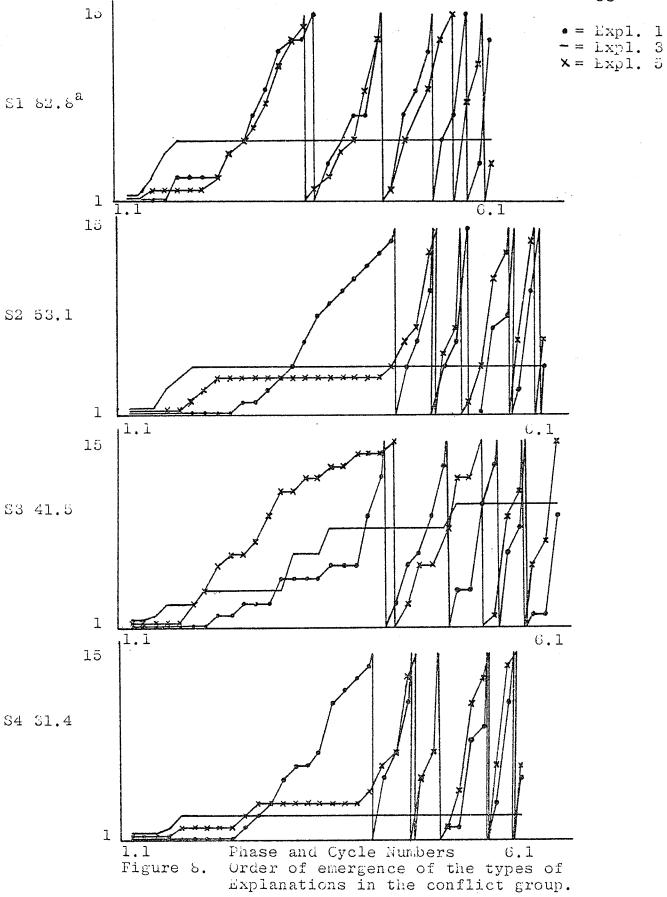
Group El Compensati	on E3 Addition/Subtraction	E5 Initial Equality	Total
Conflict Group			
Subject 1 73	5	63	141
Subject 2 79	4	66	149
Subject 3 69	12	60	141
Subject 4 91	2	<u>37</u>	<u>130</u>
Total 312	23	226	561
% of Total = 50	of Total = 4	% of Total = 40	
Errorless			
Subject 1 344	O	0	344
Subject 2 265	0	0	265
Subject 3 255	O	. 0	255
Subject 4 204	0	0	.204
Total 1,068			1,068
% of Total = 10	0		

Order of emergence of the types of explanations in the conflict group. Although the conflict training was explicitly designed to facilitate the emergence of the compensation explanation, a glance at Figure 8 reveals that the addition/subtraction and initial equality explanations emerged spontaneously and prior to the first compensation explanation.

Insert Figure 8 about here

Relation between the emergence of conflict and explanations in the conflict group. No correct explanations occurred prior to conflict. In each case conflict emerged first. For subject 1 eleven conflicts occurred prior to or simultaneously with the reasoning out of the first correct explanation. For subject 2, subject 3, and subject 4, twenty-seven, ten, and nine conflicts respectively occurred prior to or simultaneously with the first correct explanation.





 $<sup>^{\</sup>mathrm{a}}$  Subjects developmental level score.

#### CHAPTER IV

#### DISCUSSION AND CONCLUSIONS

## Evidence of the Equilibration Process

In Piaget's theory equilibration is an inferred explanatory concept. Several different types of data have been described which when taken together are convergent in their support of this inference.

The reason that these data are supportive is that they are confirming of several hypotheses that follow from Piaget's conceptualization of equilibration. These hypotheses are:

First, that development should only occur when appropriate disequilibrium is created in the child's cognitive structures.

Second, this disequilibrium should occur prior to or simultaneous with the change in understanding. Third, the change in understanding will only be indirectly controlled by the external contingencies of reinforcement. Their control will be limited by the child's pretraining level of cognitive development and the extent to which equilibration takes place.

## The Success of the Conflict Induction Method

This method was successful in two relevant ways. First, it effectively induced adaptational disequilibrium, as measured on the behaviors taken to be indicative of this state.

Second, only this method had a significant effect in develop-

ing the conservation of continuous quantity ability.

The errorless method was able to hold conflict at a minimum and also to gain control over the relevant conservation verbal behavior. Yet it did not induce an understanding of conservation of continuous quantity ability.

The errorless method was able to hold conflict at a minimum and also to gain control over the relevant conservation verbal behavior. Yet it did not induce an understanding of conservation of continuous quantity as evaluated by the posttests. Therefore, one of the necessary conditions for development in this area may be disequilibrium.

## Conflict Always Occurred Prior to a Correct Judgement

The fact that in all 4 subjects of the conflict group, conflict behaviors occurred prior to the emergence of the first correct judgement, places conflict in the right temperal relation to these judgements to enable it to be causally related to them.

## Relation Between Reinforcement and Development of Conservation Behaviors.

Several of the results need to be discussed here.

Order of emergence of types of explanations not directly determined by reinforcement contingencies. The reinforcement contingencies for the conflict group were deliberately designed to facilitate the development of the compensation explanation. In spite of this the addition/subtraction and

initial equality explanations emerged first for all 4 subjects. In the context of Piaget's theory one would expect the initial equality explanation to develop first because it is less difficult to reason with than the multiplication of asymmetrical relations. This is substantiated by the fact that even with the natural conservers compensation explanations constituted only 32% of the total while initial equality constituted 43%. The addition-subtraction explanation appears to be the most difficult since the natural conservers used it only 13% of the The fact that this explanation emerged first in the time. conflict group could be evidence against this. However, the type of addition/subtraction explanations that were used by these subjects was much more elementary than that used by In each case these early explanations natural conservers. used by the subjects occurred after a wrong prediction. they were asked to explain why they were wrong, they would correctly explain that the error was in leaving some liquid in one of the beakers at the top, i.e., they recognized that some was taken away.

This result can be interpreted as supporting Piaget's postulate that an interior process of self-regulation determines the developmental sequences and that external reinforcement procedures do not control these processes but only facilitate them.

Posttest frequencies of each type of explanation not directly proportional to their frequency during training. Table 9 shows that for the conflict group 56% of the explanations were of the compensation type and 40% were of the initial equality type. Yet on the posttests the frequencies were reversed with the compensation type constituting only 37% and the initial equality type constituting 60%. In the errorless group a similar phenomenon occurred with the compensation type constituting 100% during training and 0% on the posttest, while the initial equality type constituted 100% on the posttest. These reversals represent the prevalence of responses with substantially lower reinforcement during training over those with higher frequencies of reinforcement. This would not be expected if reinforcement is the primary variable that determined the probability of these responses. Thus, while the prevailing reinforcement contingencies during training determined the relative frequencies of these explanations during training, once these were removed a different natural ordering occurred. This is once again supportive of the postulate of a natural sequence which is organismically regulated.

Errorless group reinforced 100% more than conflict group but showed no significant development on posttests.

The errorless group was reinforced 1,068 times for correct explanations whereas the conflict group was reinforced only 561 times for the correct explanations. Yet on the posttests the errorless group showed no significant development.

This again throws doubt on the position that reinforcement is the primary variable controlling these developmental sequences.

The above three results may be interpreted as supporting Piaget's position that organismic processes of self-regulation determine developmental sequences and the environmental processes serve to facilitate development by activating these processes (cf. Halford, 1970; Overton & Reese 1973).

## Developmental Score Predicts Development Through Training

Figure 5 indicates that the subject's pretest developmental score may be a good predicter of the subject's capacity
to respond to training. This supports Piaget's position that
external events will only effect the development of these
behaviors when the subject's cognitive system possesses
competence for these events.

This general section can be closed with the conclusion that this research has given some support to Piaget's postulate of an intrinsic process of self-regulation which he calls equilibration.

# Evaluation of Behavioral Indices of Adaptational Disequilibrium

Table 8 indicates that only pauses are rank ordered in a manner that corresponds approximately to the rank ordering of both the developmental scores and the actual developments that occurred. This could indicate that pauses are better indices of disequilibrium than the other behaviors.

# Logical Necessity and the Closure of Cognitive Structures

Piaget (1970b, 1971b) has theorized that logical necessity is the result of the closure of a cognitive structure and that these structures once formed should be resistant to countersuggestion. The data presented above on the resistance of the natural conservers and the conflict trained conservers is supportive of this position.

## Evidence of the Contingencies of Reinforcement

The discussion thus far indicates that relative to the development of C.C.Q. the contingencies of reinforcement may function as subordinate causes which when applied appropriately, as in the conflict group, activate the equilibration process by creating cognitive disequilibrium in the child's cognitive system. However, a further question needs to be asked. Are the contingencies necessary to the initiation of this development? The evidence presented here supports the conclusion that the contingencies are necessary and effective when their use is guided by an understanding of the organismic processes of development. That they are the necessary initiators of development is shown by the fact that the three nonconservers in the control group did not develop in their absence. That their effectiveness may be determined by organismic processes is shown by the differences between the two experimental groups.

## Critique

One of the central shortcomings of this research was the fact that all of the behavioral indices of disequilibrium could also be taken as indices of difficulties in recall, as occurred in the errorless training without transformation portion of the experiment. Thus, even though these behaviors did not significantly increase in frequency in the errorless training with transformation portion, there is the possibility that some of these behaviors might have been indicative of genuine conflict. Fortunately the data recorded by the experimenter's themselves (which was reliable by interobserver checks) complements the data off the tapes in indicating that only a minimal amount of conflict occurred in the errorless group.

## Conclusion

It is the writer's opinion that the reported research supports Overton's (1973) thesis that all development involves an indissolvable strong interaction between organismic and environmental processes. In closing, it may be appropriate to quote the philosopher of science Bunge: "Efficient causes are effective solely to the extent to which they trigger, enhance, or damp inner processes . . . An adequate picture is provided by a synthesis of self-determination (organismic activity) and extrinsic determination (environmental activity)

- . . . The two exaggerations of environmentalism and innatism
- . . . are thereby avoided (quoted in Overton & Reese, 1973, p. 79)."

#### APPENDIX I

# Piaget's Concepts of Equilibration and Disequilibrium

For Piaget the concept of equilibration is a theoretical construct which is used to explain the fact that the development of human intelligence is <u>directed</u> toward an end which, as cross cultural research indicates, may be species-specific (given of course the appropriate intellectual environment). This end is the logical-mathematical formal operations (c.f. Goldschmidt, Piaget, 1964, 1976). The central question is, how are we to explain the fact that the logical-mathematical operations follow the definite developmental path that is constituted by the invariant sequence of the four periods: the sensory-motor, preoperational, concrete, and formal operational periods.

For Piaget maturation, experience, and social transmission are the necessary, but not sufficient, conditions of
this development. Maturation alone cannot explain it because
the average ages at which the stages appear varies too greatly
from culture to culture for this development to be genetically
preprogrammed. Physical experience is inadequate because the
properties, such as species, genus, seriatedness, numerosity,
on which these operations are based, are not the properties
of objects. Therefore, these operations cannot be the

products of abstractions from objects. Neither can linguistic transmission of knowledge totally explain these acquisitions and their directedness because in order to understand these transmissions the child must have the prerequisite structures to assimilate them. <sup>8</sup>

In order to explain this orientation of development towards a species-specific end state Piaget posits the process of equilibration. The idea of equilibration has its basis in Piaget's conception of the organism as an organization. This organization gives rise to emergent properties that cannot be explained by summing the properties of the elements out of which the organism is made. 9 One of these properties is that

<sup>&</sup>lt;sup>8</sup>The whole peripheralist theory of thought, which would identify thought with behavior, is called into question by the research of Smith, Brown, Loman, and Goodman (1947), in which an anesthesiologist had his total peripheral musculature paralyzed by curarine and yet was capable of lucid thought.

<sup>9</sup>Examples of these emergent properties, which cannot be explained by the properties of the elements are: (a) The different melting points and boiling points of the two alkanes n-butane and isobutane. These are structural isomers. Structural isomers have the same molecular formulas i.e., are made out of identical elements in identical numbers, but different structural formulas, i.e., their only difference is their organization. Because the only difference between these alkanes is their organization, only it can explain their different properties. (b) The biological functions of proteins are also emergent properties. Proteins have several levels of organization referred to as the primary, secondary, tertiary etc. levels. At the higher levels no new elements are added. Rather, only new forms of organization occur. However, the biological functions of the protein are determined by the higher levels of organization. This is proven by the fact that the denaturation of the protein, which breaks up only its higher levels of organization, destroys its biological function.

of self regulation. There are two generic types of self regulation. The first is based upon the operation of substructures e.g., genetic regulation, and constitutes the influence of the parts of the organism on the whole. Piaget calls these regulations the specialized functions (1971a). The second is based upon the dynamic interaction of all the parts in the whole. This constitutes the influence of the whole on the part and represents a much more general form of self regulation which Piaget (ibid.,) refers to as the organization function or equilibration and von Bertalanffy (1951, 1952, 1967, 1968, 1975) refers to as primary regulations. Bertalanffy posits that these regulations are at the basis of equifinal development where an organism can reach a species-specific end state from different initial conditions and in different ways. e.g., the development of a normal see urchin from only one quarter of a fertilized egg. If we place Piaget's concept of equilibration in this context we can begin to understand why he states, "Equilibration, as I understand it, is thus an active process. It is a process of self-regulation. I think that this self-regulation is a fundamental factor in development" (1964, p. 181).

Equilibration can be examined both as a process (the diachronic perspective) and as a state (the synchronic perspective).

Looked at as a process equilibration can be defined as the central principle of self-regulation of systematically organized wholes. By this process these wholes direct their own development towards a state which is species-specific by relevantly varying the activities of their parts. This enables them to (a) control the form of new structures that are being constructed, e.g., cellular induction in physiological developments and the construction of the operations in intellectual development and (b) to compensate, within limits, for disturbances to the developmental processes, e.g., equifinal phenomena such as the development of the formal operations in different cultural environments.

Looked at as a state equilibration can be defined as the central principle of self-regulation of systematically organized wholes. In this state, these wholes by which these wholes maintain a relative equilibrium by relevantly varying the activities of their parts which enables them to compensate for disturbances to their equilibrium. An example at the physiological level is observed in the coordination of all the homeostatic mechanisms in the maintenance of the complex but highly specific interior milieu which characterizes the steady state of the organism. An example at the intellectual level would be the coordination of scientific reasoning by the formal operations (c.f. Furth, 1969; Harris, 1959; von Bertalanffy, 1968).

It might now be asked, what is it that activates this process of equilibration? For Piaget, intellectual equilibration is activated whenever disequilibrium is created in the cognitive system. As he states, "All development is composed of momentary conflicts and incompatibilities which must be overcome to reach a higher level of equilibrium" (1964, p. 185).

When this disequilibrium is introduced externally it is called adaptational disequilibrium. When it is introduced internally it is called organizational disequilibrium.

Brainerd (1973) has analyzed several methods for experimentally creating adaptational disequilibrium. The first is called dimensional discrimination training. This procedure creates disequilibrium by creating conflict between perceptual and quantitative cues. The second method is called predictionoutcome training. Here the child is asked to make a prediction about the result of an action which is contradicted by the outcome of that action. The third method is called conformity training. This can be accomplished by having the child model a conserver, or by placing conservers and nonconservers together and asking them to reach an agreement about the conservation judgement. The final method for creating adaptational disequilibrium is called direct feedback training where the experimenter tells the child that he/she is right or wrong after they have made their judgement.

It is because disequilibrium is essential to the posited process of equilibration and because there are experimental methods for manipulating it and also because behavior indices of it can be defined, that it was one of the central variables chosen for study in the research reported in this dissertation. This research had as its goal the test of the equilibration hypothesis.

## APPENDIX 2

## Summary of Conservation Research

Table 1

Analysis of the Conservation Induction Experiments

					Prope	rties o	f the Exp	eriments							
Experiment	Suc- cess- ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed	De- velop- mental Level of Ss	an hx-	Tested For Specific Gener- aliza- tion	Tested For Non Specific Gener- aliza- tion	Test- ed For RTL	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses-	Trials	Meets Meth- od- ologi- cal Cri- teria
Eearison 1969	Yes	Measure- ment opera- tions	Dimensional- discrimination -neg., comp., counting feed- back, in- direct verbal feedback	c.c.Q.	N.C.	Yus	Yes (weak) success- ful	Yes success- ful	No	No	Yes 1 mo. 7 mos. suc- cess- ful	Мо	1 25- 45'	?	Yes
Beilin 1965	Yes	Gpl Verbal rule instruc- tion and reinfor- cement	Dimensional- discrimination -comp., neg., direct verbal feedback and physical r'fmt.	C.N. C.L.	Mixed NCs- TCs	Yes	Yes success- ful	Yes unsuc- cessful	No	No	Yes X of 3 weeks suc- cess- ful	No	2	35 ea. con- cept	Yes
Ibid.	No	Gp2 Non- verbal reinfor- cement	Dimensional- discrimination -comp., direct physical r'fmt.	C.N. C.L.	Mixed NCs- TCs	Yes	Yes unsuc- cessful	Yes unsuc- cessful	No	No	Yes X of 3 weeks unsuccess-ful	No	2	36 ea. con- cept	Yes
Ibid.	Ю	Gp3 Verbal orienta- tion re- inforce- ment	Ibid.	C.N. C.L.	Mixed NCs- TCs	Yes	Yes unsuc- cessful	Yes unsuc- cessful	No	No	Yes X of 3 weeks unsuc- cess- ful	No	2	36 ea. con- cept	Yes
Ibid.	No	Gp4 Equili- bration	Dimensional- discrimination -neg.	C.N. C.L.	Mixed NCs- TCs	Yes	Yes unsuc- cessful	Yes unsuc- cessful	No	No	Yes X of 3 weeks unsuc- cess- ful	Νο	2	36 ea. con- cept	Yes

aRefers to the use of methods which will enable the diagnosis of the genuineness of the understanding of conservation.

Table 1 (Continued)

Experiment	Suc- cess- ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed		an Ex-	Tested For Specific Gener- aliza- tion	Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
Boesma & Wilton 1974	Yes	Discrimi- nation learning sets	Dimensional discrimination -comp., direct verbal feedback & physical r'fmt.	C.N. C.L.	NCs	Yes	Yes suc- cess- ful	Yes success- ful	No	No	Yes 3 wks. suc- cess- ful	No	2	192 ea. con- cept	Yes
Brainerd 1972a	Yes	Direct feed- back	Dimensional discrimination -comp., direct verbal feed- back	c.c.q.	NCs	Yes	Yes suc- cess- ful	No	Yes suc- cess- ful	Νο	No	No	1	12	Yes
Brainerd 1972b	Yes	Direct feed- back	Ibid.	C.N.	Mixed NCs- TCs	Yes	Yes suc- cess- ful	No	No	No	Yes l wk. suc- cess- ful	No	1	18	Yes
Brainerd 1974	Yes	Direct feed- back	Ibid.	C.L.	Mixed NCs- TCs	Yes	Yes (weak) suc- cess- ful	Yes success- ful	No	No	Yes  1 wk. suc- cess- ful	No	1	12	Yes
Brainerd 1976	Yes	Direct feed- back	Ibia.	C.B.Q.	Mixed	No	Yes suc- cess- ful	No	No	No	Yes im- med- iate l wk. suc- cess- ful	Ю	1	8	No
Brison 1966	Yes	Con- formity train- ing-cons- erving peer	Dimensional discrimination - eg., comp. direct verbal feedback, physical r'fmt.	c.c.q.	NCs	Yes	Yes suc- cess- ful	No .	Yes 4 out of 5 train- ed Ss suc- cess- ful	No	No	Ио	2	5	Yes

Table 1 (Continued)

Experiment	Suc- cess- ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed	mental	Re- quired an Ex- plana- tion		Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
Bucher & Schneider 1973	Yes	Operant condi- tion- ing	Dimensional discrimination -A-S, comp., direct verbal feedback, & physical r'fmt.	c.c.q.	? Con- ser- va- tion not pre- test- ed	ИО	Yes (weak) suc- cess- ful	Yes unsuc- cess- ful	No	ОИ	Ио	No	App. 48	Min. of 236	No
Charbon- neau, Robert Boorassa & Gladu- Bissonn- ette 1976	Yes	Conform- ity training adult model	Dimensional discrimination -comp., direct verbal feed- back from model's judgment	c.c.q.	NCs	Yes	Yes uc- cess- ful	No	No	No	Yes im- med- iate l wk. 3 mo. suc- cess- ful	No	1	4	Yes
Christie & Smothergill 1970	No	Gp.1 Dis- crimi- nation learning set Gp.2 Ss un- Inform- ed of results	Dimensional discrimination -comp. direct feedback	C.L.	N.C.	Yes unsuc- cess- ful	Yes .	No	Ио	No	No	No	?	96	No
Cooley & Martin 1972	Yes	Operant condi-tioning pro-grammed learning	Dimensional discrimination A-S, direct verbal feedback, physical r'fmt	c.c.q.	NCs	Yes	Yes suc- cess- ful	Yes success- ful RE.C.W.	No	Ио	Yes im- med- iate l mo. 5 mos. suc- cess- ful	No	X. 13	X. 329	Yes

Table 1 (Continued)

						1 (0011									
Experiment Cooley, Braun, & Kerger 1977	Suc- cess- ful No	Training Method  Operant conditioning: programmed learning	Confounded with Disequilibrium Methods	Con- cept Train- ed C.W.		an Ex-	Tested For Specific Gener- aliza- tion Yes unsuc- cessful	Tested For Non Specific Gener- aliza- tion Yes unsuc- cessful	Test- ed For RTE No	ed For RTCS Yes un- suc-	Tested For Dura- bility Yes im- med- iate 1 mo. 6 mos. unsuc- cess- ful	of Con-	Ses- sions X. 16	Trials X. 266	Meets Neth- od- ologi cal Cri- teria Yes
Curcio, Kattef, Levine & Robbins 1972	Yes	1. Dimensional discrimination 2. Addition-subtraction 3. Revers bility		C.D.Q.	Mixed NCs- TCs	Yes	Yes success- ful Re- compen- sator Ss	No .	No	No	Yes im- med- iate l wk. suc- cess- ful re- comp- ensa- tor Ss	No	2	8	Yes
Figurelli & Keller 1972	Yes	Verbal rule in- struc- tion	Dimensional discrimination -comp., dir- ect verbal & visual feed- back, physical r'fmt.	C.N. C.S. C.2.	Mixed NCs- TCs	Yes	Yes success- ful re middle class Ss	ИО	No	No	No	No	1	? .	No
Fleishman, Gilmore Ginsburg 1960, Exp. I.	Yes Re Gp. 3	Gp.1 Continuity training Gp.2 Continuity - visual training (language activation) Gp.3 Feedback	None  None  Dimensional discrimination -comp. direct verbal feedbad		NCs	Но	Yes success- ful	No	No	Yes unsuc cess- ful		No	1	3	No

Dimensional discrimination -comp. direct verbal feedback

lu.

Table 1 (Continued)

Experiment	Suc- cess- ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed	De- velop- mental Level of Ss	an Ex-	Tested For Specific Gener- aliza- tion	Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses-	Trials	Meets Meth- od- ologi- cal Cri- teria
Ibid. Ext. II	No	One to one cor- res- pond- ence	None	C.D.Q.	? Not pre- tested	Ю		No	No	No	No	No	1	?	Ио
Ibid. Exp. III	No	One to one cor- res- pond- ence	None	C.D.Q.	? Not pre- tested	No	No	No	No	No	No	No	1	?	No
Frank 1966	Yes Gp. 2	Gp.1 Per- ceptual screen- ing, -4-5 yr. olds	1. Pre- diction -outcome 2. Dimen- sional discrimination -comp. direct visual feed- back	c.c.q.	Mixed	Yes	Yes success- ful	No	No	No	No	No	?	?	No
19		Gp.2 Per- ceptual screen- ing 5-7 yr. olds	Ibid.	-											· · · · · · · · · · · · · · · · · · ·
Gelman 1969	Yes	Dis- crimina- tion learning sets	Dimensional discrimination -comp., direct verbal feed-back & physical r'fmt.	C.N. C.L.	NCs	Yes	Yes success- ful	Yes suc- cess- ful Re C.C.Q., C.M.	No	No	Yes im- med- iate 2-3 wks. suc- cess- ful	No	2	192 ea. con- cept	Yes

Table 1 (Continued)

Experiment	Suc- cess- ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed		Re- quired an Ex- plana- tion	Gener-	Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	As- ess- ment of Con- flict	Ses-	Trials	Meets Meth- od- ologi- cal Cri- teria
Greitzer & Jeffrey 1973	Yes Gps. 1, 2,	Gps. 1 & 2, dis- crimina- tion learning set pretest- to pre- test Gps. 3 & 4, op- erant condi- tioning fading (pretest- no pre- test)	Dimensional discrimination -comp., direct feedback	C.L.	N.C.	Yes	?	No	No	No	No	No	?	?	No
Gruen 1965	Yes Re Gp. 2	Gp. 1 pretrain- ing + direct training Gp. 2 pretrain- ing + conflict training	Dimensional discrimination -comp., feed- back from counting Dimensional discrimination -A-S	C.N.	NCs	Yes	Yes Gp. 2	Yes Gp. 2 success- ful re C.M., C.L.	No	No	No	No	2	32	Yes
Halford 1970	Yes	Classi- fication learning set training	1. Dimensional discrimination 2. Prediction outcome 3. Direct feedback	C.D.Q.	NCs	No	Yes success- ful	No	No	No	Ю	No	7	?	No

Table 1 (Continued)

Evacviment	Suc- cess- ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed	De- velop- mental Level of Ss	Re- quired an Ex- plana- tion	Tested For Specific Gener- aliza- tion	Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	As- ess- ment of Con- flict	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
Experiment Halford & Fullerton 1970	Yes	One-to- one cor- respond-	1. Prediction- outcome 2. Dimensional discrimination- comp., indirect verbal feed- back, visual	C.N.	ИСя	Yes	Yes success- ful	No	No	No	Yes im- med- iate 3 wks. suc- cess- ful	No	5	?	Yes
Hamel 1971	No	Identity training (language improve- ment)	None	c.c.Q.	NCs	?	Yes	No	No	No	No	No	?	?	No
Hamel & Riksen 1973	Yes	Gp. 1 Identity V.R.I. training Gp. 2 reversi- bility V.R.I. Training	Dimensional discrimination -comp., direct verbal feed- back 1. Dimensional discrimination -neg., comp. direct verbal & visual feed- back 3. Prediction outcome	<b>-</b> .	Mixed NCs- TCs	Yes	Yes Gp. 1 + 2 suc- cessful	Yes Gp. 1 + 2 suc- cessful Re C.S., C.N., C.W	•		Yes im- med- iate l wk. Gp. 1 & 2 suc- cess- ful	No	1	5	Yes
26 Hamel, Van Der Veer, & Westerhof 1972	Gp. 2	Gp. 2 + 3 Language ctiva- tion verbal rule instruc- tion	Dimensional discrimination -comp. indirec & direct verba feedback	t	Gp. 2- TCs Gp. 3- NCs		Yes Gp. 2 suc- cess- ful	No	No	No	No	No	1	?	No

Table 1 (Continued)

Experiment	Suc- cess- ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed		Re- quired an Ex- plana- tion	Gener-	Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
Hatano & Soga 1969 Expt. 1	Yes Gps. 1, 3, 4	negation no ext. rein- force- ment Gp. 3 Ext. re- inforce- ment re conser- vation Gp. 4 Conser- vation conflict, ext. re- inforce- ment Grp. 5 Conflict negation no ext. rein- force- ment, counting, verbal sugges-	Dimensional discrimination -comp., physical r'fmt.  Dimensional discrimination -comp., A-S, physical	C.N.	NCs	No	Yes Gps. 1, 3, 4 success- ful ke posttest 2	No	No	Yes un- suc- cess- ful	Yes	No	2	48	No
28		tion													

Table 1 (Continued)

Experiment	Suc- cess- ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed		Re- quired an Ex- plana- tion		Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses-	Trials	Meets Meth- od- ologi- cal Cri- teria
Ibia. Expt. 2	Yes Gp. 1	Gp. 1 Verbal sug- ges- tion, inter numeri- cal rela- tions, ext. rein- force- ment Gp. 2 Same as 1 but no rein- force- ment	Dimensional discrimination -comp., A-S, indirect verbal feed-back, physical reinforcement  Dimensional discrimination -comp., A-S, indirect verbal feedback	C.N.	NCs	No	Yes Gp. 1 success- ful	No	No	No	No	No	2	48	No
Inhelder Sinclair Bovat 1974a	Yes TCs	1. Dimensional discrimination -comp., indirect verbal feedback, visual feedback 2. Predictionoutcome	None	c.c.q.	NCs TCs	Yes	Yes TCs success- ful .	No	No	Yes TCs suc- cess- ful	Yes im- med- iate 1-3 wks. TCs suc- cess- ful	Qualitativ prese in some Ss	e	?	Yes

Table 1 (Continued)

Experiment	Suc- cess ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed		Re- quired an Ex- plana- tion		Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
Ibid. 1974b	Yes TCs	1. Dimensional discrimination -comp., indirect, verbal feedback & feedback from counting	None	С.р.Q.	NCs TCs	Yes	Yes TCs success- ful	No	No	Yes TCs suc- cess- ful	Yes 4-6 wks. TCs suc- cess- ful	Qualitative present in-some Ss	3	?	Yes
Ibid. 1974c	Yes TCs	1. Dim- ensional discri- mination -comp., indirect verbal feedback	None	C.M. C.N.	NCs TCs	Yes	Yes TCs success- ful	Ио	No	Yes TCs suc- cess- ful	Yes 6-8 wks.	No	3	?	Yes
Ibid. 1974d	olí	Verbal training	None	C.M. C.N.	Mixed	Yes	Yes unsuc- cessful	Ио	No	Yes suc- cess- ful	Yes 2 wks. un- suc- cess- ful	No	3	?	Yes
Ibid. 1974e	Yes NCs & TCs	1. Dim- ensional discri- mination -comp., indirect verbal feedback	None	C.L.	NCs TCs	Yes	Yes NCs & TCs success- ful	No	No	Yes suc- cess- ful	Yes 4-6 wks. NCs & TCs suc- cess- ful	Quali- tative pre- sent in some Ss			Yes

Experiment	Suc- cess ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed	mental	an Ex-		Tested For Non Specific Gener- aliza- tion	Test- ed For KTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
Ibid. 1974f	Yes NCs & TCs	1. Dim- ensional discri- mination -comp., neg., indirect verbal- visual feedback, feedback from counting	None	c.D.Q.	NCs TCs	Yes	Yes NCs & TCs suc- cessful	Yes C.W. suc- cess- ful	No	Yes suc- cess- ful	Yes time? suc- cess- ful	Quali- tative pre- sent in some Ss		?	Yes
Kingsley & Hall 1967	Yes	Learning sets	Dimensional discrimination -comp., direct verbal-visual feedback A-S re C.L.	C.W.	Mixed	Yes	Yes success- ful	No	Yes unsuc- cess- ful		Yes 4 mos.	No	9		Yes
Lefebre & Pinard 1972b	Yes	1. Di- men- sional discri- mination -comp., indirect verbal feedback	None	C.C.Q.	N.C.	Yes	Yes success- ful	?	?	?	Yes 2 mos. suc- cess- ful	?	?	?	Yes
LeFrancois 1968	Yes	Learning sets	1. Dimensional discrimination -comp., indirect verbal feedback	C.M.	NCs	No	Yes success- ful	No	No	No	No	No	?	?	No .

bAnalysis is based upon Charbonneau et. al.'s (1976) description.

Table 1 (Continued)

Experiment	Suc- cess ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed	mental	Re- quired an Ex- plana- tion		Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses-	Trials	Meets Meth- od- ologi- cal Cri- teria
Mermel- stein, Carr, Mills & Schwartz 1967	No ,	Gp. 1 Cognitive conflict Gp. 2 Multiple classification Gp. 3 Verbal rule instruction Gp. 4 Language activation	Dimensional discrimination -comp., direct verbal feed- back Dimensional discrimination -comp., neg. direct verbal feedback Prediction outcome	C.N.	Mixed	Yes	Yes unsuc- cessful- all groups	No	Yes un- suc- cess- ful	No	Yes 1 wk. 2 mos. 3 mos. un- suc- cess- ful	No	8	?	Yes
Mermel- stein & Meyer 1969	No	Gp. 1 Cogni- tive conflict Gp. 2 Multiple classi- fication  Gp. 3 Verbal rule instruc- tion Gp. 4 language activa- tion	Dimensional discrimination -comp., direct verbal feed- back Dimensional discrimination -comp., neg. direct verbal feedback Prediction outcome	C.N.	Mixed	Yes	Yes unsuc- cessful - all groups	Yes, un- suc- cess- ful	Yes un- suc- cess- ful	No	Yes 3 wks. 2½ mos 5 mos. unsuc- cess- ful	No •	8	?	Yes
Miller & Brownwell 1975	Yes	Conform- ity con- serving peer	Dimensional discrimination -comp., direct verbal feed-back	C.L. C.W.	NCs	Yes	Yes success- ful	No	No	Not on post- test	No	No	1	?	No

Table 1 (Continued)

Experiment	Suc- cess ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed	mental	Re- quired an Ex- plana- tion		Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
Murray 1972	Yes	Conform- ity con- serving peer	Dimensional discrimination comp., direct feedback	C.S. CN CM C.C.Q. C.D.Q. C.W:	Mixed but sig- nifi- cant effect with ll NCs	Yes	Yes success- ful	Yes suc- cess- ful	?	?	Yes l wk. suc- cess- ful	No	1	3	Yes
Murray 1974	Yes	Conform- ity-con- serving peer	Dimensional discrimination	C.W.	NCs TCs	Yes	Yes success- ful	Yes suc- cess- ful re NCs & TCs to C.M. & not to C.C.Q.	No	No	No	No	1	4	Yes
Overbeck & Schwartz 1970	Yes Re Gps. 1 & 2	Gp. 1 Rein- forced active training  Gp. 2 Rein- forced passive training Gp. 3 Non re- inforced active training Gp. 4 Non re- inforced passive training training training training training	Dimensional discrimination -comp., direct verbal & visual feed- back Ibid.  None		Mixed	Yes	Yes success- ful re Gp. 1 & 2	No .	No	No	No	No	1	12	No

Table 1 (Continued)

Experiment	Suc- cess ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed	mental Level	Re- quired an Ex- plana- tion		Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For kTCS	Tested For Dura- bility	of Con-	Ses-	Trials	Meets Meth- od- ologi- cal Cri- teria
Peters 1970	Yes Re Gp. 1, 2, 3	Gp. 1 Non cued dis- covery Gp. 2 Per- ceptual cue guided dis- covery Gp. 3 verbal didactic instruc- tion	Dimensional discrimination neg.  Dimensional discrimination -counting, cue discrepancy, neg.  Dimensional discrimination -neg., direct feedback	C.N.	Mixed	Yes	Yes success- ful Gps. 1, 2, 3 on post- test 1. Gps. 2, 3 on posttest 2.	Yes unsuc- cessful re C.A.	No	No	Yes 2 wks. suc- cess- ful Gps. 2	No .	2	3	Yes
Rosenthal & Zimmerman 1972 Expt. 1	Yes	Gp. 1 Model, rule & feed- back to model Gp. 2 Model, o rule, feedback to model Gp. 3 Model, rule, no feedback to model, rule, no feedback to model compodel	Dimensional discrimination -comp. direct feedback  Ibid.  Ibid.	C. Space C.M. C.W. C.N. C.C.Q. C.D.Q.	e Mixed NCs	Yes	Yes success- ful all gps.	No	No	No	No	No	?	?	No

Table 1 (Continued)

<b>L</b> xperiment	Suc- cess ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed		an Ex-	For Specific	Gener- aliza- tion	ed For RTE	ed For RTCS	For Dura- bility				
Rosenthal & Zimmerman 1972 Expt. 3	Yes Gp.1	Gp. 1 Model rule no feedback to model Gp. 2 V.R.1 - no model- ing, no expos- ure to trans- forma- tion	Dimensional discrimination -comp., direct feedback		?	Yes	Yes suc- cess- ful re Gp. 1	No	No	No	ИО	No	?	?	No
Ibid. Expt. 4	Yes	Model, no rule no feed- back to model	Dimensional discrimination -comp., direct feedback	Ibid.	?	for	Yes success- ful re judge- ments	No	Ио	No	Но	No	?	?	No
Rothenberg & Orost 1969 Expt. 1	Yes	Learning sets con- formity-conserving peer	Dimensional discrimination -neg., A-S, direct feed-back	C.N.	Mixed	Yes	Yes success- ful	No	No	No	No	No	?	?	No
Ibid. Expt. 2	Yes	Ibid.	Ibid.	C.N.	Mixed	Yes	Yes success- ful	ой	No	Мо	Yes im- med- iate 2 mos.	No	3	?	Yes
Ibid. Expt. 3	Yes	Ibid.	Ibid.	С.И.	Mixed	Yes	Yes success- ful	Yes suc- cess- ful to C.D.Q.	No	Но	Yes im- med- iate 2 mos. 3 mos. suc- cess- ful		4	?	Yes

Table 1 (Continued)

Experiment	Suc- cess ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed		Re- quired an Ex- plana- tion		Tested For Ron Specific Gener- aliza- tion	Test- ed For kTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
Sheppard 1974	Yes Gps.	Gp. 1 Compensa- tion and combi- natorial training Gp. 2 Ibiu.	(1) Dimen- sional dis- crimination- comp., indirect feedback (2) Predic- tion-outcome  Dimen- sional dis- crimination- comp., neg., indirect feed- back	C.C.Q. C.M.	ИСѕ	Yes	Yes success- ful both groups	Yes Gp. 1 success- ful to C.N. Gp. 2 success- ful to C.N., C.W., C.V.	No	No	Yes 4 days 2 wks. 2 mos. both groups suc- cess- ful		4	?	Yes
52 Siegler & Liebert 1973	Yes Gps. 1, 2 & 3	Gp. 1 Verbal rule instruc- tion Gp. 2 feed- back  Gp. 3 V.R.I + feed- back	Dimensional discrimination -comp., A-S, direct feed- back (rule) Dimensional discrimination -comp., A-S, direct feed- back (right or wrong) Ibid.	c.c.Q.	NCs	Yes	Yes success- ful - three groups	Yes unsuc- cessful re C.L.	No	ÑО	Yes 1 wk. suc- cess- ful - three groups	No	1	18	Yes
Sigel Roeper & Hooper 1966	Yes	fication	Dimensional discrimination comp., neg., indirect feedback	Not trained direct- ly on conser- vation		Yes		Yes success- ful to C.M., C.C.Q., C.W., not to C.V.	No	No	Yes 2 wks. suc- cess- ful	No	?	?	Yes

Table 1 (Continued)

Experiment	Suc- cess ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed	mental Level	Re- quired an Ex- plana- tion	Tested For Specific Gener- aliza- tion	Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For NTCS	Tested For Dura- bility	As- ess- ment of Con- flict	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
Silverman & Geiringer 1973		Conform- ity-con- serving peer	Dimensional discrimination -comp. direct feedback	C.L.	NCs	Yes	Yes success- ful	Yes success- ful to C.	No	Yes dur- ing expt. suc- cess- ful	Yes l mo. suc- cess- ful	No	1	?	Yes
Silverman & Stone 1972	Yes	Conform- ity-con- serving peer	Dimensional discrimination -comp. direct feedback	C.A.	NCs	Yes	Yes success- ful	No	No	Yes dur- ing expt. suc- cess- ful	Yes 1 mo. suc- cess- ful	No	1	?	Yes
Sjöberg, Hoijer & Olsson 1970	Yes Re Gp.3	Gp. 1 Reversibility verbal rule instruction Gp. 2 Decentering VRI Gp. 3 Additionsubtraction VRI Gp. 4 External visual reinforcement, reweighing	Dimensional discrimination -comp., direct feedback  Ibid.  Dimensional discrimination -comp., direct visual feedback		NCs OCs	Yes	Yes success- ful re VRI Gps.	Yes success- ful re A-S, VRI Gp.	Yes suc- cess- ful A-S, VRI & OCs		No	No	1	?	Yes

Table 1 (Continued)

Experimen*	Suc- cess- ful	Training Method	Confounded with bisequilibrium Methods	Con- cept Train- ed		Re- quired an Ex- plana- tion		Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses-	<b>Trials</b>	Meets Meth- od- ologi- cal Cri teria
Smedslund 1961a	No	Gp. 1 External visual r'fmt.  Gp. 2 External r'fmt of addition subtraction	Dimensional discrimination -comp., direct visual feed- back Dimensional discrimination -comp., A-S, direct visual feedback	C.W.	Mixed	Yes	Yes unsuc- cessful	No	No	No	Yes in- medi- ately l no. unsuc- cess- ful	No		32	Yes
Smedslund 1961b	No	Extinc- of visual cues	Dimensional discrimination -comp., direct verbal & visual feedback	C.W.	Mixed	Yes	Yes unsuc- cessful	Yes unsuc- cessful re C.S.	No	Ио	No	No	3	36	Yes
Smedslund 1961c	Ио	Conflict without external r'fmt.	Dimensional discrimination -comp., A-S, neg.	C.M.	й.С.	Yes	?	ÑO	No	No	Йо	No	3	36	No .
Smedslund 1961d	Yes Re Gp. 2	Gp. 1 C.C.Q. training Gp. 2 C.D.Q.	Dimensional discrimination -comp., A-S. Ibid.	C.C.Q. C.D.Q.	NCs	Yes	Yes success- ful re Gp. 2	No	No	ЙO	Ио	No	3	15	No

Table 1 (Continued)

Smedslund   Yes   Gp. 4   Step-   Dimensional C.L.   NCs   No   Yes   No   Yes   No   No   No   Yes   No   No   No   Yes   No   No   No   Yes   No   Yes   No   No   No   Yes   No   No   No   Yes   No   No   No   Yes   No   No   No   No   Yes   No   No   No   Yes   No   No   No   No   No   Yes   No   No   No   No   Yes   No   No   No   No   No   Yes   No   No   No   No   No   Yes   No   No   No   No   No   No   No   N	Experiment	Suc- cess- ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed	mental Level	Re- quired an Ex- plana- tion	Gener-	Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For ETCS	Tested For Dura- bility	of Con-	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
	1963		Step- wise addition subtrac- tion- Muller- Lyer Gp. 2 Com- pound addition subtrac- tion- Muller Lyer Gp. 3 Streng- thening Muller Lyer Gp. 4 Predic- tion out- come Gp. 5 Combin- ation of	A-S  Ibid.  None  Prediction outcome - neg., visual feedback	С. Б.	NCs	Мо	successful Gp. 4	No	suc- cess- ful		Ио	Quantita- tive re Gp. 1 some evid- ence of it invol	s	?	No .

Table 1 (Continued)

Experiment	Suc- cess- ful	Training Metnod	Confounded with Disequilibrium Methods	Con- cept Train- ed	mental Level	Re- quired an Ex- plana- tion		Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	As- ess- ment of Con- flict	Ses-	Trials	Meets Meth- od- ologi- cal Cri- teria
Smith 1968	Yes Gps. 4,5 &6	Gps. 1 & 2 Addition—sub—trac—trion Gps. 3 & 4 Re—inforce—ment pract—ices Gps. 5 & 6 Verbal rule in—struc—tion	Dimensional discrimination -A-S.  Dimensional discrimination comp., visual feedback  Dimensional discrimination -comp., direct feedback, neg.	C.W.	NCs TCs	Yes	Yes V.R.I. success- ful for NCs & TCs. R.P. successful for TCs	No	Yes unsuc- cess- ful	No -	Yes 1 wk. un- suc- cess- ful	No	1	12	Yes
Strauss & Langer 1970	No	Gp. 1 Conflict & screen- ing Gp. 2 Conflict & no screen- ing Gp. 3 To con- flict & screen- ing Gp. 4 To con- flict & no screen- ing	Prediction outcome-visual feedback  1. Prediction outcome 2. Dimensional discrimination -comp., visual feedback None	C.C.Q.	Mixed	Yes	Yes unsuc- cessful	No .	No	No	Yes 10 days to 2 wks. unsuc- cess- ful	No	2	8	Yes

Table 1 (Continued)

Experiment	Suc- cess- ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed		an Ex-	Tested For Specific Gener- aliza- tion	Tested For Non Specific Gener- aliza- tion	Test- ed For RTE	Test- ed For RTCS	Tested For Dura- bility	of Con-	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
Wallach & Sprott 1964	Yes	Reversi- bility training	1. Prediction outcome 2. Dimensional discrimination -neg., A-S, comp. visual feedback	C.N.	N.C.	Yes	Yes success- ful	No	No	Yes suc- cess- ful	Yes 2-3 wks. suc- cess- ful	Ио	1	8	Yes
Wallach, Wall & Anderson 1967	Yes Gp. 1	Gp. 1 Reversibility training  Gp. 2 Additionsubtraction	1. prediction outcome 2. Dimensional discrimination -comp., neg., visual feedback None re conservation: arrays not transformed	C.N.	N.C.	Yes	Yes success- ful re Gp. 1	Yes unsuc- cessful to C.C.Q.	No	Yes suc- cess- ful re Gp. 1	suc- cess-	No	1	4-6	Yes
Winer 1968 expt. 1	Yes Gp. 1	Gp. 1 Addi- tion- subtrac- tion set training & con- flict Gp. 2 Addition subtrac- tion set training no con- flict	Dimensional discrimination -A-S,	C.N.	NCs	Yes	Yes success- ful re Gp. 1	Yes unsuc- cessful to C.C.Q.	No	No	Ио	Yes quantitative Gp. 1 showe none		26	Yes

Table 1 (Continued)

Experiment	Suc- cess- ful	Training Method	Confounded with Disequilibrium Methods	Con- cept Train- ed	mental Level	Re- quired an Ex- plana- tion	For Specific Gener-	Gener-	Test- ed For RTE	Test- ed For RTCS	For Dura-	As- ess- ment of Con- flict	Ses- sions	Trials	Meets Meth- od- ologi- cal Cri- teria
Wohlwill & Lowe 1962	No	Gp. 1 Rein- forced practise  Gp. 2 Addition subtraction  Gp. 3 Dissociation	1. Prediction outcome 2. Dimensional discrimination -comp., feed-back from counting 1. Prediction outcome 2. Dimensional discrimination -comp., A-S, feedback from counting 1. Prediction outcome 2. Dimensional discrimination -comp., feed-back from counting discrimination -comp., feed-back from counting	С.И.	Mixed	Yes rever- bal tests	·		No	No	ИО	No	2	18	No
Zimmerman & Lanaro 1974	Yes Gps. 1 & 2	Gp. 1 Modeling judge- ment & expla- nation Gp. 2 Modeling judge- ment, ex- planation & neg.	1. Prediction- outcome 2. Dimensional discrimination -comp., direct feedback As above, plus neg.		N.C.	Yes	Yes success- ful	Yes success- ful to 2 dim. space re judgements only	No S	No··	Yes 9 days suc- cess- ful	No	2	24	Yes

Table 1 (Continued)

		Methods	Train- ed	Level of Ss	plana- tion	Gener- aliza- tion	Gener- aliza- tion	ed For RTE	ed For RTCS	Tested For Dura- bility	of Con-	Ses- sions	Trials	ologi- cal Cri- teria
& Rosenthal Gps. Model 1974 1, 2, & ex 3 plan tion  Gp. Verbrule institution Gp. Model	odeling ex- lana- ion p. 2 erbal ule nstruc- ion	1. Prediction outcome 2. Dimensional discrimination -comp., direct feedback Dimensional discrimination -comp., direct feedback Same as Gp. 1		N.C.	Yes	Yes success- ful all gps.	Yes successful to C.N., C.S., all gps.	No	Ио	Yes 7-10 days suc- cess- ful	<b>N</b> O	1	12	Yes

## APPENDIX 3

## Programs for the Errorless Training

		SCHEMATIC OF AFTER THE TRA		ANSWER TO		KNOWN CONCEPT ALTERNATED WITH TEST CONCEPT
TRANSFORMATIONS	TYPE OF CONTAINERS		S's Container	QUESTION 1 FROM FIGURE 1	VERBAL RULE (ANSWER TO QUESTION 2 FROM FIGURE 1)	i.e., THE QK.
<ol> <li>S's fluid completely transferred to another container</li> </ol>	Three 600 ml. beakers			Same	Because they were the same to begin with and you just poured mine into this jar.	
2. S's fluid completely transferred to another container	Three 500 ml. Erlenmeyer beakers			Same	Same as above	
3. S's fluid completely transferred to another container.	Three 500 ml. flat-bottom- ed :lasks			Same	Same as above	
4. S's fluid comp- letely transferred to a container of different dimen- sions	2 3-quart	Perceptual illupartially fille aid judgment of	d contrained to	Same	Because they were the same to begin with and you just poured mine into this jar. Now it's high but it's skinnier than yours. So they're the same.	1
5. Fluid added to S's container	Three 600 ml. beakers			More	Because mine had more to begin with and you just poured mine into this jar.	4
6. Some fluid poured out of S's container	Three 600 ml. beakers			Less	Because mine had less to begin with and you just poured mine into this jar.	5

The answers and verbal rules that were taught in the first five programs in the errorless training.

•		SCHEMATIC OF C AFTER THE TRAM		ANSWER TO		KNOWN CONCEPT ALTERNATED WITH TEST CON-
TRANSFORMATIONS	TYPE OF CONTAINERS	E's Container	S's Container	QUESTION 1 FROM FIGURE	VERBAL RULE (ANSWER TO QUESTION 2 FROM FIGURE )	CEPT AS PER THE DATA SHEET (FIGURE )
7. Fluid is added to the S's contain er and It is then transferred to a larger container	beakers 1 - 250 ml. beakers E's beaker @ 80 E's beaker @			More	Because mine had more to begin with and you just poured it into this jar.	4
8. S's fluid tra- hisferred to a larger container so that the levels of E's and S's fluid become the same height.	beakers 1 - 250 ml.			More	Because mine had more to begin with and you just poured it into this jar. Now it's lower than it was but it's wider than yours. So it's still more.	4
9. Fluid is taken from the S's con-tainer and it is then transferred into a smaller container	2 - 250 ml. beakers 1 - 150 ml. beaker E's beaker @ 120 ml. S's beaker @50			Less	Because mine had more to begin with and you just poured it into this jar.	8
10. S's fluid is transferred to a smaller container so that the levels of E's and S's fluid become the same height.	2 - 250 ml. beakers 1 - 150 ml. beaker E's beaker @ 120 ml. S's beaker @80			Less	Because mine had less to begin with and you just poured into this jar. Now it's higher than it was but it's skinnier than yours. So it's still less.	8
11,12,13,14,15,16. the same as #4, ex 2 qt. container wa little, so that th lusion was faded o end of program 16, appropriately cons quantity (at least cartons used) with ual illusion.	cept that the s cut little by e perceptual il ut, and by the the subject wa erving continuo with the milk	us v		Same	Because they were the same to begin with and you just poure mine into this jar. Now it's high but it's skinnier than yours. So they're the same.	· dı

, [		·	SCHEMATIC OF		ANSWER TO	,	KNOWN CONCEPT ALTERN
	TRANSFORMATIONS	TYPE OF CONTAINERS	AFTER THE TRAI		QUESTION 1 FROM FIGURE	VERBAL RULE (ANSWER TO	ATED WITH TEST CON- CEPT AS PER THE DATA
T to A to to	7,18,19,20,21,22 & B. Using skinnier artons, the percep as again faded out ad of program 23 topropriately consenantity.	tual illusion so that by the he subject was	Final comparis	on of Program 2	3 Same	Because they were the same to begin with and you just poure mine into this jar. Now it's high but it's skinnier than yours. So they're the same.	4 0 30
10	4. Fluid from 's container poure ito completely ew container.	Two 600 ml. d beakers and one 150 ml. beaker (this i the first tran formation with the beaker).	s- [ ]		Same	Same as above.	8
2	5. Same as above.	Two 1000 ml. beakers and one 150 ml. beaker			Same	Same as above	10
1.3	i. Same as above.	Two 500 ml. Erlenmeyer beak ers and one 125 ml. Erlenmeyer beaker	-		Same	Same as above	8
123	7. Same as above.	Two 1000 ml. flat-bottomed beakers and one 500 ml. flat-bottomed beaker.			Same	Same as above	10

3		<b>—</b>				y
	TYPE OF	SCHEMATIC OF CONTAINERS AFTER THE TRANSFORMATION		ANSWER TO QUESTION 1		KNOWN CONCEPT ALTERN
TRANSFORMATIO		E's Container	S's Container	FROM FIGURE	VERBAL RULE (ANSWER TO QUESTION 2 FROM FIGURE )	ATED WITH TEST CON- CEPT AS PER THE DATA SHEET (FIGURE )
23. Using sking partons, the pervass again faded and of program	nier 1 qt. milk rceptual illusion out so that by the 23 the subject was onserving continuou		on of Program 2	3 Same	Because they were the same to begin with and you just poure mine into this jar. Now it's high but it's skinnier than yours. So they're the same.	
24. Fluid from	Thus GOO					
s's container pointo completely new container.	Two 600 ml.  Dured beakers and one 150 ml. beaker (this i the first tran formation with the beaker).	s s-		Same	Same as above.	8
25. Same as abo	beakers and one 150 ml. beakers and one house the beaker			Same	Same as above	10
26. Same as abo	Erlenmeyer beak- ers and one 125 ml. Erlenmeyer beaker		A	Same	Same as above	8
27. Same as abo	ve. Two 1000 ml. flat-bottomed beakers and one 500 ml. flat-bottomed beaker.			Same	Same as above	· · · · · · · · · · · · · · · · · · ·

FEMELY 1	APPARATUS Three 600 ml beakers	TRANSFORMATION S's juica
CONSTRUCT Same	2 @ 300 ml	to another besker.

		Allega Caracter de Caracter de Cara	gg Asswers		<u> </u>
· .	(Assign jars & get agreement of same amount before transformation & then give prompt)  I am pouring your juice into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give answer)  Why? This is what I want you to tell me  (Gat 8 to scho the rule)		The same. Because they were to same to begin with you just poured min this jar.	£	If correct response: Good boy, Hare's your
Ça,	Lets do it again. (paric again task). Now would say that you have the sa to drink as me, or more or less than me? - Why?	mt ditto		ditto	
72	попа			, ,	
(\$	nona				
· Qa	As above	Qa	As above	Qa	As above
G	Challed in the second of the s	ÇŞE		Ο×	
O <sub>5</sub>	la adeva	Çpa	do abovo	Qn	As obove
Çz	Embers Filmondard (1960-1980)	Qk		Qt	**************************************
Q <sub>2</sub>	An above	Ça	As above	Qn	As above
Çŝ	Another read where the read of the second sec	173		dk	
Qp)	As above	Qn.	As sbove	Çpa	evode ev

PROGRAM 2	APPARATUS three 500 ml	TRANSPERMATION 50 juice
	Erlenmeyer beakers	completely transfered
COMCERT Same	2 @ 500 ml	to another beaker,

	<b>1</b>		gg Answere		3.	
•	(Assign beakers & get agreement of same amount before transformation, then give prompt).  I am pouring your juice into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give answer)  Why? This is what I want you to tall me  (Get S to echo the rule).		The same.  Because they were the same to begin with and you just poured mine into this jer.		If correct response: Good boy. Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.	
Pa				······································		
<b>A</b>	Lets do it again. (perform task again task) Now would you say that you have the same amount to drink as me, or more than me, or less than me? - Why?				ditto	
72	anca					
Ç3	nona					
Ça	As shove	Ça	As abova	Qu.	La abova	
Çis.		Qk	全面建筑上面1000mm (1200 mm )	Q's		
<b>Q</b>	erods så	Ça	evade ed	Çm.	evods sa	
Çt		φp		Gk		
Q <sub>3</sub>	An abovo	Ça	evodo sA	Çp	As above	
Çž		\$18	The Conference of the American special control of the Conference o	Ο'n		
Q3	As above	Qn	ya apoae	Qn.	As above	

Processia 3	APPARATUS three 500 ml	TRANSPOSMATION S's juice
	flat-bottomed flasks	completely transfered
COLORE Same	2 8 500 ml	to another container.

	2		<u>La</u> Aresto te	lynnaturas antisas sas	3
	(Assign jars & get agreement of same amount before transformation and then give prompt)  I am pouring your juice into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give answer).  Why? This is what I want you to tall me  (Get § to scho the rule)		The same. Because they were the same to begin with and you just poured mine into this jer.		If correct response: Good boy. Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
<b>\$</b>	Lets do it again. (perfagain task) Now would y that you have the same to drink as me, or more or less than ma? - Why?	ditto		ditto	
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<b>\$</b>	none	Consequence of the second		o physical process of the control of	
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¢.		<b>63</b> 5	Explantinum de	Çk	породу издирувания на принципания н
Qn.	Ad Diovo	Qua.	As above	Çp,	erces es

PROGRAM	4
CONCERT	C.C.O.

alternate with prog. 1

APPARATUS two 3-quart milk cartons @ 250 ml. each and bms 2-quart milk carton (2,1)

TRANSFORMATION 8's juice

completely transfered to a

container of different dimensions

(ie./ to the 2-quert certan)

			in Angers		į.
			ET 2000018		8
	(Assign jars & get agree same amount before trans & then give prompt)  I am pouring your juice jar. Now, would you say have the same amount to ma, or more than me, or than me (Give answer) Why? This is what I want tell me  (Get § to echo the rule)	formatio into thi that you drink as loss	to begin with and yo poured mine into this Now it's high but it as kinnier than yours.	u just s jar. 's	
Pa		.ranyahan-a-dar <sup>a</sup> 444			
<b>දා</b>	Lets do it again. (perfoagain task). Now would y that you have the same a drink as me, or more the or less than me? - Why?	ou say	ditto	indiscolored S-condiscolor	ditta
THE REAL PROPERTY OF THE PROPE	(Assign Jars & get agree same amount before trans & then give prompt)  I am pouring your juics jar. Now, would you say have the same amount to use or more than me, or as (Give.answer)  Why? This is what I wan tell me	into thi that yo drink as lass tha	to begin with and yo poured mine into thi	u jest	Hitto
73					
	Lets do it again. (perfagain task). Now would that you have the same a drink as we, or more that less than me? - Why?	you say mount se	ditto		ditto
•	. As corre	Çan	As above	Ça	As above
Ç\$	CONTRACTOR OF THE SECOND CONTRACTOR OF THE SEC	Q%.		Орг	
Ça	As shere	Çn	la abore	Çn	As shows
Ç.		Ġ₽	Western Completo de Carte Com-	Q3s	
<b>\$</b>	As share	Qsa .	la chero	Q <sub>2</sub>	As ebavo
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ca .	As above	Qa	As shows	Ça	As above

730GRAY <u>5</u>	APPARATUS three 600 pd.	to Siz container before trans-
OCHCEPT Cons. of	E 0 100 ml	formation
inequalities. Altern.	S's @ 500 ml	Where the state of

	<u> </u>		<u>fg</u> Answers		\$
	Assign jars & get agreems having more before trans and then give prompt).  am pouring your juics in ar. Now, would you say have the same amount to d as, or more than me, or 1 as (Give answer) thy? This is what I want tell me  (Get 8 to echo the rule)	ato this that you rink as	poured mine into thi	us -	If correct response:  Good boy. Here's your chip.  If incorrect response:  Oh. you just missed a chip but you will have lots more chances.
	Lets do it again. (perfor again task). Now would y shat you have the same am to drink as me, or more to pr less then me? - Why?	ount ount	dirto		ditto
- Consumer	(Assign jars & get agreem same amount before transf then give prompt)  I am pouring your juice it ar. New, would you say have the same amount to the company of the company	nto thi that yo irink as	just poured mine in this jar. Now it's but it's skimmier to yours. So they are	ou to high han	ditto
73	(Get 3 to acho the rule)		·		
Q's	Lats do it again. (performation task)" Now would y that you have the same a to drink as me, or more for less than me? - Why?	ou say mount	ditto	<del></del>	ditto
Çp	ebove .	Çn	As above	Qn	Да дъств
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AND DESCRIPTION OF THE PERSONS	Le apovo	Qn	avods an	Qu	arone an

PROGRAM 6	APPARATUS three 500 ml. beskers.	Poured out of 8's 1st before
CONCURT Cons, of	E's 0 500 ml.	transformation
inequalities. Altern,	S's 6 100 ml,	

	ith prog. 3				
	2		gg Anewore		Ä
	(Assign jars & get agraer S having lass before transtion than give prompt)  I am pouring your juice : jar. Now, would you say have the same amount to asse, or more than me, ot than me (Give answer)  Why? This is what I want tall me  (Get 8 to scho the rule)	Into thi that you irink or less you to	น	just	If correct response:  Good boy. Here's your chip.  If incorrect response:  Oh, you just missed a chip but you will have lots more chances.
Pa					
	Lets do it again. (parfiggin task). Now would that you have the same a drink as me, or more that less than me? - Why?	you say			ditto
	(Assign jers & get agreement of B having more before transformation and then give prompt).  I am pouring your juice into this jer. Now, would you say that you have the same amount to drink as me, or more than me, or less than me. (Give answer)		More. Because mine had more to begin with and you just poured mine into this jar.		ditto
	Why? This is what I wan call me (Get 8 to echo the rule)	t you to			
Ç3.	Lets do it again. (perfo again task). Now would that you have the same a to drink as ms, or more by lage than mg? Why?	you say	ditto		ditto
<b>Ç</b> pa	As obeve	Cpa	creds sA	Ça	As above
<b>©</b>	CONTROMOCOSCOCIONESIDANCED	qk		qμ	
Ç.	do shora	Qu	evoda ak	G <sub>S</sub> s.	As above
Çs.		CÇ3		Qia.	
Ça	As shove	Ça.	As above	Çn	evoda aa
Ç\$		<b>\$3</b>		Ċ≱	
¢3	As abova	. Qn	Ao above	Qn	cvods sA

PROCEAN 7	APPIDET & TWO 150 ml beatists	(4% ภาพทุฬ) เกณะ <u>อับรอช โล addad</u>
	one 250 ml beaker	to S's jar & it is then trans-
CONCEPT Cons. of	E's 0 80 ml	fared to a larger jar.
inequalities. Altern.	S's @ 150 ml	

	2		<u>De</u> Anevers		Z.
,	(Assign jars & gat agree S having more before tramation then give prompt)  I am pouring your juice jar. Now, would you say have the same amount to me, or more than me, or me (Give answer) Why? This is what I wan tell me	into thi that yo drink as leas the	n .	ou just	
Pa					
	Lets do it again. (parfo again task). Now would y that you have the same a drink as me, or more tha less than me? - Why?	on say			ditto
	(Assign Jars & get agree same amount before trans & then give prompt)  I am pouring your juice jar. Now, would you say have the same amount to me, or more than me, or me (Give answer)  Why? This is what I wan tell me  (Get 3 to scho the rule)	into thi that yo drink as lass the	to begin with and y poured mine into the Now it's high but it skinniar than yours they are the same.	ou just is jar. t's	
Çı	Lats do it again. (perfo again task). Now would that you have the same a to drink as me, or more or less than me? - Why?	you say	dirto	- Carley and Provide House	ditto
Ça İ	As above	qр	evods ca	Çn	As above
Ç#		χp		Qk	purakinganjanjankahani Mass
Çn.	As ebove	Çn	As above	Çn	As above
Ç2		q's		ηs	empi sigariyeyininkisikasikisikisikisi
Ça	evoda eA	Ça	As above	Qn	evoda s.l
Çs		Sh	A THE PROPERTY OF THE PROPERTY	Qk	
Ça)	aveda sA	Qn	ės abova	Çes	As above

PIDGRAN 8	APPARATUS two 150 ml backers	TRANSPORMATION S's tuice traps-
	& one 250 ml beaker	fered to larger far so that
CONCEPT Cons. of	E's @ 80 ml	the lavels of R's & S's juice
inequalities. Altern.	S's \$ 120 ml	become the same baight.

	in prog. 4.				
	3		<u> 15</u> Angueta		1
	(Assign jars & get agreed S having more before traination than give prompt)  I am pouring your juice if jar. Now, would you say have the same amount to may, or gore than me, or may (Give answer)  Why? This is what I wantell me  (Get S echo the rule)	into this that you drink as less than	was, but it's wider yours. So it's stil	uat s jar. it than	T. R.
7a					
	Lets do it again. (perf. again task). Now would that you have the same at to drink as me, or more or less than me? - Why?	you say	ditto		ditto
	(Assign jars & get agreement of same amount before transformation & then give prompt)  I am pouring your juice into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give answer)		to begin with and you just poured mine into this jar. Now it's high but it's skinnier than yours. So they are the same.		ditto
	Why? This is what I wan tall ma	t you to			
Çîz.	Lets do it again. (parfo again task). Now would that you have the same at to drink as me, or more pr less then me? - Why?	you say mount	ditto		dizto
Ç <sub>ja</sub>	As above	Çn	evods sa	Qn	As abava
Qž		d#		Qlz	
<b>\$</b>	As abova	Ça	As recas	Ça	As above
ÇS	Carried and Advanced Market Children Co.	Q'z		Qλ	mangankun magankun mengankun mengankun mengankun mengankun mengankun mengankun mengankun mengankun mengankun m Balangankun mengankun mengankun mengankun persembankan persembankan pengankun pengankun mengankun mengankun me
Q <sub>2</sub>	evoća sA	Qa	As above	Q <sub>E</sub> D,	As above
Ç\$	SUM NUMBER AND ADDRESS OF THE SECOND	\$32.		Q%	
Ça	ereds sk	Qa,	vs spans	Çn	As above

PROGRAM 9	APPARATUS two 250 ml beakers & one 150 ml, beaker	TANNE DAMATION Juice is taken from S's jer & IE is then
concept Cons. of inequalities. Altern.	E's @ 120 ml. S's @ 50 ml	transfered into a smaller

	3.		Eg Answers		
	(Assign jars & get agrees S having less before transation then give prompt)  I am pouring your juice jar. Now, would you say have the same amount to me, or more than me, or than me (Civa answer) Why? This is what I wan tell me  (Get 8 to scho the rule)	into this that you irink as lacs		just	If correct response:  Good boy. Here's your chip.  If incorrect response:  Oh, you just missed a chip but you will have lots more chances.
Pa Ga	Lets do it again. (perf again task). Now would that you have the same a to drink as me, or mors or less than me? - Why?	you say mount	dirro		ditto
	(Assign jars & gat agraement of S having more before transformation then give prompt)  I am pouring your juice into this jar. Now, would you say that you have the same amount to drink as me, or pore than me, or less than me (Give answer)  Why? This is what I want you to tall me  (Get 3 to scho the rule)		than it was, but it's wider than yours. So		ditto
Ok.	Late do it again. (parte again thak). Now would y that you have the same a to drink as me, or more or less than ma? - Why?	ou sey	ditto	and a control of the	ditto
G	eveds sa	Çn	às above	प्रिम	As above
Ça		QŁ		QŁ	
Ça	hg above	Qn.	As shove	Qn	Va epoda
Q's		Qž		Ċ‡.	nego egenesia e e e e e e e e e e e e e e e e e e e
Ça	evoda qA	C <sub>F</sub> Ca	As above	Сра	EVODS SA
дъ		Çi	Better from the strategic of the contribution of the strategic of the stra	Úμ	
Ça	As above	Qn	As above	Çm	groes es

PROGRAM 10	APPARATUS Two 250 ml.	FRANSFORMATION S's juice is transfered to a smaller lar
inequalities eltern. with Prog. 8	beaker. F's @ 120 ml. 5's @ 80 ml.	so that the levels of E's &  S's juice become the same height.

	with Prog. 8		height.			
	2		<u>Se</u> Answers		<u>.</u>	
,	(Assign jars & get agreement of S having less before transformation then give prompt)  I am pouring your juice into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give answer) Why? This is what I want you to tell me  (Get 8 to echo the rule)		Less. Because mine had less to begin with & you just poured mine into this jar. Now it's higher than it was, but its skinnier than yours. So it's still less.		If correct response:  Good boy. Here's your chip.  If incorrect response:  Oh, you just missed a chip but you will have lots more chances.	
Fm .						
<b>Ç</b> a	Lets do it again (perform task again task). Now would you say that you have the same amount to drink as me, or more than me, or less than me? - Why?		ditto		ditto	
Pk.	(Assign jars & get agree S having move before trans & then give prompt)  I am pouring your juice jar. Now, would you say have the same amount to me, or more than me, or me (Give answer) Why? This is what I wan tell me	into this that you drink as lass than t you to	begin with and you poured mine into t jar. Now, it's lo than it was, but i wider than yours.	juet his wer t's	ditto	
Qž.	Lets do it again. (performance of the same of the same of the same of the same than the same of the sa	you say	ditto		ditto	
Qna.	eveda ak	Çm.	avoda ak	Qn.	Yd Spoas	
Ç8		ОF	with a state of the state of th	QΣ		
Ç <sub>i</sub> a	As above	Çm	As above	Çn	As above	
Çis		Qlk	Qk q			
Ça	As above	Ą	As above	Сm	evoda sA	
Çž		q's		Qk		
Ça	As abova	Qъ	As above	Ç <sub>F</sub> ,	As abov⊕	

FROGRAM	11
602CZPT	c.c.q.

altarn, with Prog. 8

milk cartons 6 ope 2
quart carton cut one inch
(2.2) @ 250 ml ca.

completely transferred to a container of different dimensions (1.e.) to 2-quest cartons.

				NB.	
	Ł		<u>le</u> Answers		<u> </u>
•	(Assign jars & get agreement of same amount before transformation & then give prompt)  I am pouring your juice into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give answer)  Why? This is what I want you to tall me		If correct response:  Good boy. Here's your chip.  If incorrect response:  Oh, you just missed a chip but you will have lots more chances.		
78					
Ĉ <sub>i</sub> a	Lats do it again. (perfo again task). Now would say that you have the sa to drink as ma, or more or less than me? - Why?	you ma smount	ditto		ditto
72	(Assign jars & gst agraement of Shaving mora before transformation & then give prompt)  I am pouring your juice into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give enswer) Why? This is what I want you to tall me  (Get 8 to scho the rule)		dirto		
¢x	Lats do it again. (perf again task). Now would that you have the same drink as me or more tha less than me? Why?	you say	say ditto		ditto
Ça,	evods sA	Çan	As above	Qn	As above
Ç3s		Qis		Qk	
Ça	is spare	Çĸ	As above	Çm	As above
Ç1s.	sub-quarting grassocial Contract field	dir	qk qk		
C <sub>2</sub> a	evoću nA	Ça	Ça As above Ça		As abova
Ça		q <sub>b</sub>		Qk	
93	As shows	Çm	ya apona	Ça	As above

PROGRAM 12	APPARATUS 2 - 3 5 1 - 2.3	Philadelinearick Sta Juice
	type carto; s	transferred from 3 to
C.C.Q.	@ 250 mls.	2.3
Altern. with prog. 10		

			Eg Answera		I.
•	(Assign jars & get agree same amount before trans tion & then give prompt)  I am pouring your juice jar. Now, would you say have the same amount to me, or more than me, or than me (Give answer)  Why? This is what I wan tell me	into the that ye drink as less at you to	but it's skinnier to yours. So they are same.	and s into high han	If correct response: Good boy. Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
Pa					
Ça	Lets do it again. (perfo again task). Now would say that you have the sa to drink as me, or more or less than me? - Why?	me amon	ditto		ditto
	(Assign jars & get agrees S having less before tration then give prompt)  I am pouring your juice jar. Now, would you say have the same amount to as me, or more than me, than me (Give answer) Why? This is what I was tell me	into the charty drink or less	Because mins had less to begin with 6 you poured mins into this jar. Now it's higher than it was, but its skinnier than yours. So it's still less.	just s T	If correct response: Good boy. Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
Ç3.	Lets do it again (performagain task). Now would say that you have the sto drink as me, or more or less than me? - Why	you ame amou	nt ditto		ditto
Çss	Au stove	Çm	As above	Çn.	As above
Ç\$		Qž.	**************************************	Qk	
Qs.	As above	Cjta.	Aa above	Çn	As above
63		Q½		(ik	was a require transcent and process and a requirement of the control of the contr
Gn	As shove	Ça	As above	Qn	As above
Qk	ACTIVITY AND THE STREET AND THE STRE	qts		qк	
<b>3</b> 3	a abova	Qn	As shove	Qn	As above

PEOCEAN 13	APPARATUS 2 - 3 6 1 - 2.4	ROLLI S'E POITAGES AND
	type cartons	transferred from 3 to 2.4
concept c.c.q.	€ 250 mls.	Married and the control of the contr
Altern. with prog. 8		

1			Se Answers		ž.
	(Assign jars & get agree same amount before trans tion & then give prompt)	forma-	The same. Because they were the same to begin with a you just poured mine this jar. Now it's	ind into	If Correct response: Good boy. Here's your chip.
•	I am pouring your juica jer. Now, would you say have the same amount to me, or more than me, or than me (Give answer) Why? This is what I wan tell me	that you drink as less	but it's skinnier than yours. So they are the same.		If incorrect response: Oh, you just missed a chip but you will have lots more chances.
Pa	(Get 8 to echo the rule)				
<b>\$33</b>	Lets do it again (perforagain task). Now would say that you have the sate drink as me, or more or less than me? - Why?	ma amoun	t dicto		ditto
	(Assign jars & get agree S having more before tre macion then give prompt	nsfor-	More Because mine had mo begin with and you poured mine into th Now, it's lower tha	just is jar.	If correct responsa: Good boy. Here's your chip.
	I am pouring your juice into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give answer) Why? This is what I want you to tell me		s was, but it's wider than u yours. So it's still more		If incorrect response: Oh, you just missed a chip, but you will have lots more chances.
F	(Get 8 to echo the rule	)			
Ç:	Lets do it again. (Parfagain task). Now would that you have the same drink as ms, or more the lass than me? - Why?	you say amount to	ditto		ditto
Φ.	As above	Çя	As above	Çn	As shove
ÇB.	New Company of the Co	Q%.		Q'n	March of Section 1 and the property of the pro
ĜA	As above	Çıs	As above	Qn.	AS above
qs.	SALE ACCOUNTY AND	q₃		Q1≥	encerty physical structure and the state of
Qa.	as above	Qn.	As above	Çn	As above
Çk	ACTION AND THE COLUMN AND A STATE OF THE COLUMN AND A STATE OF THE COLUMN AND A STATE OF THE COLUMN AND A STATE OF THE COLUMN AND A STATE OF THE COLUMN AND A STATE OF THE COLUMN AND A STATE OF THE COLUMN AND A STATE OF T	€\$	generala yinkusinin kitariyi kalikinin kitariyi kalikinin kalikinin kitariyi kalikinin kalikinin kalikinin kal	Qk	
Q3	Au above	Qm	As above	C <sub>13</sub>	evoda aA

PROTRAIS 14	APPARATUS 2 - 3 & 1 - 2.5	TRANSPORMATION of sintee
<del></del>	type cartuna	transferred from 3 to 2.5
CONCEPT C.C.Q.	@ 250 mls.	
altern. with prog. 10		

	<u> </u>		ig Anavers		Ē
	(Assign jars & get agreer same amount before transition & then give prompt)  I am pouring your juice jar. Now, would you say have the same smount to me, or more than me, or than me (Give answer)  Why? This is what I wan tall me	into this that you irink as lass	The same. Because they ware the same to begin with a you just poured mine this jar. Now it's but it's skinnier the yours. So they are same.	ind into high man	If correct response: Good boy. Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
Pa .					
<b>©</b> 3	Lets do it again. (performagain task). Now would say that you have the age to drink as me, or more or less than me? - Why?	you me amoun	ditto		ditto
	(Assign jars & get agree S having less before traation then give prompt)  I am pouring your juice jar. Now, would you say have the same amount to as me, or more than me, than me (Give answer) Why? This is what I wan tall me	into thi that yo drink or less	was, but its skinnic than yours. So it's still less.	just ls jar. l it er	If correct response: Good boy. Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
Q2	Lets do it again (perfo again task). Now would that you have the same drink as me, or more th less than me? - Why?	you say	ditto		ditto
Qa.	As above	Qn	Aa abova	Çn	As above
Ģž		Q's		Óγ	
¢a.	As above	Qа	As above	Çn	As above
ÇL	enclaire se vencimicament	qk		Ç¥.	
Çя	As above	Ça	As above	Çn.	Pacque ev
ÇİL	Children Control Contr	<b>03</b>		Qk	
Ça	ie abova	Qn	As above	Qn	eveds sk

PROGLAM 15	APPARATUS 2 - 3 & 1 - 2.6	HOME FORMATION S's juice
	type cartons	transferred from 3
concept c.c.q.	@ 250 mis.	to 2.6
altern, with prog. 8	_	

			he Answers		A	
	E.	<del>زدنب سین پیریسی</del>	28 4004011			
	(Assign jars & get agreet same amount before transi- tion & then give prompt)  I am pouring your juice:	orma-	The same.  Because they were the same to begin with a you just poured mine this jar. Now it's	nd into high	If conrect response: Good hoy. Here's your chip.	
•	jar. Now, would you say have the same amount to ma, or more than ma, or than ma (Give answer) Why? This is what I want tell me	that you irink as less	but it's skinnier th yours. So they are same.	en i	If incorrect response:  Oh, you just missed a chip but you will have lots more chances.	
PA.		-				
Çn	Lats do it again. (perf again task). Now would say that you have the sa to drink as ma, or more or less than ma? - Why?	you me amoun	t ditto		ditto	
	(Assign jars & gat agrae S having more before tra mation than give prompt)	nsfor-	More. Because mine had mobegin with and you poured mine into the Now, it's lower than	just is jar	If correct response: Good boy. Here's your chip.	
	I am pouring your juics into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give answer) Why? This is what I want you to tell me		was, but it's wider than yours. So it's still more.		If incorrect response:  Oh, you just missed a chip but you will have lots more chances.	
72						
Çt	Lets do it again. (perfagain task). Now would that you have the same drink as ms, or more the lass than me? - Why?	you say amount t	ditto		ditto	
Qa	. As shove	Ça	As above	Qя	As stora	
Çŝ	COLUMN TO THE PROPERTY AND THE	qъ		Qk		
Ga Ga	evods så	Q#A	evode e4	Qn	As above	
QI <sub>2</sub>	Angele and Control Con	Qъ	477.00	Qk		
Ça	As shove	Qa	As above	Çn	As above	
Ç	. todas como de como como como como como como como com	ÇB.	THE THE THE THE THE THE THE THE THE THE	Qk		
-	As above	Qm	As above	Qa	As above	

PROGRAM 16	APPARATUS 2 - 3 & 1 - 2.7	TRANSPORMATION S'R JUICE
	type cartons	transfarred from
CCECCEPT C.C.Q.	@ 250 mls.	3 LO 4.7
altern. with prog. 10		

	I.		ig Anowers		¥
	jar. Now, would you say you have the same amount as me, or more than me, than me (Give answer) Why? This is what I wan tall me	Because they were the same to begin with and you just poured mine into this jar, Now it's high but it's skinnier than		If correct response: Good boy. Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.	
Fa	(Get 8 to echo the rule)				
Ça	Lats do it again. (perfo again task). Now would that you have the same a drink as me, or more tha or less than me? -Why?	you say mount to	ditto		ditto
	(Assign jars & get agree S having less before tramation the give prompt)  I am pouring your juice jer. Now, would you say you have the same amount drink as me, or more the less than me (Give answed) why? This is what I wantall me  (Get S to scho the rule)	into thi that to to to to to to to to to to to to to to t	skinnier than yours.		If correct response: Good boy. Hers's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
Çs.	Lats do it again (performagain task). Now would that you have the same drink as me, or more the or less than me? - Why?	you say smount to	ditto	Quantitation (1)	ditto
Ø,	evode ed	Qn.	As abova	Çп	evoda sa
Ç\$		Qk.		Qk	
<b>Ç</b> şa	FF PPand	Ça	An Adore Qn		As above
Ç5		Qts	ch		Angle Speciment in the control of th
Ça	Aa abovo	Qn	As above Cn		As above
Ç\$		Q's		qk.	
Ça	As abova	Qa	As above	Qn.	As above

PROGRAM 17	APPARATUS two 3-quart	TRANSPORMATION S's juice
	cartons & one 1-quart carton	transfered to 1-quart carton
c.c.q.	(cut one inch) (1.1)	
altern. with Prog. 8	2 @ 250 ml	

	8		12	Answere		A
	(Assign jars & get agreer same amount before transition & then give prompt)  I am pouring your juice : jar. Now, would you say have the same amount to do ma, or more than me, or than me (Give answer) Why? This is what I wan tall me	into this that you rink as less	to begin poured mi How it's skinnier	hey were t with and y ne into th high but i then yours the seme.	ou just is jar, t's	If correct response: Good boy. Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
73 Qa	Lets do it again. (perforagain task). Now would say that you have the say to drink as ma, or more or less than ma? - Why?	you me amoun	t	ditto		ditto
<b>3</b>	(Assign jars & get agree S having more before tramation then give prompt)  I am pouring your juica jar. Now, would you say have the same amount to me, or more than me, or than me (Give answer)  Why? This is what I wan tell me	into thi that you drink as lass	begin wi pourad m m How, it' was, but yours.	mine had ment you ine into it s lower the it's wide so it's st	just his jar an it r then	
Ç\$	Lets do it again. (perfagain task) Now would y that you have the same to drink as ma, or more or less than ma? - why?	ou say amount		ditto		ditto
9	to space	Qn	de abo	) 4.0	Q <sub>2</sub>	As above
Ç3	One of the particular of the contract of the c	Qk	<del></del>	andro de la companyo de la companyo de la companyo de la companyo de la companyo de la companyo de la companyo	Q3s	
<b>(3)</b>	As eders	Çs	As ab	970	Ça	Aa abova
Ç3	China Characteristic SECO SECO	Q½	q <sub>k</sub>			
Ça	da shove	Qa	As ab	eva	Ça	As above.
Çs.		f/s			Gt.	
Q3	As above	du	da ad	OV8	Ça	As above

PROGRAM 18	APPARATUS 2 -3 6 1 - 1.2 type cartons	THANHYORMATICM S's juice transferred from 3
CECQ.	0 250 mls.	to 1.2
Altern. with prog. 10		

	1		is Anomi		8.
•	I am pouring your juica into		The same. Because they were the same to begin with and you just poured mine into this jar. How it's high but it's skinnier than yours. So they are the same.		If correct response: Good boy. Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
7a					
Ça	Lets do it again. (performance to drink as me, or more or less than ma? - Why?	you me amoun	ditto		ditto
	drink as me, or more the	less before transforms— then give prompt)  buring your juice into it. Now, would you say on have the same amount to is me, or more than me, or it is skinnier than your san me (Give answer) This is what I want you to		just s r s	ditto
Pa					
Ç.	nona		ditto		416622
Ģ.	evods sa	<b>G</b> SA	As sbeve	Ça	Va 23020
Ç\$		d#		q's	
Q <sub>D</sub>	As above	Ça	As above Qn		As above
Çk		qs	Property Control and Control and Control and Control and Control and Control and Control and Control and Control and Control and Control and Control and Control and Control and Control and Control and Control and Control		
Ça	As shove	Сра	As above Qn		As above
*		雜		শ্বঃ	And the second s
93	a abovo	Qа	As chove	Ċa	As above

PROGRAM 19	APPARATUS 2 - 3 5 1 - 1.3  type cartons	TRANSFORMATION 3's juice transferred from
C.C.Q.	@ 250 mls.	3 to 1.3
altern. with prog. 8		

			gg Anevers		ā
	(Assign jars & get agreement of same amount before transformation & then give prompt)  I am pouring your juics into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give answer) Why? This is what I want you to tell me		The same. Because they were the to begin with and yo poured mine into this low it's high but it skinnier than yours, they are the same,	If correct response: Good boy, Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.	
7a Ça	Lats do it again (perforagain task). Now would say that you have the ast o drink as me, or more or less than me? - Why?	ne smour			ditto
	(Assign jars & get agrae shaving more before trams f & then give prompt)  I am pouring your juice jar. How, would you say have the same amount to me, or more than me, or me (Give answer) Why? This is what I wan tall me	into thi that yo drink as less tha	begin with and you just poured mine into this jar. Is Now, it's lower than it was, but it's wider than yours. So it's still more.		
	Lets do it again (perform task again task). Now would you say that you have the same amount to drink as me, or more than me, or lass than me? - Why?		ditto		ditto
<b>(3a)</b>	As above	Ça	As above	Ça	erede sa
Ç'a		Qia		Ο×	
Ça	abova	Qы	As abova Ga		V3 Speas
Çşs		Çk	CAR		
Ça	As above	Ça,	As above	Qa	avoda sk
Qt.		ęs		Qk.	
Ga	evods cA	Q <sub>78</sub>	As shove	Qrs	As sbove

PROGRAM 20	APPARATUS 2 - 3 5 1 - 1.4	TRANSPORMATION S's juice
	type cartons	transferred from
CC.C.Q.	@ 250 mls.	3 to 1.4
altern, with prog. 10		

	1		is Answers		ā.		
•	(Assign jars & get agrees same amount before transtion & then give prompt)  I am pouring your juice jar. Now, would you say have the same amount to me, or more than me, or than me (Give answer)  Why? This is what I wantell me	into th that yo drink a less	Because they were the same to begin with and you just poured mine into this jar. Now it's high but it's skinnier than yours. So they are the same.		Because they were the same to begin with and you just poured mine into this jar. his Now it's high but it's ou skinnier than yours. So they are the same.		chin.
Pa	(Get 8 to echo the rule)						
¢s.	Lets do it again (performagain task). Now would say that you have the set to drink as me, or more or less than me? - Why?	you une amou			ditto		
	(Assign jars & get agraes having lassbefore trans then give prompt)  I am pouring your juice jar. Now, would you say have the same amount to me, or more than me, or than me (Give answer) Why? This is what I wanted in the control of	into the that you drink a lass	on Because mine had le to begin with & you poured mine into th jar. Now it's high than it was, but it skinnier than yours So it's still less.	Because mine had less to begin with & you just poured mins into this jar. Now it's higher than it was, but it's skinnier than yours.  So it's still less.			
qs.	none		ditto		ditto		
(a)	As shave	Qn	As above	Çn	. As above		
Çş.		Qk		ď₽	**************************************		
Ça	As abova	Çn	As above	Q <sub>2</sub>	As above		
Çž		Qk	q;				
Ça	As above	Qn	As above	Qu	evoda sk		
Qt.	· well-re-out-refugition-reserve	q <sub>2</sub>		२४			
Ça	Au abova	Qn	As above	Qn.	Às above		

PERMAN 21	APPARATUS 2 - 3 & 1 - 1.5 type cartcqs	THANSFORMATION S's juice transformed from
compar c.c.q.	@ 250 mls.	3 to 1,5
altern, with prog. 8		

	2	, III	A.	Answere		Z
,	(Assign jara & get agrees same amount before transition & then give prompt)  I am pouring your juice jar. Now, would you say have the same amount to ma, or more than me, or than me (Give answer) Why? This is what I wantell me	into this that you drink as less	to begin w poured min Now it's h	ey were the ith and you into this igh but it han yours. he same.	i just Bjar. B	If correct response: Good boy. Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
	Lets do it again. (perfo again task). Now would say that you have the sa to drink as me, or more or less than me? - Why?	you me amount	d	litto		ditto
72	(Assign jars & get agrae S having morsbefore trans tion & then give prompt)  I am pouring your juice jar. How, would you say have the same amount to me, or more than me, or ma (Give answer)  Why? This is what I wan tell me	into this that you drink as less than t you to	begin wit poured mi Now, it's was, but yours. S	Because mine had more to begin with and you just poured mine into this jar. Now, it's lower than it was, but it's wider than yours. So it's still		ditto
Ø.	Lats do it again (perfor again task). Now would that you have the same a to drink as me, or more or lass then me? - Why?	you say	ditto			ditto
Ça	åa sbove	Ça	Aa abor	ria	Qn.	As sbovs
ÇB3	Chickownighternance	ঀ৳			qŁ	
Ça	da abova	Qn	As above q		As above	
Ç's		Qts	- Qk		Qk	
C <sub>S</sub> a	As above	Çn	oda ba	A8	qn	As above
Ġŗ.	The state of the s	ejs	2000年1月1日日本 (1900年1日 - 1900年1日 - 19	1274-1474-1784	Qk	
\$30	An abova	Qn	ode aA	79	Qa	evods cA

PROGRAM	APPARATUS 2 - 1 & 1 - 1.6	PRANSPORTATION 6'8 Jules
	type cartons	transferred from
COMOSTT C.C.Q	@ 250 mls.	3 to 1.6
altern, prog. 10		

		-		······································	gn
			ge Answers		2
	(Assign jars & get agree same amount before trans tion & then give prompt)  I am pouring your juice	into th	Because they were the same to begin with and you just poured mine into this jar. Now it's high but it's skinnier than you k as same.		If correct response: Good boy. Here's your dhip.
•	jar. Now, would you say have the same amount to me, or more than me, or than me (Give answer) Why? This is what I was tell me	drink a less			If incorrect response:  Oh, you just missed a chip but you will have lots more chances.
<b>7</b> 9.	(Get B to scho the rule				
Ça	Lets do it again (perform task again task). Now would you say that you have the same amount to drink as me, or more than me, or less than me? - Why?			,	ditto
	(Assign jars & get agraement of S having less before transformation & then give prompt)		Because mine had less to begin with & you poured mine into the	juat La	
	I am pouring your juice into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give answer) Why? This is what I want you to		akinnier than yours. 80 it's still less.		ditto
78	(Get § to acho the rule)		•		
Ç3s	none		ditto	ditto	
Ça,	ya epaka	Çn	As above	Qа	As above
Çs	167	qk		Qk	
Q <sub>3</sub>	4s abovo	Ça	eveds sk	Çm.	As above
¢3s		Qk	AND THE CONTRACT OF THE PROPERTY OF THE PROPER	Qk	
Qn.	As abeva	Çpa	As above	Çn	As above
<b>©</b>		Ç3s		Qk	
Ça	As shove	Qn	As above	Çn	Az sbove

PRICE N 23	APPARATUS 2 - 3 & 1 - 1.7	STANGSORMATE MOITAMSORAMAN
	type cartons	transferred from
cocy c.c.q.	@ 250 mls.	3 to 1.7
altern. with prog. 8		

T	1		Ss Answers		I.
	(Assign iara 6 get agreement of same amount before transformation 5 then give prompt)  I am pouring your juice into this jar. Now, would you say that you have the same amount to drink as me, or more than me, or less than me (Give answer) Why? This is what I want you to tell me g		The same.  Because they wars the same to begin with and you just poured mine into this jar. Now it's high but it's skinniar than yours. So they are the same.		If correct response: Good boy. Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
Fa	(Get § to scho the rule)				
•	Lets do it sgain (performagain task). Now would say that you have the sate of the same or less than me? - Why?	you ame amoun	t ditto		ditto
Hz	(Assign jars 5 get agraed having more before transition 5 then give prompt)  I am pouring your juica this jar. Now, would yethat you have the same drink as me, or more the less than me, (Give answhy? This is what I was tell me	into ou say amount to an me, or war) nt you to		just his er 's	ditto
Çts	Lets do it again (perfo again task). Now would that you have the same drink as ma, or more th less than me? - Why?	you say	ditto		ditto
<b>Q</b> a	As shere	C)Ta	As above	Qn	Yo open
Ç%	September 10 March 10	Qk.		ďķ	
Çs.	As above	Ça	As above	Çn	evoda ed
C/ts		Q13		q <sub>3</sub> .	
Qp.	As above	Ças	As above	Çn	evods eA
C/A		St.		Qk.	gers som general en en en en en en en en en en en en en
Ç <sub>N</sub>	An above	Çn	la sbove	Çn	As above

PROCEAN: 24	beakers and one 150 ml.	THAN SUCRMATION Juice from 8's jar into 150 ml. jar.
cology: C.C.Q.	beaker	
altern. with Prog. 8	2 @ 150 ml.	

l	<u> 2</u>		ig Anewers		2
	(Assign jars & get agree same amount before trans tion & then give prompt)  I am pouring your juica this jar. Now would you you have the same amount as me, or more then me, then me (Give answer)  Why? This is what I wan tell me	into say that to drink or leas	The same. Because they were the same to begin with a you just poured mine this jar. Now it's but it's skinnier the yours. So they are same.	nd into high sn	If correct response: Good boy, Here's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
Fa	(Get § to scho the rule)		·		
Ça.	Lats do it again (perfor again task). Now would that you have the same a drink as me, or more the or less than ma? - Why?	you say mount to	ditto		ditto
	(Assign jars & gat says as a says and a says and a says a says and a says a says and a says a s	into ou say emount then ma, ngwer) nt you to		just is jar. n it than	ditto
Qk.	Lets do it again (performance again task). Now would say that you have the sto drink as me, or more or last than ma? - Why.	you ama amoun	ditto		ditto
Qn.	As above	<b>Q</b> n	As above	Çn	As shove
ব্যঃ	Section Sectio	OF.		Qk	ないとうながらない。 をいってはながない。 をいってはながない。 をいってはながない。 ではないないない。 ではないない。 ではないない。 ではないない。 ではないない。 ではないない。 ではないないない。 ではないないない。 ではないないない。 ではないないない。 ではないないないない。 ではないないないない。 ではないないないないないない。 ではないないないないないないない。 ではないないないないないないないないないない。 ではないないないないないないないないないないないないないないないないないないない
Çsa	As above	Ça	ta spors	Qn	Ya apusa
Qk.		Qk	College Control College Colleg	Qk	
Çpa	As shove	Ça	As abovs	Qn	As above
ОF	Designative Committee of the Committee o	23	North Company (Selection Company) and the Company of the Company o	Qk.	
Ça	As above	Qn	de abota	Qs	avoda sa

PROGRAM 25	APPARATUS two 1000 ml.	THANK YURKATION Juice from
	beakers and one 150 ml.	Sa jar into 130 mg, jar,
	beaker.	
alkama entota awaa 10	2 & 150 ml.	

	<b>.</b>		<u>įg</u> Azovoto		2
•	(Assign jars & get agraessame amount before trans & then give prompt)  I am pouring your juice this jar. Now, would you that you have the same a drink as wa, or more that less than me (Give answe why? This is what I wan tall me	into u say mount to n ma, or r) t you to	same to begin with a you just poured mine this jar. Now it's but it's skinniar the yours. So they are same.	nd itato high an	If correct response: Good boy, Hage's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
Pa	(440 2 54 5544 544 544 544 544				
	Lets do it again (parfor again task). Now would that you have the same a drink as ma, or more that less than ma? - Why?	you say mount t	ditto		ditto
	(Assign lars & get agree 8 having less before tremation then give prompt)  I am pouring your juice this jar. Now, would you have the same strink as me, or more the lass than me (Give answere	into u say mount t	Because mine had la to begin with a you poured mine into th jar. Now it's high than it was, but it skinnier than yours So it's still less.	just is sr s	ditto
	Why? This is what I was tall me	it you s			
ys.					
Çîs	Lets do it again (performagain task). Now would say that you have the sto drink as me, or more or less than me? - Why?	you ama amou	at ditto		ditto
Ça	As above	Çpa,	às abovo	Фа	As above.
Çk.		q <sub>ls</sub>		Qk	
Ça	As shows	Qa,	As abeve	Qn,	As above
Çŝ	conditional designation of the contraction of the c	9%	approximate to the part of the second	Qk.	quinter the manner of the mann
Qa.	As above	Ça	As above	Çın	As above
Q9s	And A State And And And And And And And And And And	e%.	Total and an in-	QΈ	CONTRACTOR OF THE PROPERTY OF
			As above	Q <sub>B</sub>	As above

Process 26	APPARATUS two 300 ml.  & one 125 pl. Erlenmayer	TRANSFORMATION juice from 8's jar into 125 ml. jar.
ocaces c.c.q.	beaker.	
altern. with Prog. 8	2 0 125 ml.	

			-			
				El Answore		2
	I am pouring your juice this jar. How, would yo that you have the same a drink as me, or more than less than me (Give answe why? This is what I want tell me	I am pouring your juice into this jar, How, would you say that you have the same amount to drink as me, or sore than me, or less than me (Give answer)				If Correct response: Good boy. Hare's your chip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
Pes,						
G <sub>3</sub>	Lats do it again (parforagain task). Now would that you have the same a drink as me, or mose the or less than me? - Why?	you say	٥	ditto		ditto
73	(Assign jars & set agraes S having more before tremation then give prompt)  I am pouring your juice this jar. Now, would yethat you have the same drink as me, or more the less than me (Give answers) This is what I wanted the same that we tall me	into into out say smount t sm me, out	Because mine had more to begin with and you just poured mine into this jar. Now, it's lower than it was, but it's wider than yours. So it's still more.		ditto	
q <sub>8</sub>	Lets do it again (perfo again task). Now would that you have the same to drink as me, or more or less then me? - Why!	you sa	<b>'</b>	disto		ditto
Ç	eroce ea	Çç.		a abova	Qn.	As above
CQL		q٤			Qk.	
9	As above	Qa	As above Ca		Ça	As above
Q3		Q3s	q <sub>k</sub>			
<b>Q3</b>	As above	Q <sub>E</sub>	nP sveda sA :		Qn	evoda eA
¢.		彝			Qk	
93	As shore	C)sa		ya epcas	Çpa	As above

PROGRAM 27	APPARATUS two 1000 ml.	TRANSPORMATION juice from
<del>- 11 - 1 - 1</del> - 1 - 1	flat-bottomed bankers &	S's jer into 500 ml, jer,
cciony c.c.q.	one 500 ml. flat-bottomed	
altern. with Prog. 10	besker. 2 @ 500 ml.	

	2		<u>la</u> Anesers		Ł
	(Assign jars & gat agree same amount before trans tion & then give prompt)  I am pouring your juice this jar. Now, would yo that you have the same & drink as me, or more the less than me (Give snawe Why? This is what I wantell me	into u say mount to n E, or r) t you to	The same. Because they were the same to begin with a you just poured mine this jar. How it's but it's skinnier the yours. So they are same.	nd into high an	If correct response: Good boy, Here's your thip.  If incorrect response: Oh, you just missed a chip but you will have lots more chances.
Ç <sub>3</sub>	Lats do it again (perforagain task). Now would that you have the same a drink as me, or more the or less than me? - Why?	you say mount to	ditto		ditto
	(Assign jars & gat agrae S having lass before transition than give prompt	msfor-	Less. Because mine had less to begin with a you poured mine into this jar. Now it's highs	just .s	
	I am pouring your juica into this jar. Now, would you say that you have the same amount to drank as me, or more than me, or less than me (Give answer) Why? This is what I want you to tell me		than it was, but iss skinnier than yours So it's still less.	ŀ	dicco
7's	(Get 8 to scho the rule	)			
Ç3	Lets do it again (perfo again task). Now would say that you have the s to drink as me, or more or less than me! - Why?	you ama amour	t ditto		ditto
Ça	ereds ad	Ça	As shove	Çp.	As above
Ç¢.		Q%		Ç'à	estadorios reconocidos de compresente reconocidor es estado
Ça,	ys spans	Çm	As above	Qn	As above
Ç\$		Ç3	The restant light bear completed and a finite stated in the second and the second	LJ	maga pakan kanan >Pangan kanan k
Ça	As above	Qu	As chove	Ça	As above
Çķ	Total processing and a second control of the	<b>9</b>	22-25-de-relative in proposition of the proposition	G:	
C <sub>3</sub>	As above	Q3A	eveds es	Qn	As above

P2000AH28	APPARATUS two - 1000 ml. flat-bottomed beakers	TRANSPORMATION juice from S's ist into 500 ml.
CONCEPTC.S	& one 500 ml. flat-bottomed	jar,
cp. C.C.Q.	basker @ 500 ml.	

	3		<u>aa</u> Answers		Ę				
:	(Agrism lays & get agrisms amount before trantion & then give promp  I sa pouring your juicthis jar. Now, would that you have the same drink as me, or more these than me (Give ans Why? This is what I would tell me,	nsforma- t)  a into you say amount to han ma, on	same to begin with you just poured min this jer. Now it's but it's skinnier to yours. So they are same.	Because they were the same to begin with and you just poured mine into this jer. Now it's high but it's skinnier than yours. So they are the same.			Because they were the same to begin with and you just poured mine into this jar. How it's high but it's skinnier than yours. So they are the		
•	(Gat S to scho the rul	a)							
gk gk	Lets de it again (perf again task). Now woul that you have the same drink as me, or more t or less than me? - Why	d you say amount t han me,	o ditto		ditto				
	How you know that the war is that they'rs the because they were the begin with and you justine into this jar. I high but it's ekinnier yours. So they are the However, look at how hers. Don't you think actually makes it more what I want you to take	same to ; st poured fow it's than he same. high it is that	Because they were same to begin with you just pourad muthis jar. Now it but it's skinnier yours. So they as same.	Because they were the same to begin with and you just poured mine into this jar. Now it's high but it's skinnier than yours. So they are the					
ån.									
ġn.	Look at how high it i. Don't you think that makes it more.	a. actually	ditto	ditto					
<b>₽</b>	As chave	Qan .	As above	Qn	As shove				
()t		Qk	Name and Associated States of the States of	ďέ					
<b>(</b>	do share	Çşa.	As shove	Çn	As above				
Çiz.		q%	Questi light fill a league companie de league	Qk					
ĝa	As shave	Çn	evoda ek	Qп	As above				
(\$	Colonial Victoria and Colonial	Q <sub>2</sub> s	Company of the Compan	Qk					
	Aa sbove	Qn	evoda eA	Qα	evoda sk				

PROCESS 29	APPARATUS END-1000 ml.	DESCRIPTION TO THE PROPERTY OF
	flat-bottomed beakers a	Sa jar into 500 ml. jar.
C.S.	one 500 ml. flat-bottomed	
on C.C.Q.	beaker. @ 500 mls.	

	I.		<u> 86</u> Answers		829					
	(Assign jars & get agrees same amount before transi- tion & then give prompt)  I am pouring your juice	Into	Because they were the same to begin with and you just poured mine into this jar. Now it's high but it's skinnier than							
	this jar. Now, would you that you have the same as drink as me, or more that less than me (Give answer Why? This is what I want tell me	mount t n me, o r)	o same.	gama.				yours. So they are the same.  If incorrect responsible to the same is a same.  Oh, you just misse chip, but you will lots more chances.		
Pk	(Gat 3 to echo the rule)									
Qk.	Lets do it again (perfor again task). Now would that you have the same a drink as me, or more that or lass then me? - Why?	yon say wunt t	ditto		ditto					
Pn	Now you know that the risnswer is that they're to because they were the sabegin with and you just mine into this jar. Now high but it's skinnier to yours. So they are the However, someone else sabecause this one is high contains more. Where the or wrong? This is what you to tell ms	same to begin with anyou just poured mine this jar. Now it's but it's skinnier the yours. So they are same.	Bacause they were the same to begin with and you just poured mine into this jar. Now it's high but it's skinnier than yours. So they are the							
Qn.	Someone else said taht I this one is higher it co more. Where they right	ontains	ditto							
Ç <sub>i</sub> a	As above	Çη	As above	Çn	Ye spons					
Q7s		ďβ		Q <u>u</u>						
Q <sub>3</sub>	Aa abova	Çв	As above	Qr.	Ãa above					
Çk		Qk		Q≱						
Çs	As above	Ça	As above	Qn	As above					
ÇÇL	AND DESCRIPTION OF THE PROPERTY OF	Q1s		Çķ						
Qn.	eveds sa	Qn	evode as	Qa	a above					

## APPENDIX 4

## Phases and Cycles for the Conflict Training

Sign	Significate
Α .	Top left beaker
В	Middle left beaker
C	Bottom left beaker
A t	Top right beaker
В	Middle right beaker
C'	Bottom right beaker
F	Beaker or flask used for filling A and A'
1	150 ml. tapped beaker
2	250 ml. tapped beaker
3	400 ml. tapped beaker
4	1000 ml. tapped beaker
5 .	250 ml. flat bottomed flask
6	500 ml. flat bottomed flask
7	1000 ml. flat bottomed flask
8	125 ml. Erlenmyer beaker
9	500 ml. Erlenmyer beaker
10	150 ml. standard beaker
11	250 ml. standard beaker
12	400 ml. standard beaker

Figure 9: Signification of the symbols for the conflict training program.

PHASE NO.	PHASE PURPOSE	CYCLE NO.	APPARATUS	TRANSFORMATION
1	1. Adaptation of S to equipment. 2. Focus S's attention on the closed cycle of the liquid flow. 3. Teach active search for contradictory judgements.	1	A <sub>3</sub> A' <sub>3</sub> B <sub>3</sub> B' <sub>3</sub> C <sub>6</sub> C' <sub>6</sub> F <sub>6</sub> @ 400 ml.	
1	Same as phase 1, cycle 1.	2	A <sub>3</sub> A' <sub>3</sub> B <sub>3</sub> B' <sub>3</sub> C <sub>6</sub> C' <sub>6</sub> F <sub>6</sub> @ 400 ml.	
2	1. Focus S attention on the fact that equal amts. rise to same level in A and A' and in C and C' but to different levels in B and B'.  2. To facilitate	-	A <sub>3</sub> A' <sub>3</sub> B <sub>4</sub> B' <sub>3</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 400 ml.	
2	CCQ by: (a) approximating Piaget's 4 stages of the equilibration process and (b) prediction outcome conflict.  Same as phase 2, cycle 1.		A <sub>3</sub> A' <sub>3</sub> B <sub>4</sub> B' <sub>2</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 250 m1.	
2	Same as phase 2, cycle 1.	3	A <sub>3</sub> A' <sub>3</sub> B <sub>4</sub> B' <sub>1</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 150 m1.	

PHASE NO.	PHASE PURPOSE	CYCLE NO.	APPARĄTUS	TRANSFORMATION
2	Same as phase 2, cycle 1.	4	A <sub>3</sub> A' <sub>3</sub> B <sub>1</sub> B' <sub>2</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 150	
2	Same as phase 2, cycle 1.	5	A <sub>3</sub> A' <sub>3</sub> B <sub>1</sub> B' <sub>3</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 150	
2	Same as phase 2, cycle 1.	6	A <sub>3</sub> A' <sub>3</sub> B <sub>1</sub> B' <sub>4</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 150	
3	1. Same as phase 2 except the saliency of the unequal levels at B & B' is increased due to the surprise effect when the screen is removed.  2. Create conflict		A <sub>3</sub> A' <sub>3</sub> B <sub>4</sub> B' <sub>4</sub> C <sub>12</sub> C <sub>12</sub> F <sub>12</sub> @ 400	
3	re judgments high- er = more and skin- nier = less.  Same as phase 3 cycle 1.	2	A <sub>3</sub> A' <sub>3</sub> B <sub>4</sub> B' <sub>2</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 250	Same as phase 3, cycle 1, but with $B_4\ \&\ B'_2$

ſ					
	PHASE NO.	PHASE PURPOSE	CYCLE NO.	APPARATUS	TRANSFORMATION
	3	Same as phase 3, cycle 1	3	A <sub>3</sub> A' <sub>3</sub> B <sub>4</sub> B' <sub>1</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 150	
	3	Same as phase 3, cycle 1	4	A <sub>3</sub> A' <sub>3</sub> B <sub>1</sub> B' <sub>2</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 150	Same as phase 3, cycle 1, but with $_{\rm B_1~\&~B'_2}$
Company of the Compan	က	Same as phase 3, cycle 1.	5	A <sub>3</sub> A' <sub>3</sub> B <sub>1</sub> B' <sub>3</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 150	Same as phase 3, cycle 1, but with B <sub>1</sub> & B' <sub>3</sub>
		Same as phase 3, cycle 1.	6	A <sub>3</sub> A' <sub>3</sub> B <sub>1</sub> B' <sub>4</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 150	Same as phase 3, cycle 1, but with B <sub>1</sub> & B'4
The same of the sa	4	To develop conser- vation of inequali- ties by having un- equal amounts in A & A' which rise to the same level in B & B'.	1	A <sub>3</sub> A' <sub>3</sub> B <sub>1</sub> B' <sub>2</sub> F <sub>10</sub> @ 80 ml. for A <sub>3</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>10</sub> @ 120 ml. for A' <sub>3</sub>	

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PHASE NO.	PHASE PURPOSE	CYCLE NO.	APPARATUS	TRANSFORMATION
4	Same as phase 4, cycle 1	2	A <sub>3</sub> A' <sub>3</sub> B <sub>2</sub> B' <sub>1</sub> F <sub>12</sub> @ 120  ml. for A <sub>3</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 80	
			ml. for A' <sub>3</sub>	
4	Same as phase 2. This cycle constitutes a review of CCQ.	3 .	A <sub>3</sub> A' <sub>3</sub> B <sub>4</sub> B' <sub>1</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @	
	•		150 ml.	
5	To facilitate the development of the generalization of unequal CCQ		A <sub>3</sub> A' <sub>3</sub> F <sub>12</sub> @ 100 ml. for A B <sub>3</sub> B' <sub>3</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @ 200	
			ml. for A'	
5	Same as phase 5 cycle 1	2	A <sub>3</sub> A' <sub>3</sub> B <sub>1</sub> B' <sub>2</sub> F <sub>10</sub> @ 80 ml. for A <sub>3</sub>	
			C <sub>12</sub> C' <sub>12</sub> F <sub>10</sub> @ 120 ml. for A' <sub>3</sub>	
5	To facilitate the development of the generalization of equal CCQ.	3	A <sub>3</sub> A' <sub>3</sub> B <sub>3</sub> B' <sub>3</sub> F <sub>12</sub> @ 250 ml. C <sub>12</sub> C <sub>11</sub>	
5	Same as phase 5, cycle 3.	4	<sup>A</sup> 3 <sup>A</sup> '3 <sup>B</sup> 2 <sup>B'</sup> 1 <sup>C</sup> 9 <sup>C'</sup> 8 <sup>F</sup> 10 <sup>@</sup> 125	

PHASE NO.	PHASE PURPOSE	CYCLE NO.	APPARATUS	TRANSFORMATION
5	Same as phase 5, cycle 1	5	A <sub>3</sub> A <sub>3</sub> ' B <sub>1</sub> B <sub>2</sub> ' F <sub>10</sub> @ 80 ml. for A <sub>3</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>10</sub> @ 120 ml. for A' <sub>3</sub>	
5	Same as phase 5, cycle 3.	6	A <sub>3</sub> A' <sub>3</sub> B <sub>3</sub> B' <sub>2</sub> C <sub>7</sub> C' <sub>5</sub> F <sub>10</sub> @ 250 m1.	
5	Same as phase 5, cycle 1	7	A <sub>3</sub> A <sub>3</sub> ' B <sub>1</sub> B <sub>2</sub> F <sub>10</sub> @ 80 m1. for A <sub>3</sub> C <sub>12</sub> C' <sub>12</sub> F <sub>10</sub> @ 120 m1. for A' <sub>3</sub>	
6	To facilitate the development of generalization and resistance to countersuggestion of equal CCQ	1	A <sub>3</sub> A' <sub>3</sub> B <sub>3</sub> B' <sub>2</sub> C <sub>7</sub> C' <sub>5</sub> F <sub>10</sub> @ 250 m1.	

## Glass Beaker Sessions

Fha	ase	t Cycle 1 Sheet 1 Of 1	Apparatus		Tape r	oota	ge			
Subject Experimenter Cobserver		imenter			Start	Start Time				
Cab	ser	ver	- B <sub>3</sub> B' <sub>3</sub> C <sub>6</sub> C' <sub>6</sub> F <sub>6</sub> @500 ml.		Stop T	ime_				
			C6 C'6 F6 @5	00 ml.	Reel #		_ Side	#		
	N.	Q = No Question E = Expla A = No Answer R = Red C J = Judgement (/of/) W = White	Legend	Conflict Sym	hols					
	Т	E's Request or Question	S's F	esponses	Y	11	CHF	Chips		
SYRD	#			NA, or verbat	m X	Х				
Š	L		rep	orti	J	E	flict	WW, RR		
1	h	Put juice in F <sub>6</sub> filling to tape								
2	1	Pour juice from F <sub>6</sub> →A <sub>3</sub>								
3	1	Pour juice from A <sub>3</sub> →B <sub>3</sub>	* ***							
4		What happened when $A_3 \rightarrow B_3$								
	<del> </del>	When we $B_3 \rightarrow C_6$ will juice come		<u></u>		+				
		up to, over top, or below tape?								
5	2	Let $B_3 \rightarrow C_6$								
6	1	Where you right when you said						-		
	2	You answered like a young child didn't you (W)								
	3	Let's findolder childanswer.								
	4	How high did you think - juicecome? (W)								
	5	But what happened $$ $B_3 \rightarrow C_6$								
	5	Can show me on C <sub>6</sub> how high yo thought and how high actuall came? (W)	1							
	7	Can tell me what older child would think when $B_3 \rightarrow C_5^2$ (W,W)	,							

		1 Cycle 2 Sheet 1 Of 1	Apparatus	<del>2</del> .				e		
Sub	jec	menter	A <sub>3</sub> A' <sub>3</sub>		Date_ Start					
Obs	erv	menter er	B <sub>3</sub> B'3		Stop 1	ime		<b>7.3.</b> 3		
			C6 C, 6 E 6 620			<i></i>		- 51 3ei		
		n a managaran	Legend	Conflict Sy	ymbols	mor	. +	OF AVE	lanation	
	NÇ	<pre>1 = No Question</pre>	D (PAKA.)	H = Hummin	or budge , pausir	ıg		Or evi	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
	j	A = No Answer R = Red Chi = Judgement (/oR1) W = White C	hip	F = Facial	Expressi	on,	, (	frown,		
_		E's Request or Question	S's Res	looking	g away)				Chips	-
Sten	#	A s request or Question	Answer (NQ,N	A, or Verba			_	Con-		
			repo			7 E		flict	WW,RR	_
1	1	Put juice in F filling to tape								
2	1	Pour juice from F <sub>6</sub> → A' <sub>3</sub>								
3	1	Pour juice from A' <sub>3</sub> → B' <sub>3</sub>							•	
4	1	What happened when $A'_3 \rightarrow B'_3$				1				
	2	When we B' <sub>3</sub> → C' will juice come up to, over top, or								
		come up to, over top, or below tape?	1							
						_	_			
5	1	Let B' <sub>3</sub> $\rightarrow$ C' <sub>6</sub>								
6	1	Were you right when you said								
		?								
	2	You answered like a young child								
		didn't you (W)								
	3	Let's find older child answer.								
	4	How high did you think - juice come? (W)				1				
						-			ļ	
	5	But what happened $3 \rightarrow C'$ (W)	5		ļ					
	6		u			$\dashv$				
		thought and how high actually came? (W)				j				
	7	Can tell me what older								
		child would think when $B'_3 \rightarrow C'_6$ ? (W,W)								
	+					1				•
			1						ļ	
					•	, ,	,		1	
		1								
	1									
	1	{	i			. !	,		Ī	

Phase 2 Cycle 1 Sheet 1 Of 2 Subject	Apparatus  Apparatus	Date	ootage
Experimenter	- 3, B' 3 F.2	Start '	
Observer			ime
	C <sub>12</sub> C' <sub>12</sub> G400 ml.	Reel	Side
	Legend	Conflict symbo	ols
NQ = No Question E = I	Explanation ( / or X)		
NA = No Answer R = I	Red Chip	explanation	
J = Judgement ( * or %) W = 1	White Chip	H = Humming,	
· · · · · · · · · · · · · · · · · · ·			pressions (frown,
		looking a	·
E's Request or Question	Ç'c	Responses /	/ C.H.F. Chips
2 2 2 100 400 01 2 400 010 11	· · · · · · · · · · · · · · · · · · ·	Verbatim X	X Con- W, R
32 · #:	Allawer (LOTTA OF		E flict WW, RR
1 1 Pour F into A <sub>3</sub> and A' <sub>3</sub>			E IIICE WY ILL
2 Do A <sub>3</sub> and A' <sub>3</sub> have same amount:	: :		
2 1 Pour A <sub>3</sub> ->B <sub>4</sub>	:		
2 Pour A' <sub>3</sub> →B' <sub>3</sub> , just as Some to drink		ļ	
3a 1 You did it like a young child		!	
2 When in A <sub>3</sub> & A' <sub>3</sub> how -did-	!		
have-drink? (W)   3 How much did you-re A <sub>3</sub> >B <sub>4</sub> ?		· · · · · · · · · · · · · · · · · · ·	<u> </u>
3. How much did you—re $A_3 \rightarrow B_4$ ? (W)	!	: !	
4 How much did you re A' 3	<u> </u>	:	
B'3? (W)		i : 1	
5 If A <sub>3</sub> =A' <sub>3</sub> and all A <sub>3</sub> >B <sub>4</sub> and	<u>                                     </u>	<del></del>	1
only some A'3-B'3 how can	: !	;	
B <sub>4</sub> =B' <sub>3</sub> ?			<u> </u>
6 You left some for B' in A' 3	1		
7 How much would an older child pour from A' <sub>3</sub> to B' <sub>3</sub> ? (W,W)	!		
3b 1 That's right (R)	: 	<u> </u>	
2 How can - be same when B'3.7	i	·	<del></del>
than B <sub>4</sub> ? (R)		:	
3 Does B'3=B4 because f and			1 1
(R)	1		
4 Can - tell me why B'3=B4			<del></del>
when B' <sub>3</sub> $\uparrow$ B <sub>4</sub> (R,R)	• •	! !	
<u> </u>	<u> </u>		
4 1 Elastic on levels of B <sub>4</sub> and B' <sub>3</sub>			
4 12 3 12		:	
C <sub>12</sub> and C' <sub>12</sub> have same or more in one			
	•	:	
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		į	1
1 1		•	1
i i		1	

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	Glass Beaker Sessions	
Phase <u>2                                    </u>	2 Of 2 Apparatus	Tape Footage
Experimenter	A <sub>3</sub> A' <sub>3</sub>	Start Time
Observer	B, B', F,	Stop Time
	c <sub>12</sub> c' <sub>12</sub> @400 ml.	ReelSide
	Legend	Conflict Symbols
NQ = No Question	$E = Explanation (\nu or X)$	C = Change of judgement or
MA - No Anguer	R = Red Chin	explanation

1	J:	= Judgement ( √ or X) W = White	$\mathbf{F} = \mathbf{F}$	umming, Pausing acial expressions (fr ooking away)	
	1	E's Request or Question;	S's Responses	C.H.F.	Chips
	T		Answer (NQ,NA Or Verba		W, R
	#			J E flict	WW,RR
Ī	1	Let B <sub>4</sub> $\rightarrow$ C <sub>12</sub> and B' <sub>3</sub> $\rightarrow$ C' <sub>12</sub>			
r	1	Do we have same, more, less?			
	-	(R). Why? (R,R)			
		1			
Ī	1	Do we have same, more, etc?		; 1 1	
t	7	You answered like a young			
١	-	child (W)		1 1	
†	31	Did juice in B <sub>4</sub> =B' <sub>3</sub> ?(W)			
		4 3			
	Ì				
÷			· · · · · · · · · · · · · · · · · · ·		
i	4	When $B_4 \rightarrow C_{12}$ and $B'_3 \rightarrow C_{12}$		1 1 1	
١	ļ	what happened?			
	1				
i	5	Does C'12 = C12?			
ŧ	5	Could B <sub>4</sub> =B' <sub>3</sub> then? (W)			
١	٦	3 21011 (11)			
1	i				
+	_	THE RESERVE AND ADDRESS OF THE PARTY AND ADDRE		<del></del>	
	1	What about juice here A'3			
1		ļ		1 1	;
Ť	8	If A'3 > B'3 & B'3 - C12			}
1	-				1
I	ļ	would C' <sub>12</sub> = C <sub>12</sub> ? (W)			1
İ	į				
	1	Let A'3 >B'3 >C'12	•		
		Do we both have same? (R)			
-	i				<del> </del>
ì	2	Why? (R)			
-	7	What is the difference			
İ		between the younger & older		i   1	!
1		girls' way of pouring A3->			1
Į		B <sub>4</sub> & A' <sub>3</sub> ⇒B' <sub>3</sub> ?			İ
		(W,H)			
		(4,4)			<u> </u>
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			ss Beaker S	essions					
		2 Cycle 2 Sheet 1 Of 2	Appa	ratus	Tape Date	Foo:	tag	e	<del></del> .
Sui	-	imenter	A <sub>3</sub> A' <sub>3</sub>		Start	Ti	ne		
		ver	B <sub>4</sub> B' <sub>2</sub>		Stop				
				F <sub>12</sub> @250 m	D 1			Side_	
				12		1 ~			
	NO	= No Question E = Exp	Legend	vor X)	Conflict Symbo	iude iude	zem.	ent o	•
		⇒ No Answer R = Red		02,	explanatio		,		•
	J	= Judgement ( $\nu$ or X) $N = Nhi$	te Chip		H = Humming, P		_		
					F = Facial exp		sio.	ns (f:	cown,
_	; ]	E's Request or Question		S's Resp	looking aw onses		√lc	н.г.	Chips
37E, P	: †		Answer		Verbati)			on~ ;	
ñ	#_								WW,RR
		Pour F into A <sub>3</sub> and A' <sub>3</sub>				1 1			
	2	Do A <sub>3</sub> & A' <sub>3</sub> have same amount?							
2	1	Pour A <sub>3</sub> →B <sub>4</sub>					T	1	
		Pour A'3 >B'2, just so				+	+		
	: 1	Same to drink					1		
3a	1	You did it like a young child				1	+		
	- 1	When in A <sub>3</sub> &A' <sub>3</sub> how - did -				<del>;                                    </del>	<del>-  </del> -		
		have - drink? (W)				1	i	1	
	3:	How much did reA <sub>3</sub> →B <sub>a</sub> ?				1 1			
		(H)				1		:	
		How much did you re			·				
	7	A'3>B'2? (W)				: :	1	:	
		3 2						į	
	5	If A <sub>3</sub> =A' <sub>3</sub> and all A <sub>3</sub> →B <sub>4</sub>			<del></del>	1 :	:		<del></del>
		and only some A'3 > B'2 how					1		
		can B <sub>4</sub> =B' <sub>2</sub> ?		•			}	j	
	.6	You left some for B' in A' 3				+++			
		How much would an older child			·····		<del></del>		<del></del>
	'	pour from A'3 to B'2? (W,W)				,	:	ļ	
		3 2				1 '	:		
3b	1	That's right (R)		· · · · · · · · · · · · · · · · · ·		!!!	:		
	2	How can - be same when B' 24							
	1 !	than B <sub>4</sub> ? (R)				; ;	!		
						,			
		Does B'2=B4 because and (-)				1	:		
	4	Can - tell me why B'2=B4				<del></del>			
		when B'2 1 B4 (R,R)					:		
	:					1	:		
4	1	Elastic on levels of B <sub>4</sub> & B' <sub>2</sub>	·						
5	1	If B <sub>4</sub> >C <sub>12</sub> & B' <sub>2</sub> >C' <sub>12</sub> will				1			
		C <sub>12</sub> and C' <sub>12</sub> have same or				: ,			
		more in one				:	;		•
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		G1:	ass I	Beaker Session	<u>5</u>			
		2 Cycle 2 Sneet 2 Of 2	Ar	paratus			otage	
		rimenter	Aa	A' 3		Date_	i ma	
Obs	se:	rver		B'2		Start T Stop Ti		
					2 1		Side	
			12	2 C'12 F12 @250	J ml.			
		N		Legend	Conflict	Symbols	_	
	N	$Q = No \ Question$ $E = Exp$ $A = No \ Answer$ $R = Rec$	orana	ition ( V or X)	) C = chan	ge of ju	dgement o	r
		$J = Judgement ( \sqrt{or X}) W = White$	ite C	nio Thio	H = Humm			
		, ,					ssions,(f	rown,
		,			100k	ing away	·)	
3		E's Request or Question		S's Re	sponses	ال	vC.H.F.	Chips
516.	#			Answer (NO,NA	or Verbatim	.X	x Con-	W,R
		Let $B_4 \rightarrow C_{12}$ and $B' \rightarrow C'_{12}$		· · · · · · · · · · · · · · · · · · ·			E flict	WW,RR
7-	-	7 12 2 12						] }
/a	1	Do we have same, more, less? (R). Why? (R,R)					1	
	ŀ	120,1						
7b	1	Do we have same, more, etc?					1	:
	2	You answered like a young	·			<del></del>		<del></del>
	1_	child (W)						1
	13	Did juice in B <sub>4</sub> ≠B' <sub>2</sub> ? (W)						i
							1 1	
-	4	When $B_4 \rightarrow C_{12}$ and $B'_2 \rightarrow C_{12}$		<del></del>	<del></del>		<u></u>	<del> </del>
		what happened?						:
	ļ	what happeneds						: 1
	5	Does C' <sub>12</sub> =C <sub>12</sub> ?				<del></del>		<del>                                     </del>
	5	Could B <sub>4</sub> = B' <sub>2</sub> then? (W)			<del></del>	<del></del>	<del>-  </del>	<del>!</del>
•		and b <sub>4</sub> b <sub>2</sub> dien. (w)				1	: :	:
	i	i						i
	7	What about juice here A'3						į
							: :	İ
	8	If A' <sub>3</sub> →B' <sub>2</sub> & B' <sub>2</sub> →C <sub>12</sub>			<del></del>		<del></del>	<del></del>
							i :	;
		would C' <sub>12</sub> = C <sub>12</sub> ? (W)					:	i
							1 1	
8	1	Let A' <sub>3</sub> →B' <sub>2</sub> →C' <sub>12</sub>		<del></del>	<del></del>			·
9	1	Do we both have same? (R)				<del></del>		<del></del>
	L.,	1			<del></del>			<del> </del>
	2	Why? (R)						:
						÷		
	3	What is the difference	***************************************			<del></del>	<u> </u>	ī ·
		between the younger & older	•					
		girls' way of pouring A <sub>3</sub> →				:		) 1
		B <sub>4</sub> and A' <sub>3</sub> B' <sub>2</sub> ?						Ì
		(W,W)						į
					************************************		<u> </u>	<u>L</u>
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<b>".</b>			ss Beaker Sessions	_	
		e 2 Cycle 3 Sheet 1 Of 2 ect	Apparatus	Tape Foot	age
	_	rimenter	A <sub>3</sub> A' <sub>3</sub>	Start Tim	
Ob	se	rver	B <sub>4</sub> B' <sub>1</sub>	Stop Time	
			C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @15	O ml Reel	Side
			Legend	Conflict Symbols	
	NQ	= No Ouestion E = Exp. = No Answer R = Red	lanation ( V or X)	C = Change of judge	ement or
	J	= Judgement ( or X) W = White	te Chip	H = Humming, Pausi	na
			-	F = Facial express	
<del>-</del>	Τ.	E's Request or Question	S's Respon	looking away)	C.H.F. Chips
SPE	'		Answer (NC,NA or	Verbatim X X	Con- W, R
	#	Pour P into A and A!		ĮΈ	flict WW,RR
	1 2	Pour F into A <sub>3</sub> and A' <sub>3</sub>			
		Do A <sub>3</sub> and A' <sub>3</sub> have same amount?			!
2		Pour A <sub>3</sub> →B <sub>4</sub>			
	2	Pour A'3>B'1 just so			
	i	Same to drink			
3a	1	You did it like a young child		:	i
	2	When in A <sub>3</sub> and A' <sub>3</sub> how - did			
	!	have - drink? (W)		!	
	3	How much did youre A <sub>3</sub> -≫B <sub>4</sub> ?		•	:
	<u>.</u>	(11)			!
	4	How much did you re A'3			
	Ì	B',? (W)			
<del></del>	5	If $A_3 = A_3$ and all $A_3 \rightarrow B_4$ and	 		
	1 .				
	1	only some A' <sub>3</sub> →B' <sub>1</sub> how can			
		B <sub>4</sub> *B' 1?	<b>i</b>	i	
	6	You left some for B' in A' 3			
		How much would an older child			
		pour from A' <sub>3</sub> to B' <sub>1</sub> (W,W)		:	
3b		That's right (k)			
	2	How can - be same when B'15			
		than B <sub>4</sub> ? (R)		1	
	3	Does B' = $B_4$ because $\#$ and $\Leftrightarrow$		: !	
		(R)			
	4	Can - tell me why B' 1 = B4		1	
		when B'1 B4 (R,R)		,	
4	!!	Elastic on levels of B <sub>A</sub> and			
78					
_		B' <sub>1</sub>			
5	1	If $3_4 \rightarrow C_{12}$ and $3'_1 \rightarrow C'_{12}$ will			
		C <sub>12</sub> and C' <sub>12</sub> have same or more			
		in one		• 1	
				. }	
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		<u>G1</u>	Lass Be	aker	Sessions					
		2 Cycle 3 Sheet 2 Of 2	- Ap	para	atus		Tape E	'oot	tage	
		ct		A'			Date_ Start	Tin	ne	
		ver	_	в'			Stop 1	ime.	2	
					'12 F <sub>12</sub> @150	ı ml	Reel		Side	
			_						-	
	NO	# No Ouestion E = Fo	M Tanati	eger	id ( v or X)	Conflict S	symbols of in	i G <b>a</b> e	mant or	_
	NA	= No Question E = Ex = No Answer R = Re	d Chip	-0	( V 02 A)	explai	nation	uge	EMEIL OI	•
	J	$R = Re$ $= Judgement ( \lor or X) W = W$	ite Ch	<b>i</b> p		H = Hummin				
						F = Facia			ions (fr	own,
_		l Ble Beneat en O				looki	ng away	<u>)</u>	<del>,</del>	
STEF		E's Request or Question	Αı	) GWA	s's Mespo	nses or Verbatin	1 1		C.H.F.	
	#				(21): /2112/	01 1012401			flict	
6	1	Let B <sub>4</sub> ->C <sub>12</sub> and B' <sub>1</sub> ->C' <sub>12</sub>						T		
7a		Do we have same, more, less?						+	<del> </del>	
		(R). Why? (R,R)					1	!		
							1	į		
772	-	Do up have gone and about	· · · · · · · · · · · · · · · · · · ·					<del>Ļ_</del>		
νp	<u> </u>	Do we have same, more, etc?			**	······································				
		You answered like a young							1	
_	3	child (w) Did juice in B <sub>d</sub> =B' <sub>1</sub> ? (W)						+	-	
	٦	1 7 7 - 1 . (")					ļ	Ì	į .	
							<u> </u>	L	!	
	4	When $B_4 \rightarrow C_{12}$ and $B'_1 \rightarrow C_{12}$					į	T		
	}	what happened?					i i		į į	
		1						1_	i	
	5	Does C' <sub>12</sub> = C <sub>12</sub> ?						1		
	6	Could $B_4 = B'_1$ then? (W)				1		i	i	
		-						!	;	
							i	į		
	7	What about juice here A' 3					i	1	i	
							;			
	8	If A' $_3 \rightarrow$ B' and B' $_1 \rightarrow$ C <sub>12</sub>								
		would C' <sub>12</sub> = C <sub>12</sub> ? (W)					ļ			
		12 12					i			
8	1	Let A' <sub>3</sub> →B' <sub>1</sub> →C' <sub>12</sub>	<del></del>					1		
9	_	Do we both have same? (R)	···					-		
_			·				i .		ļ	
	2	Why? (R)					i	1		
							į			
	3	What is the difference					<del>-  </del>			
		between the younger & older					ļ			
		girls' way of pouring A3->					-			
		$B_4$ and $A'_3 \rightarrow B'_1$ ?					-			
		4 3 I (W,W)							• •	
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		2 Cycle 4 Sheet 1 Of 2	Apparatus	Tape Date			je	
	-	ect	A A' 3	Star				***
	-	ver	B <sub>1</sub> B'2	Stop		-		
							Side	
			c <sub>12</sub> c' <sub>12</sub> F <sub>12</sub> @150				-	
	ŊÇ	2 = No Question E = Exp A = No Answer R = Rec	Legend planation ( vor X)	C= Change of	ols judg	eme	ent or	
	N.A	A = No Answer R = Red	i Chip	explanation	n n	4	_	
	J	$y = Judgement (\sqrt{or x})$ $w = Whi$	ite Chip	H= Humming or F = Facial Exp	rac		19	
				looking a			/115 (I.	LO#1. j
$\frac{1}{2}$		E's Request or Question	S's Resp⊙	nses			C.H.F.	Chips
STEP			Answer (NO, NA or	Verbatim)	у.	X (	Con- ;	W, R
'n								WW,RR
1	1	Pour F into A <sub>3</sub> and A' <sub>3</sub>					į	
-		Do A <sub>3</sub> & A' <sub>3</sub> have same amount?			:			
2					<del></del>	++		
١		Pour A <sub>3</sub> →B <sub>1</sub>				+		
	2	Pour A'3 >B'2, so some to drink			!	Li		
3	1	Do we have same, more, less?			•			
					:			
_		You answered like a young child			<del></del>	++		
1	2	(W)			:	1 1		}
-	3	Why is B' less than B,?	·····		1	1		
	_	2 1				į :		
					i	1		
-	4	No part of mistake. You only						
i	Ī	looked at how &B' 2 is						
_		Look how fat B' is			<del></del>	++		<del> </del>
_	i :	·				-		<u> </u>
	6	Is it $\rightarrow$ (than B <sub>1</sub> ? (W)			į			ļ
								í
	7	You should look at how fat &			<del></del>	+		I
		how v juice is before answering			. :	1		
_		Do you think because B'2>- B1			•			-
		but \( \mathbb{B} \), that B' = E, ? (R)			į			
		2 1 (1)			;			
					<u>!</u>	: !		<u> </u>
_	9	How much would older child say			;			
		is in B' <sub>2</sub> ? (W)			;			!
							···	
_		How much would younger child			i			1
		say is in B'2 (W)			!			
		-			:	1		1
_	11	Who would be right? (W)						1
	12	Why (W,W)			<del></del>	+ +		1
				•	i	; ;		
					!	++		<del> </del>
4		Elastic on levels B <sub>1 &amp; B'2</sub>						<u> </u>
5	1	If $B_1 \rightarrow C_{12}$ and $B'_2 \rightarrow C'_{12}$ will						
		C' <sub>12</sub> and C <sub>12</sub> have same or less			1	: ;		:
		i i			:	1 1		į
		in one			:	1		•
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		Gla	ass Beaker Sessions	_	_			
		2 Cycle 4 Sheet 2 Of 2	Apparatus			ota	.ge	
	_	ct	A <sub>3</sub> A' <sub>3</sub>	Date		-		
_		imenter						
Obs	er	ver	B <sub>1</sub> B' <sub>2</sub>	- 1	TII	e_	C4.1-	<del></del>
			C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @150				_Side_	
			Legend	Conflict Symbo	ls			
	NO	= No Question E = Exp = No Answer R = Red = Judgement ( or X) W = Wh	planation ( or X)	C = Change of	ju	ige	ment o	r
	NA	= No Answer R = Rec	d Chip	explanation	n			
	J	= Judgement ( √ or X) W = Wh:	ite Chip	H = Humming, p	aus	sin	ıg	
				T - INCTUT CUE			ons (f	rown
				looking aw	ay.	)	<i>L c</i>	01-4
ď		E's Request or Question	S's Respon	ise				Chips
STEP			Answer (NÇ,NA c	or verbatim,			Con-	W, R WW, RR
6	#	Tot B ac C B! mac!			+	123	11100	1111 141
		Let B <sub>1</sub> ->C <sub>12</sub> & B' <sub>2</sub> ->C' <sub>12</sub>			╄	<u> </u>		
7a	1	Do we both have same etc? (R)			1	1		
	2	Do you agree we have a problem?			T	Ī		
	-	(W)				l		
					_	<u> </u>		 
	3	Did B <sub>1</sub> = B' <sub>2</sub> ? (W)			1		1	
		Did you think that C <sub>12</sub> = C' <sub>12</sub>			$\top$			
							1	ļ
		after $B_1 \rightarrow C_{12} \circ B'_2 \rightarrow C_{12}$ ? (W)						
					$\perp$	1	1	
		Can you tell me what the					1	
		problem is? (W,W)					1	
						!	i	
		the 12 am alice while house			+	-	<del> </del>	ļ
	0	Would an older child have						
	1	looked at how $\sqrt{B'}_2$ and how				!	1	}
		fat B' <sub>2</sub> is? (R)					!	
_	7	Why should you look at how y and		<u></u>	Т	1		
		fat B' is? (R,R)					Ì	
	Į	2					1	
	L				╀-	<u> </u>	<u> </u>	
7b	1	Do we have same, more, less?				! i		ĺ
		(R)	1		!		1	1
	1	Why? (R,R)						ţ
			1			1	į	
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		s Beaker Sessions			
	e 2 Cycle 5 Sheet 1 Of 2	Apparatus		e Footage	
SWOJ	ectrimenter	A <sub>3</sub> A' <sub>3</sub>	Date Sta	rt Time	
	rver	B <sub>1</sub> B' <sub>3</sub>		p Time	
				lSide	
		C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> 0 150			
	= No Question E = Expl = No Answer R = Red = Judgement ( $\mathcal{V}$ or X) W = Whit	Legend	Conflict Sym	bols	
NQ	= No Question E = Expl	anation ( v or X)	C = Change o	f judgement o	or
NA	= No Answer R = Red	Chip	explanat	lon nauging	
J	a budgement ( voi A) " = will	e curb	F = Facial E	xpressions (:	Erown.
			looking	away)	
ð	E's Request or Question		<del> </del>	√C.H.F.	Chips
S75.6		Answer (NO, NA,	or Verbatim)		W, R
1, 1	Doug E into 3 and 3!		<del></del>	J E flict	WW, RR
	Pour F into A <sub>3</sub> and A' <sub>3</sub>				
2	Do A <sub>3</sub> and A' <sub>3</sub> have same amount?				
2 1	Pour A <sub>3</sub> >B <sub>1</sub>				
1 2	Pour A'3->B'3, so some to drink			† † † † † †	
	Do we have same, more, less?			+++	
٦	to we have same, more, less!				
2	You answered like a young child				-
+-	(W)			1	
3	Why is B' <sub>3</sub> less than B <sub>1</sub> ?				
4	No part of mistake. You				
-	only looked at how / B' 3 is				
5	Look at how fat B' is				
	Is it >- (than B <sub>1</sub> ? (N)			<del>-   -  </del>	
Ĭ	13 10 ()				
7	You should look at how fat &				
ــــــــــــــــــــــــــــــــــــــ	how \$\square\$ juice is before answering			<del>                                     </del>	
; 8	Do you think because B'3 - B1				
ļ	but $\downarrow$ B <sub>1</sub> that B' <sub>3</sub> =B <sub>1</sub> ? (R)				
+ 9	How much would order child say				
1	is in B' <sub>3</sub> ? (W)				
				<del></del>	
10	How much would younger child				
1	say is in B' <sub>3</sub> ? (W)				
111	Who would be right? (W)				
4				1	
12	Why? (W,W)				<u> </u>
i					
4, 1	Elastic on levels B, & B',				
	1	<del> </del>		<del>                                      </del>	
7) 1	If $B_1 > C_{12}$ and $B'_3 \rightarrow C'_{12}$ will				
i	C' <sub>12</sub> and C <sub>12</sub> have same or less			:	
	in one				
$\dot{+}$	<del>                                     </del>	<del> </del>			<del></del>
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	Glass Beaker Sessions											
	Phase 2 Cycle 5 Sheet 2 Of 2 Apparatus Date											
		rimenter	A <sub>3</sub> A' <sub>3</sub>	Start T	ime							
		ver	B <sub>1</sub> B' <sub>3</sub>	Stop Ti								
				Reel	Side							
			C <sub>12</sub> C' <sub>12</sub> F <sub>12</sub> @150	O								
	<b>N</b> 1/	2 = No Question E = Expla A = No Answer R = Red (	Legend Conflict	Symbols	dement c	.~						
	N	S = NO  Question $E = Red ($	Thin expla	e of jud nation	igenienic c							
		J = Judgement ( ✓ or X) W = White	e Chip H = Hummi	ng, paus	ing							
		•	F = Facia	l expres	sions (f	rown,						
				ng away)	<del>- 45 - 12</del>							
STEP	-	E's Request or Question,	5's Responses Answer (NQ,NA, Verbatim)		VC.H.F.							
S	#		Answer (NO, NA, Verbacim)		E flict							
6	1	Let B <sub>1</sub> ->C <sub>12</sub> & B' 3 C' 12		1		!						
		Do we both have same etc? (R)			<del>-                                    </del>	<del></del>						
10				<u> </u>		<u> </u>						
	2	Do you agree we have a problem?		1		i						
		(W)		•	į							
	_			· · · · · · · · · · · · · · · · · · ·								
	3	Did B <sub>1</sub> = B' <sub>3</sub> ? (W)		· · · · · · · · · · · · · · · · · · ·		<u>:</u>						
	4	Did you think that C <sub>12</sub> = C' <sub>12</sub>			;							
		after $B_1 \rightarrow C_{12} \in B'  C_{12}$ ? (W)		1		ì						
		1 12 3 12				i						
_	5	Can you tell me what the	<u> </u>			1						
		problem is? (U,W)		\$ :								
		•				•						
	_	Wanta an alam shift hass		· · · · · · · · · · · · · · · · · · ·	· ·							
		Would an older child have looked at how B', and how		į	1							
		3		•								
		fat B' 3 is? (R)			1							
	7	Why should you look at how,		;	i :	:						
		and fat B' is? (R,R)		;								
į		i			1 :	1						
7b	1	Do we have same, more, less?		i	<del></del>	!						
		(R)		•								
į		Why? (R,R)		•	1 1	:						
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			ss E	Beaker	Sessio	ns						
		e 2 Cycle 6 Sheet 1 Of 2	Ατ	parati	ıs				tag	ge		
	_	ect	-	A'3			Dat					
	_	cimenter	_	_								
O.	)2E1	ever		3'4						Side		
			c <sub>12</sub>	2 C'12	F <sub>12</sub> @1	.50	nec.	<u>-</u>		.5146_		
		= No Question E = Expl = No Answer R = Red = Judgement ( \( \superscript{v} \) or X) W = Whit		Legend	1,		Conflict Sym	bols				
	NQ	= No Question E = Expl	anat	tion (	√or x	:)	C = Change o	f jud	ger	ment o	r	
	NA	= No Answer R = Red	Chir	,			explanat	10n		_		
	J	= Judgement ( $\vee$ or X) W = Whit	e Cr	up			F = Facial E	paus	THE	d nne (f	rown.	
							looking			J.1.5 ( ±		
7		E's Request or Question			S's R	espo	nses			C.H.F.	Chips	_
SFE			F	Answer	(NO,NA	, or	Verbatim)				W, R	_
_			<u> </u>					J	E	flict	WW,RR	
1		Pour F into A3 and A'3	<u> </u>					1	1		·	
	2	Do A <sub>3</sub> & A' <sub>3</sub> have same amount?	į						} ;			
2		Pour A <sub>3</sub> ⇒B <sub>1</sub>	i					:				
-	- 2	Pour $A'_3 \rightarrow B'_4$ , so some to drink	-									_
_			· 					<del></del>	-			_
3	7	Do we have same, more, less?	i									
i			,					1	i			
_	2	You answered like a young child	:	····					П			_
		(W)	<u> </u>						<u>'</u>			
	3	Why is B' <sub>4</sub> less than B <sub>1</sub> ?						•	;			
								;				
-	4	No part of mistake. You	<del>                                     </del>									
	_	only looked at how ba is.	1					:				
-		Look at how fat B' <sub>4</sub> is	<del> </del>		·····				1			
_			<u> </u>						-		: 	
į	6	Is it > (than B <sub>1</sub> ? (W)							1			
								1				
_	7	You should look at how fat &	<del></del>						: :			_
_		how $\nu$ juice is before answering	!						+ !		!	
į	8	Do you think because B'4 B1						i				
		but $\downarrow$ B, that B' = B,? (R)						:	1			
		±						:			! !	
4	_	How much would older child say						<del>-  -</del>	+		:	
	9	is in B' <sub>4</sub> ? (W)						,	:		:	
		4						-				
	10	How much would younger child									<u> </u>	
		say is in B' <sub>4</sub> ? (W)	l					i			•	
-	11	Would he be right? (W)							1	<u></u>	<del>.</del>	
_			<u> </u>					<del></del>	-			
	12	Why? (W,W)						ĺ			t 1	
			i					i }			<u>.                                    </u>	
4	1	Elastic on levels B <sub>1</sub> & B' <sub>4</sub>						1	1	<u> </u>	:	-
5		If $B_1 \rightarrow C_{12}$ and $B'_4 \rightarrow C'_{12}$ will	<del>                                     </del>	<del></del>				<del></del>	;		:	
•	-	1 12 4 12							!		-	
		C' <sub>12</sub> and C <sub>12</sub> have same or less							į .	•	i	
		in one?	i i					1			:	
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Su Ex	bje per	0 0-1- 0 0 0 06 0	Apparatus  Apparatus  A3 A'3  B1 B'4  C12 C'12 F12 @150  Legend	Date Star Stop	t Tim	tage me eSide		- - -
	NQ NA J	= No Question E = Expl. = No Answer R = Red ( = Judgement ( Vor X) W = White	anation (*/or X) Chip e Chip	F = Facial Exp looking aw	judg n ausi ress	ement o ng ions (f	r rown	
Ź		E's Request or Question		nses	2 2	C.H.F.		_
いれて	#		Answer (NO, NA,	Verbatim)		Con-	W, R WW, RR	
6	ï	Let $B_1 \rightarrow C_{12} \times B'_4 \rightarrow C'_{12}$			T	11110.5	7.117 20	·
		Do we both have same etc? (R)			<del>                                     </del>			
	2			<del></del>				
	2	(W)						
	3	$Did B_1 = B'_4? (W)$						_
	4	Did you think that C <sub>12</sub> = C' <sub>12</sub>					<u> </u>	
		after B <sub>1</sub> C <sub>12</sub> & B' <sub>4</sub> C <sub>12</sub> ? (W)						
	5	Can you tell me what the problem is? (W,W)						
		Would an older child have						
	6	looked at how B' and how				i	i [	
		fat B' <sub>4</sub> is? (R)			.			F
	7	Why should you look at how iv and fat B' 4 is? (R,R)						
7ь	1	Do we have same, more, less? (R) Why? (R,R)						
	ŀ							
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		Glass	peaker Sessions	<b></b>		_	
Pha	se_	3 Cycle 1 Sheet 1 Of 2	Apparatus	-	COLER	٣	
			3 A'3		Time		
				Stop I	ine		
		c	C'12	-		510e	
			Legend	Conflict Sym			
	įΨ	= No Question E = Expl	anation ( for X)	C = Change o		ge <del>wen</del> t	or
	NA.	m No Answer R = Red	Chip	expresser 2 minmus = H	Tou		
	J	- Inddenent ( A or y) % - wurt	e carp	F = Facial s	xpres	sions	(from,
				looking	амау)		
9	I	E's Request or Question	S's Respon	nse		C.H.F.	Chips
7	+		Answer (MQ, MA or	Verbatim)			WW, ER
53	Answer (AQ, NA or Verbatim)  1 Pour F into A <sub>3</sub> and A' <sub>3</sub> 2 Do A <sub>3</sub> and A' <sub>3</sub> have same amount?  1 Pour A <sub>3</sub> >> B <sub>4</sub> 2 Pour A' <sub>3</sub> >> B' <sub>3</sub> , just so Same to drink  1 E removes shield  2 When S does it wrong. Do we both have the same to drink?  3 You did it like a young child didn't you? (W)  4 Can you tell me what the problem is? (W, W)  5 When juice in A <sub>3</sub> & A' <sub>3</sub> how much did we both have to drink? (W)  6 How much did you think we would both have in B <sub>4</sub> & B' <sub>3</sub> (W)  7 But now you think there is more in B' <sub>3</sub> (W)  8 Your problem seems to be that you thought B <sub>4</sub> would = B' <sub>3</sub> but now you think B' <sub>3</sub> has more  9 Now can you tell me what the problem is? (W, W)  10 Let's see if we can find out			11			
1	4	Pour F into A <sub>3</sub> and A' <sub>3</sub>			44	ļ	
	2	Do A <sub>3</sub> and A' <sub>3</sub> have same amount?			++		
2	1	Pour A >B				1	
				<del></del>	+ +		
	2	Four A' 3 B' 3, Just 80	•				1
	L			· · · · · · · · · · · · · · · · · · ·		<del>                                     </del>	
3	1 1	_			++	<del> </del>	-
		have the same to drink?					1
	ᇻ	You did it like a young child				1	1 .
	1 1					1	
	Ц				++	<del> </del>	<del> </del>
	4					Ì	
		problem is? (w,w)				1	
	11	•	·			<b> </b>	-
	5	When juice in A, & A', how					
		much did we both have to			11		
	11	drink? (W)				1	
	-	How much did you think we					
	Ĭ						
						<u> </u>	
	7					•	
						Ì	
	<u> </u>	•				1	
	8					1	1
		•					1
					╌┼╌├╴	+-	<del> </del>
	9					Ì	
		problem is? (W,W)				Ĭ	1
					$\dashv \dashv$		
	10	Let's see if we can find out					1 .
		more about this problem				1	
	11	Is the juice in B <sub>4</sub> and B' <sub>3</sub>				į	
•		different in any way? (W)					
	1	Is there another way the juica				1	
	12	is different in B <sub>4</sub> & B' <sub>3</sub> ?				A STATE OF THE STA	
	1	(W)					
	13	Do you think that B' 3 has more					
	1	because it is (W)					
	1	Decause it is ( (w)			$\rightarrow$	1	
	14	If it has more because it is 7					
		won't it have less because it i	a			200	
		skinnier? (W)					
	+	1			1		
		I	·	•	!	"	1
	1		1		,		

			seaker Sessions	et Via			
	se.	3 Cycle 1 Sneet 2 Of 2	Apparatus	Tape Fo	OCE	ge	
	_	imenter	A'3	Start 1			
			B' F 12 @ 400	Stop Ti Reel	me_	64.5	
			c' <sub>12</sub>		-		
				Conflict Symb			
	MQ	= No Question E = Expl	(anation ( ) or X)	C = Change of explanati	-	ozenent	UI
	AA L	= No Answer R = Red = Judgement ( or X) W = Whit	chip te Chip	H = Humming			
	_		•	F - Facial ex			(frown,
	<del></del> -			looking a	WRY	) С.н. F.	Chine
9	+	E's Request or Question	S's Respon Answer (NQ,MA or			Con-	
STEP	#		more (ngjar or				WW, RR
3	ष	So its more because its † 5					
		less because its skinnier?(W)					
	16	But how can it be more & less		•			
		at the same time?					
	H	Maybe the problem is that you			$\vdash$	1	
	Π	only thought about how high it				}	
		is and you should have thought	,			Ì	·
		about both how high and how skinny it is. Maybe because		•		1	
		it is higher and skinnier at				1	
		the same time B4 and B'3 have				1	
		the same amount. (W) if he					
	$\sqcup$	answers yes.			- -		ļ
	18						
	1	tell me what the problem is? (W,W)					
		(,					
	1_1				-		
		Elastic on levels of B <sub>4</sub> & B' <sub>3</sub>					
5	1	If $B_4 \rightarrow C_{12}$ and $B'_3 \rightarrow C'_{12}$					
		will C <sub>12</sub> & C' <sub>12</sub> have same or				1	
		more in one?				<b>!</b>	
6	1	Let $B_4 \rightarrow C_{12}$ and $B' \rightarrow C'_{12}$			П		
					+		
7a	۲	S answers right Do we have same, or one a lot					
		and one a little (R)					
	2	Why? [(R,R) if S refers to both	<u> </u>		$\Box$		
		dimensions of the beakers					
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hase	3 Cycle 2 Sheet 1 Of 2	Apparatus	Tape Fo	otag	e	
ubje	CE	A A'3	Date Start T	ime		
		3	Stop Ti	ue _		
••••	•		Reel_		Side_	
		12 Legand	Conflict Symbo			
110	■ No Question E ■ Expl	lamation ( or X)	C = Change of		gewent	or
MA	= No Answer R = Red = Judgement ( ✓ or X) W = Whit	Chip	itsnalqxs gnimmuk = H	on		
J	= laddement ( A or y) M = war	te Chip	F = Facial ex	res	sions	(frown.
			looking a	zay)		
<u>. I</u>	E's Request or Question	S's Respo		4	C.H.F.	Chips
d of		Answer (NQ, NA o			Con-	W, RR
	David Difference and Difference			-	*****	77.1
	Pour F into A <sub>3</sub> and A' <sub>3</sub>					
2	Do A <sub>3</sub> and A' <sub>3</sub> have same amount?		ļ			
21	Pour A <sub>3</sub> →B <sub>4</sub>					
77	Page N' > B' just 50 ==			1		
	Pour A'3 B'2, just so					
	Same to drink E removes shield	<u> </u>		-		
717	E Temoves surerd					
2	When S does it wrong.					
11	Do we both have the same to					
+ 1 - 1	drink? You did it like a young child			$\top$		
17	didn't you? (W)					
$\perp$				+		
4	Can you tell me what the problem is? (W,W)					
	problem 13: (W/W/					
				+		
5	When juice in A <sub>3</sub> and A' <sub>3</sub> how	-				Ì
	much did we both have to drink? (W)				l	1
	di iliki (ii)				<b> </b>	
6	How much did you think we				1	
	would both have in B <sub>4</sub> & B' <sub>2</sub>				ł	
	(W)				<del> </del>	
7	But now you think there is	ŧ				
	more in B' <sub>2</sub> (W)				<u> </u>	ļ
8	Your problem seems to be					
	that you thought $B_4$ would = $B_2$					
	but now you think B' has more				l	
				+		1
9	Now can you tell me what the				3	
	problem is? (W.W)					
					<b>↓</b>	ļ
10	Let's see if we can find out					
I	more about this problem					<u> </u>
$\frac{1}{h_1}$	Is the juice in B4 and B'2					
· [-	different in any way? (W)					
1	difference in any way: (")				<u> </u>	<u> </u>
1.2	Is there another way the juice				1	
	is different in B <sub>4</sub> & B' <sub>2</sub> ?					
1	[.(w)					1
13	Do you think that B' has more					
	because it is A (W)				Betrian	
					<del> </del>	
14	If it has more because it is A	]				
1	won't it have less because it i skinnier? (W)	4				
1	SKAIMIAGE. \n/				4	<del></del>

bj.	ect Sheet 10%	Atparatus	Uate		10 E	[E	
рe					_		
2046	rverB	4 B 2 F 12 E 2 3 0	Scop 1: Reel	rme		Side	
H	Q = No Question E = Expl	Legend Lanation ( or X)	Conflict Symbol C = Change or explanat: H = Humming F = Facial ex	ool f j ion	s ud	gewent sions	or
	V's Vocuset or Guestian	Cla Bassa		100	77	C 11 E	China
-	norresult to resupen a a	Answer (NO NA or	Verhatim)				W, R
ğ		number (1191.41 or	verbacia				
7	So its more because its A & less because its skinnier? (W)						
16	But how can it be more & less at the same time?						
17	only thought about how high it is and you should have thought about both how high and how skinny it is. Maybe because it is higher and skinnier at the same time B <sub>4</sub> and B' <sub>2</sub> have the same amount. [(W) is he	,					
1.8							
ļ.	Elastic on levels of B <sub>4</sub> and B' <sub>2</sub>						
1	If $B_4 \rightarrow C_{12}$ and $B'_2 \rightarrow C'_{12}$ will $C_{12}$ and $C'_{12}$ have same or more in one?						
1	Let $B_4 \rightarrow C_{12} & B'_2 \rightarrow C'_{12}$ .						,
1	S answers right  Do we have same, or one a lot and one a little (R)	·					
2	Why? [(R,R) if S refers to both dimensions of the beakers]						
T							
	Pese 14 N	Perimenter  Server  NQ = No Question  NA = No Answer  J = Judgement ( or X)  E = Expl  R = Red  J = Judgement ( or X)  E's Request or Question  E's Request or Question  E's Request or Question  E's Request or Question  E's Request or Question  E's Request or Question  E's Request or Question  E's Request or Question  E = Expl  R = Red  J = Maybe the problem is that you  only thow can it be more & less at the same time?  Maybe the problem is that you  only thought about how high it is and you should have thought about both how high and how  skinny it is. Maybe because it is higher and skinnier at the same amount. [(W) is he answers yes]  Now for two chips can you  tell me what the problem is?  (W,W)  I Elastic on levels of B <sub>4</sub> and B' <sub>2</sub> will C <sub>12</sub> and B' <sub>2</sub> > C'  will C <sub>12</sub> and C' <sub>12</sub> have same or more in one?  I Let B <sub>4</sub> > C <sub>12</sub> & B' <sub>2</sub> C' <sub>12</sub> S answers right Do we have same, or one a lot and one a little (R)  Why? [(R,R) if S refers to both	Server    B <sub>4</sub>   B' <sub>2</sub>   F <sub>12</sub> e250     Cl <sub>2</sub> C' <sub>12</sub>     Legend   R = Red Chip     J = Judgement ( or X)   W = Waite Chip     E's Request or Question   S's Responsible Respon	Server	perimenter  Server  By A B' 2 F12 250  C12 C'12  Reel  C12 C'12  Reel  MQ = No Question  NA = No Answer  R = Red Chip  J = Judgement ( or X) W = Waite Chip  K = Kequest or Question  K = Kequest or Question  S's Response  Answer (NQ, W or Verbatim)  So its more because its A & less because its skinnier? (W)  But how can it be more & less at the same time B 4 and B' 2 have the same amount. [(W) is he answers yes]  BN Now for two chips can you tell me what the problem is?  (W,W)  L Elastic on levels of B 4 and B' 2 will C 12 and C' 12 have same or more in one?  Let B 4 C 12 & B' 2 C' 12  Why? [(R,R) if S refers to both	perimenter    Ba   B' 2 F120210   Story Time     C12 C'12   Red    NQ = No Question   E = Explanation ( \sqrt{or} X)   C = Change of just     NA = No Answer   R = Red Chip   Ergend     Answer   R = Red Chip   Ergend     Answer   R = Red Chip   Ergend     E's Request or Question   S's Response   N	Server   Bay B' 2 F12 0250   Stor Time   Stop Time

ha	86	3 Cycle 3 Sheet Of	roparatus	Tape F	001	ag	e	
ouc Ext	er:	Sheet O:  ct A3  imenter B4  C1	2.73	Start	Tir	ıe.		
)bs	er	verB	B', F <sub>12</sub> @150	Stop T	ime	•		
		, c.	, c <sup>*</sup> , ,	Reel_			Side	
			Legend /	Conflict Sym	lod	8		
	ΡV	= No Question E = Expl = No Answer R = Red = Judgement ( or X) W = White	anation ( vor X)	-			gewent	or
	XA	= No Answer R = Red	Chip	explanat	iot	1		
	J	= Judgement ( F or X) W = Whit	ie Cnip	H = numming F = Facial e	**) *	- 6-9	einns	(from.
				looking				(220.2)
_	T	E's Request or Question	S's Respon		1	7	C.H.F.	Chips
STRP	1		Answer (NO, MA or	Verbatim)	X	X	Con-	W, R
6	1				J	E	flict	WW, RE
1	1	Pour F into A <sub>3</sub> and A' <sub>3</sub>		•				
		Do A <sub>3</sub> and A' <sub>3</sub> have same amount?		<del></del>	$\top$			
	1	bo A3 and A 3 have bane another			L	_		
2	1	Pour A <sub>3</sub> →B <sub>4</sub>			1			
	2	Pour A'3 B'1, just so			T			
	: 1							
		same to drink						
3	1	E removes shield			T	Γ		ĺ
_					-	-		
		When S- does it wrong.				1		
		Do we both have the same to						
		drink? You did it like a young child			Ť	1	1	
		didn't you? (W)						
					<del> </del> -	-	<b> </b>	-
	4	Can you tell me what the					1	
		problem is? (W,W)						
								<u> </u>
	5	When juice in A, & A', how			T	Т		
		much did we both have to				1	1	Į
	{	drink? (W)						
		1 212 125-1	<u></u>		+-	+	1	<del>                                     </del>
	6	How much did you think we would both have in B <sub>4</sub> & B' <sub>1</sub>	\$				l	-
							1	
	┦╗	But now you think there is			+-	+-		<u> </u>
		more in B', (W)	,				l	
	1 1	-			+	4-	ļ	<u> </u>
	8	Your problem seems to be						
		that you thought $B_4$ would = $B_1$			-	1		1
		but now you think B', has more						
	1 1	+			+	-		<del>                                     </del>
	9	Now can you tell me what the	-					
		problem is? (W,W)						1
					1	1	<u> </u>	
	ΙO	Let's see if we can find out					1	
		more about this problem						
	1	Te the juice in R and R!			+	Ť	1	1
	+-	Is the juice in B <sub>4</sub> and B' <sub>1</sub>	1				9	
•		different in any way? (W)				ļ	9	
	12	Is there another way the juice			1	1	1	1.
	٢	is different in B <sub>A</sub> and B' <sub>1</sub> ?					100	
	1	(M)				ļ		
	L				╁	+	1	<del> </del>
	13	Do you think that B' has more			}			
		because it is 1 (W)	}				Į.	
	<u> </u>		ļ		+-	+	1	<del></del>
	14	If it has more because it is \tau won't it have less because it is					TATE OF THE PARTY	
		skinnier? (W)				i		
	1		1		1		n	1
	ł				- 1	,		i

***		3 dycle 3 0.ecg2 of 1	Deadet Sassions	. s.e To	۰.		
Sub	18i. 11 a	or cycles a breen of	Anparatus	Jate	ULC	18 e	
EXT	e:	imenter A	3 <sup>A'</sup> 3	Start T	ine	2	
Obs	er	verB	B F @150	Stop Ti Reel	me_		
				Reel		_Side	<del></del>
		Wilder C  - No Question E = Exp - No Answer R = Rec - Judgement ( or X) W = Wilder	12 Legind	Conflict Symb	ols	3	
	ΉQ	- No Question E = Exp	lamation ( or X)	C = Change of	jı	dement	or
	MA	= No Answer R = Rec	i Chip	explanati	,on		
	د	* Judgement ( Y or X) W = WAT	rte Cuip	F = Facial ex	ודמי	essions	(frown.
				looking a	Way	;)	
-	ſ	E's Request or Question	S's Respo	nse	1	C.H.F.	
srep	Ţ		Answer (NQ, NA or	Verbatim)		Con-	
in	*		<u> </u>		ᅪ	ETILCE	WW, RR
3	Ŀ	So its more because its 1 &		·			
-		less because its skinnier? (W)			- 1		
	Ц				+		
	19	But how can it be more and less			ļ		
	1	at the same time?					
		•			$\perp$		
_	17	Maybe the problem is that you				1	
	1	only thought about how high it		-			
		is and you should have thought about both how high and now		l			
		skinny it is. Maybe because		ļ			
		it is higher and skinnier at	1				
		the same time B <sub>4</sub> and B' <sub>1</sub> have	t	ļ			
	1	the same amount. (W) if he	İ			•	
		answers yes.			$\vdash$		<u> </u>
	P٩	Now for two chips can you tell					
	1 1	me what the problem is? (W,W)					1
		(,,,,,,				Ì	
			<u> </u>		$\vdash$		<u> </u>
		Elastic on levels of E <sub>4</sub> & B' <sub>1</sub>			1		<u> </u>
5	1	If $B_4 \rightarrow C_{12}$ and $B'_1 \rightarrow C'_{12}$					
		will C <sub>12</sub> and C' <sub>12</sub> have same or				1	
		more in one?					
		more in one:	·				<u> </u>
6	1	Let B <sub>4</sub> ->C <sub>12</sub> & B' <sub>1</sub> ->C' <sub>12</sub>		•		1	
		7 12 1					
7a	1	S answers right					
	1	Do we have same, or one a lot				1	
		and one a little (R)					
	12	Why? [(R,R) if S refers to both	1			1	
		dimensions of the beakers.					1
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sead	3 Cycle 4 Sheet 1 002	Apparatus	Tape F		-		
ubje	ct		Date Start	Tim	<u>e</u>	····	
	imenter A <sub>3</sub>	A <sup>†</sup> 3	Stop T	ine			
bser	verB,	B 2	Stop T Reel			Side	
	c <sub>1</sub>	2 C':2 F12 @150 Legend /	Conflict Sym				
N.C	* No Question E = Expl	anation ( or X)	C = Change o			genent	or
N'A	= No Question B = Red	Chip	explanat			_	
J	= No Answer R = Red = Judgement ( or X) W = White	e Chip	H = humming			_	
			F = Facial e	xpr	es	sions	(trown,
		Cla Ranas	looking				Chips
<b>.</b> +	E's Request or Question	S's Respor				Con-	
, ,		Auswei (avg.ai oi	701040				WW, RI
1.1	Pour F into A and A'						
اخا	Pour F into A <sub>3</sub> and A' <sub>3</sub>		<del> </del>	+	-		
2	Do A <sub>3</sub> and A' <sub>3</sub> have same amount?						
11							
, ,	Pour A <sub>3</sub> → B <sub>1</sub>			+	-		
2	Pour A' <sub>3</sub> → B' <sub>2</sub>		· · · · · · · · · · · · · · · · · · ·	4-	_		ļ
11	E removes the shield	•			L		
15	Do we both have the same amount					1	1
	to drink?		•	+	-	<del> </del>	
3	You did it like a young child						1
$\bot$	didn't you? (W)			+-	┢	<del>                                     </del>	
4	Can you tell me what the						
$\perp$	problem is? (W,W)			+	$\vdash$	<del>                                     </del>	<b> </b>
5	When juice in A <sub>3</sub> & A' <sub>3</sub> how					1	1
	much did we both have to						1
	drink? (W)			-	╁	<del> </del>	<del> </del>
6	How much did you think we						
1	would both have in B <sub>1</sub> & B' <sub>2</sub> ?	-				Ì	
	(W)			+	+		
7	, · - · <del>-</del>	,				1	
1	more in B <sub>1</sub> (W)			4	$oldsymbol{\perp}$		<del> </del>
8	Your problem seems to be that					-	]
1	you thought B1 would = B'2					1	
	but now you think B' has less					1	1
					+	<del> </del>	+
9	Now can you tell me what the			-		1	
1	problem is? (W,W)					l	
	Let's see if we can find out				Τ	1	
	more about this problem.			ļ			
- 1,	I Is the juice in B, & B'2				T	1	
1						1	
_	different in any way? (W)						+
1	2 Is there another way the juice					-	1
	is different in B <sub>1</sub> & B' <sub>2</sub> ? (W)			ļ			
-17	3 Do you think that B' has less			1	1		
1						9	
	because it is *? (W) 4 If it has less because it is *			十	$\top$	1	
1	won't it have more because it					ì	
	is fatter? (W)					ğ	. 1
				$\dashv$	+	-	
						1	
1						200	1
	1.			ĺ		OS STATE	
1						ģ.	1
1						No.	
					- 1	a de la composição de l	
					}		
				1	}	1	İ
				1		1	1
1		.1		•	١		

		Glass	beaker Sessions							
Pha	188	3 Cycle & Sheet 2 Of 2	Apparatus	Tape Foorage						
Sut	)j€ Nat	rimenter A <sub>3</sub>	A!,	Start	Tim	e				
Obs	er	ver B.	B! F @150	Stop T	ime					
000			B' <sub>2</sub> F <sub>12</sub> @150	Reel		S1de_				
		c <sub>12</sub>	C'12 Leg md	Conflict Sym	bol	s				
	350	12 = No Question E = Expl = No Answer	lenstion ( or X)	C = Change o	f 1	udgewent	or			
	NA	= No Answer / R = Red	Chip	explanat						
	J	= No Answer R = Red = Judgement ( or X) W = Wni	te Chip	H = Humming						
	_	, ,	-	F = Facial e	xpr	essions	(frown,			
				looking	ava	y)				
Q	1	E's Request or Question	S's Respon	nse		C.H.F.				
STEP	.4		Answer (NQ, NA or	verbatim)		X Con-	WW, RR			
"	-				++	BALLEC	11117			
3	归	So its less because its *		•			I			
	11	and its more because it is								
	Ш	fatter? (W)			11					
	μq	But can it be less and more								
		at the same time?			┼-!		<del> </del>			
	17	Maybe the problem is that you								
		only thought about how low it					}			
		is when you should have thought								
		about both how low it is and how					İ			
		fat it is. Maybe because its	}	-			1			
	1	lower and fatter at the same	ĺ			1 1	1			
	1	time B' and B have the same								
	'	amount. [(W) if answer is yes]				<del>                                     </del>				
	118	Now for 2 chips can you tell me					1			
	1	what the problem is? (W,W)				<del>                                     </del>				
4	1	Elastic on levels of B <sub>1</sub> & B' <sub>2</sub>								
	╁	If $B_1 \rightarrow C_{12}$ and $B'_2 \rightarrow C'_{12}$								
J	1		_		1		ŀ			
		will C <sub>12</sub> & C' <sub>12</sub> have same or			1	1 1				
		more in one?			+-	<del>├-<b> </b></del>	<del> </del>			
6	ī	more in one? Let $B_1 \rightarrow C_{12}$ and $B'_2 \rightarrow C'_{12}$					1			
	i i		ļ		+	<del>                                     </del>				
7a	1	S answers right	1		1		1			
		Do we have same, or one a lot					1			
		and one a little (R)				+-1	<del> </del>			
	2	Why? [(R,R) if S refers to			ļ					
	I	both dimensions of the beakers.								
	1						į			
						+1	-			
	Т				1		}			
							1			
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		·	1			1	1			
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	1				1	1				
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			•							

Fhi Sub	ie. Je	3 Cyclas Sneon 3 Of 2	Angereti		Tape E Date	oot	age	
Ext	er	imenter		_	Start			
Obs	er	verE	B'3 F12	@150	Stop T	ime	64.3-	
		•	1,2 C1,2		:reer		Side	
			Legind	/	Conflict Sym	ပ်ဝ1	.3	
	ИQ	# No Question E = Expl	lanation (	Yor X)	C = Change o	ī j	udgewent	or
	NA	■ No Answer R = Red ■ Judgement ( or N) W = Wall	Chip		explanat	ion	,	
	J	= Judgement ( P or R) W = Wall	te Chip		H = humming			16
					F = Facial e looking			(LIOWH,
_	Т	E's Request or Question		S's Respon	10041118	<b>ה</b> ר	VC.H.F.	Chins
ĸ	Ť				Verbatim)		X Con-	
STEP	#						E flict	
		Pour F into A <sub>3</sub> and A' <sub>3</sub>				$\prod$		
			<del></del>	·····		+-1		
	2	Do A <sub>3</sub> and A' <sub>3</sub> have same amount?						ĺ
2	7	Pour A <sub>3</sub> →B <sub>1</sub>	<del></del>			+-		
						+	<del></del>	
	4	Pour A' <sub>3</sub> →B' <sub>3</sub> .						
3	1	E removes shield		•			į	•
_	2	Do we both have the same amount	<del></del>			$\sqcap$	1	
		to drink?			-			
		You did it like a young child					İ	
_	,	didn't you? (W)		·		+		
		Can you tell me what the problem is? (W,W)					1	
	ľ	problem is: (H,H)						ļ
	5	When juice in A3 & A'3 how	<del></del>					
	• •	nuch did we both have to drink?						1
		(W)						
		How much did you think we would						
	١	both have in B, & B',? (W)	-					<b>[</b>
i	1	± ,					1	
_	7	But now you think there is more						
		in B <sub>1</sub> (W)						
		-				-	-	ļ
	8	Your problem seems to be that						1
		you thought B <sub>1</sub> would = B' <sub>3</sub>					1	
	1	but now you think B' has less.						
	ä	Now can you tell me what the	<del></del>			+	<del>- </del>	<del> </del>
	7	problem is? (W,W)					İ	
		proofed to: (win)						
	10	Let's see if we can find out				+-		
	-0	more about this problem	•					
_		·				-	1	-
	••	Is the juice in B <sub>1</sub> & B' <sub>3</sub>					1	
		different in any way? (W)		• •				1
	12	Is there another way the juice						
		is different in $B_1 \& B'_3$ ? (W)					i	
_	1 2	Do you think that 2' has loss				-	<del>                                     </del>	<del>                                     </del>
	ر ـ	Do you think that B' has less						
•		less because it is $\frac{1}{4}$ ? (W)						
	14	If it has less because it is						
		won't it have more because it						-
		is fatter? (W)					200	
						+-	-	1
							1	
į								
							Ř Ř	
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							1	
						1		1
ĺ		-				1	,	1
,		ì	•					

Ph. Su	2.5	e 3 Cycle 5 Sheet 2 Of 2 Glass	Apparatus	Tape Footage	
Op.	pe:	rimenter A <sub>3</sub>	B' <sub>3</sub> F <sub>12</sub> @150	Start Time Stop Time	
	M.		20112	Reel Side  Conflict Symbols  C = Change of judgement or explanation  H = numming  F = Facial expressions (fro looking away)	wn,
9	_	E's Request or Question	S's Respon	se C.H.F. Chi	
STEP	4		Answer (MQ, NA or	Verbatim) X X Con- W,  J E flict WW,	
	15	So its less because its vand its more because it is fatter? (W)			
		But can it be less and more at the same time?			
	1.7	Maybe the problem is that you only thought about how low it is when you should have thought about both how low it is and how fat it is. Maybe because its lower and fatter at the same time B' <sub>3</sub> and B <sub>1</sub> have the same amount. (W) if answer yes			
*******	18	Now for 2 chips can you tell me what the problem is? (W,W)			
		Elastic on levels of B <sub>1</sub> & B' <sub>3</sub>			
		If $B_1 \rightarrow C_{12}$ and $B'_3 \rightarrow C'_{12}$ will $C_{12} \& C'_{12}$ have same or			
ó	1	more in one? Let $B_1 \rightarrow C_{12}$ and $B'_3 \rightarrow C'_{12}$			
78	1	$\frac{S}{Do}$ answers right $\frac{S}{Do}$ we have same, or one a lot and one a little (R)			····
	2	Why? [(R,R) if S refers to both dimensions of the beakers]			
	***************************************				•
				The fact with the first of the fact of the	

	•	3 Cycle 6 Sheet 1 of 2 3 cession	Apparatus	nare_			.e	
			J 7	Start				
050	2 T	ACT	B <sub>1</sub> B' <sub>4</sub> F <sub>12</sub> @150	Stop '	ı ıme	<u>-</u>	Side	
3	OI AF L	* No Question E = Expl * No Answer R = Red * Judgement ( or K) V = White	C12_C1 Legend Lanation ( or X) Chip Le Chip	Conflict Syn C = Change = explana H = humming F = Facial =	nbol of j tion	ls Jud 1	gement sions	or
	7	Man Manual and Occasion	Cla Da	looking		27	CHE	Chips
,	+	E's Kequest or Question	S's Res	or Verbatim)			Con-	
	,†		Miseer (114) IN	or reruerray				WW, RR
T	+			· · · · · · · · · · · · · · · · · · ·	1	-		
.	L	Pour F into A <sub>3</sub> and A' <sub>3</sub>				,		
+	7	Do A <sub>3</sub> and A' <sub>3</sub> have same amount?			<del></del>			
- 1	٦	3 mare same amount.						
2	ᆲ	Pour A <sub>3</sub> →B <sub>1</sub>			$\top$			
1	l	3 <u>1</u>					L	
7	2	Pour A' <sub>3</sub> >B' <sub>4</sub>			T			
		5 4 E removes shield				-	<del> </del>	
1	ᅥ	E Lemokez SHIETG		-	1	į		
+	7	Do we both have the same amount				-	<b></b>	
1	- 1	to drink?				1		
+	_	You did it like a young child			1	Ī		
1	J	didn't you? (W)				L	L	
$\top$	4	Can you tell me what the			1	-		
		problem is? (W,W)						1
					_ _	L	1	
T	5	When juice in A <sub>3</sub> & A' <sub>3</sub> how						]
		much did we both have to drink?			]		1	
	١	(W)			- }	!	j	
$\dashv$	6	How much did you think we would				1	1	
1		both have in B <sub>1</sub> & B' <sub>4</sub> ? (W)				!	•	1
		± 4 · ·				!	į	
+	7	But now you think there is more			+		<b> </b>	<u> </u>
		in B <sub>1</sub> (W)			į		1	1
Ì	-	1 \"/			1		•	ļ
$\dashv$	8	Your problem seems to be that	***************************************		1	Ī		1
İ		you thought B <sub>1</sub> would = B' <sub>4</sub>				i i	j	
Ì	- 1				İ	ļ		
		but now you think B'4 has less.					İ	-
+	9	Now can you tell me what the			+	T	1	
		problem is? (W,W)			j		1	
1							1	
					j	1	}	<u> </u>
-6	LO	Let's see if we can find out			ī	T	\$	
		more about this problem					1	
,	ï	Is the juice in B, & B'			-	+	<del>                                     </del>	<del>                                     </del>
ľ	<b>.</b>	,						1
		different in any way? (W)					1	
+	12	Is there another way the juice			+	+	1	1
	-	is different in B, & B' <sub>4</sub> ?(W)					1	-
						1	1	1
	13	Do you think that B' 4 has less			T	1	1	i
- 1		because it is ? (W)			1		i	
_	_	<u> </u>				+	1	
}	L4	If it has less because it is *					1	
		won't it have more because it					Ì	
- 1		is fatter? (W)					1	
_						1	<b>}</b>	<u> </u>
$\exists$					-		1	1
1							J	
- 1							4	1
-					-		r	
-		·			į		ù	į
1		1			1	1	N	1
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1						;		

пþ	je	3 Cycle & Snear 2 )f 2	Apparatus	Jate		ge	
		imenter A3		Start			
		verB <sub>1</sub>	B' <sub>4</sub> F <sub>12</sub> @150	Stop 1	fime_		
		,	C†	Reel_		Side	
	ok ak L	= No Question E = Expl = No Answer R = Red = Judgement ( or X) W = White	2 C'12 Leg nd Lanation ( or X) Chip te Chip	Conflict Syr C = Change C explanat H = numming F = Facial C	of ju tion expre	agewent ssions	
				looking	away	)	
	1	E's Request or Question	S's Respon				Chips
,	ø		Answer (NQ,NA or	Verbatim)		Con-	
;	<b>#</b> T				JE	flict	WW, RI
	15	and its more because it is fatter (W)					
	16	the same time?					
	יני	Maybe the problem is that you only thought about how low it is when you should have thought about both how low it is and how fat it is. Maybe because its lower and fatter at the same time B' 4 and B, have the				era dela fermana del como del como del como del como del como del como del como del como del como del como del	
	18	same amount. (W) if answer yes Now for 2 chips can you tell me what the problem is? (W,W)			+	-	
	1	Elastic on levels of BliB'4					
	1	If B <sub>1</sub> > C <sub>12</sub> and B' <sub>4</sub> > C' <sub>12</sub> will C <sub>12</sub> & C' <sub>12</sub> have same or	-				
,	1	more in one? Let $B_1 \rightarrow C_{12}$ and $B'_4 \rightarrow C'_{12}$					
'a	1	S answers right. Do we have same, or one a lot and one a little? (R)					
	2	Why? [(R,R) if S refers to both dimensions of the beakers]					
_							
						Arrandom Companyon Companyon	
						W  (14" )	
						Printer on search Personal	
						i Labora, kuur artis, dimattoidiva	4
						Appropriate the second second	
						N. Charles	

	984 2 j c	4 Cycle 1 Sneet 1 072	Apparatus	Tape F	oot	ag	e	
		imenterA	A Profession A Pro	Start	ris	æ		
		ver B	1 B'2 F10@120 forA'1	Stop T	ine	<u>-</u>		
				Reel			Side	
			12 C'12 Legend	Conflict Sym				
		• No Question E = Expl		C = Change of			Semen :	or
	AN L	= No Answer R = Red = Judgsment ( or K) W = Wnit	Chip	explanat:	lor	ì		
	•	- applyming ( ) or my	e outh	F = Facial es	XD I	. 0.5	aions	(from.
				looking	aw ş	y)		
•	+	E's Request or Question	S's Respon	8 <del>6</del>	2	~	C.H.F.	Chips
STEP	4		Answer (NQ, NA or	Verbatim)	Ä	<u>X</u>	Con-	W. E
	ÍΙ	P 20 -12 data 4 120		<del></del>	۲	=	11166	WW, RR
1	-	E pours 80 mls into A <sub>1</sub> and 120						
		mls into A' <sub>1</sub>						
	2	Do these both contain the same						
2	<del>   </del>	amount or one more?		<del></del>	$\vdash$	<u> </u>		
2	11	Let A <sub>1</sub> flow into B <sub>1</sub>						
	2	When we let A' flow into B'.2						
		will we both have the same						
		amount or will one have more?						
3	11	Let A' <sub>1</sub> flow into B' <sub>2</sub>			-	-		
	11				L			
	1				Γ	Г		
en	11	? [If <u>S</u> says yes (R)]			1			
gh <u>t</u>						-		
G	2		· · · · · · · · · · · · · · · · · · ·	··	Γ			
•		more to begin with (R,R)						
40	!-			<del></del>	-	╀		
en	11	Were you right when you said						
•		? Now you've answered		•				
ong		like a young child. Let's			İ		•	
		see if we can find out more about the problem.						
	2	When juice was in A, & A',			$\vdash$	$\vdash$	i	
		did we both have the same		•			l	
		amount? (W)	•					
	3	Why do you think they both			Г	Γ		
		look the same now?						
	4	Is the juice in B', different			+	+	<del>                                     </del>	<del> </del>
		·					1	
							1	
	-	width (W)			+-	+	<del>}</del>	<del> </del>
	]	Is the juice in B' the same		٠				
•		in any way to B <sub>1</sub> ? [i.e. in					Į.	1
	Ļ	height (W)			+	+	}	ļ
	6	1 '					1	
		is wider it makes B <sub>1</sub> and B° <sub>2</sub>						
		look the same amount when					1	
		actually B' has more? (W)					1	
	+			-	+	+	1	
							1	
	1					1		
							No.	
•		T et et et et et et et et et et et et et					1	
						1	d d	
		,				1	N. C. C. C. C. C. C. C. C. C. C. C. C. C.	
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	1						ii It	1
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	l	• .				ł		

<b></b>			Beaker Sessions	m 15 -	مد مد		
Pha Sub		4 Cycle 1 Sheet 2 Of 2	Apparatus	Tape Fo	ot:	age	
	-	imenter	A A'	Start T	im	e	
		ver	B <sub>1</sub> B' <sub>2</sub> F <sub>10</sub> @80	Stop Ti	me		
				Reel_		_Side_	
			C <sub>12</sub> C' <sub>12</sub> F <sub>10</sub> @120 for Legend	Conflict Symb	01	8	
	МQ	= No Question E = Expl	lanation ( or X)	C = Change of			or
	AK	= No Answer / R = Red	Chip	explanati	on		
	J	= Judgement ( or X) W = Wait	e Chip	H = Humming			
				F = Facial ex looking a			(from,
	7	E's Request or Question	S's Raspon			C.H.F.	Chips
STEP	+	D b codotat or decorner.	Answer (NQ, NA or		X	X Con-	W, R
12	0					E flict	
	7	Now for 2 chips can you tell me what the problem is? (W,W)					·
5	1	E marks levels B <sub>1</sub> & B' <sub>2</sub> with			1		
		elastic bands			-	<del>- </del>	
. 6	$^{\mu}$	When we let $B_1 \rightarrow C_{12}$ and $B'_2 \rightarrow$				j	
į		C' <sub>12</sub> will we both have the			1		1
		same amount to drink?					<u> </u>
7a	1	Were you right when you said			ı		1
when		? (R) Good, you answered					1
<u>5</u>		like an older child.	•				
right	5	now for 2 chips can you tell me					
		why you have more? [If S says					
		because he had more in AT or		•			
		B'2 (R,R)					1
71	Ļ	4			Н		<del> </del>
when	1+	Were you right when you said	-				Í
<u>S</u>							
wrong	L				<u> </u>	<b>                                     </b>	ļ
	2	you answered like a younger child, didn't you? If S agreed (W)	,				
-	3	Let's see if we can find out more about this problem					
	4	Were A <sub>1</sub> & A' <sub>2</sub> the same amount			$\vdash$		1
	7	to drink? That's right (W)					
	5	Were B <sub>1</sub> & B' <sub>2</sub> the same amount			[		
		or did one have more to drink?					
	16	[If S says more (W)] Now does C' <sub>12</sub> have the same			Τ	T	
	1	1		•			1
	1	or more than C <sub>12</sub> (W)			1_		
	7	Now for 2 chips can you tell				1	1
		me what an older child would			1		
		have said about how much would					
		be in C <sub>12</sub> & C' <sub>12</sub> when he					
		passed the juice from B <sub>1</sub> & B' <sub>2</sub>					
•							
	+		<del> </del>		+	11-	
	1						
						3	
		-				9	
	1					9	
		<b>.</b>		•			1
	1	-				1 9	
•	1					i	

Sul Sul	388 3 1 c	4 Cycle 2 Sheet 1 Of 2	Apparat	119	Ţ	Mape Foo	tag	3 <b>e</b>	
Ex	ez	imanter A	A'3	@120 for	3	tart Ti	me		
066	<b>301</b>	rverB,	, B', F,	, @120 for	A <sub>a</sub> s	top Tim	e -		
		c.	C	F	¥. F	Reel		Side_	
	OK AK L	Column Co	Legend lanation ( Chip te Chip	or X)	r = rac	rat exb	ret	ssions	or (frown,
	_	His Vagues on Ouganian		el- a	100	king ev	( ترق	) 10 11 7	
STEP	†	E's Request or Question	Answer	S's Respo	Uerharin	<u>, 7   \$</u>		Con-	Chips
h	#		1410001	1.141.01	761001626	$\frac{1}{J}$	E	filer	W, R WH, RR
1	1	E pours 120 ml into A, and 30 ml					†		
-	17	<del>-</del>	į			ļ			
	Ц	into A' <sub>2</sub>					1		
	4	Do these both contain the same	İ			1	Ţ		
2	Н	amount or one more?	ļ		·····		+-	<del> </del>	
-	۱۶	Let A <sub>2</sub> flow into B <sub>2</sub>	<b>{</b>			į			
	2	When we let A'2 flow into B'1					†	<del>                                     </del>	
		will we both have the same						ĺ	
		amount or will one have more?							
3	1	Let A' <sub>2</sub> flow into B' <sub>1</sub>		<del>7 </del>			$\dagger$	<b>†</b>	
48	1	Were you right when you said	<del> </del>	<del></del>			+	<del> </del>	
hen		Were you right when you said ? [If S says yes (R)]				i			
<u>s</u>	}								
g <u>ht</u>	2	Why? [If S says because he had		<del></del>			十		
	_	more to begin with (R,R)							
-,-	니						$\perp$	<u> </u>	
4b en	1	Were you right when you said ? Now you've answered							
en		like a young child. Let's				.			
ong		see if we can find out more		·			ļ	1	
_	-	about the problem.	·		· · · · · · · · · · · · · · · · · · ·		+		
	4	When juice was in A <sub>2</sub> & A' <sub>2</sub>						•	
		did we both have the same							
_	3	amount? (W) Why do you think they both		<del></del>			+	<del> </del>	ļ
		look the same now?				ļ		1	1
	ļ.,						<del> </del> -	ļ	
		Is the juice in B' different				1			1
		in any way from B <sub>2</sub> ? [i.e.,				1			
		skinnier (w)j	ļ		······································		1	<u> </u>	
	5	Is the juice in B' the same in			•	1		į	
		any way to B <sub>2</sub> ? [i.e., in							
		height (W)					$\perp$		
	6	Do you think that because B'1							}
		is skinnier it makes B <sub>2</sub> & B' <sub>1</sub>	i i					Ç.	
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7 Now for 2 chips can you tell me what an older child would have said about how much would be in C <sub>12</sub> & C' <sub>12</sub> when he		į					٦	
what an older child would have said about how much would be in C <sub>12</sub> & C' <sub>12</sub> when he						or more than C <sub>12</sub> (W)		1
what an older child would have said about how much would be in C <sub>12</sub> & C' <sub>12</sub> when he		<b> </b>	+++1			Now for 2 chips can you tell me	7	-1
be in C <sub>12</sub> & C' <sub>12</sub> when he		3				what an older child would		1
passed the juice from 82 & 8.1	l	ē á	1 1				1	Ì
	1					hassed the large thom 85 g.B. I		
	-	1						
	<del></del>	j	+					$\dashv$
Septimination of the septimina	1	g L	1 4					
		and the same of th		ļ				I
7		HI COLOR	altors.					1
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01838	sealer Sessions			
hase 4 Cycle 3 Sheet 1 OF 2	Apparatus	Tape i	foorage	
ubject	A3 A'3	uate		
		Start	Time	
bserver	34 B' <sub>1</sub> F <sub>12</sub> @150 ml.	Stop 7	TimeSide	
	C <sub>12</sub> C' <sub>12</sub>	Reel_	Side_	
	Legend /	Conflict Syn	abols	
NQ = No Question E = Expl	lanatica ( v or X)	C = Change o		t or
NA = No Answer  J = Judgement ( ✓ or X) W = Wnit	Chip	explanat		
J = Judgement ( or X) W = Wait	te Chip	H = humming		
		F = Facial e	expressions	(frown,
		looking	away)	
E's Request or Question	S's Respon	88	C.H.F.	
E's Request or Question	Answer (NQ,MA or	Verbatim)	X X Con-	
7 8			J E flict	WW, RR
1   Pour F into A <sub>3</sub> and A' <sub>3</sub>				1
3 3				1
2 Do A <sub>3</sub> and A' <sub>3</sub> have same amount?			111	
2 1 Pour A <sub>3</sub> →B <sub>4</sub>		<del></del>		<del> </del>
3 , 4				<del> </del>
2 Pour A' → B', just so Same to drink				1
Same to drink				1
a l You did it like a young child				
				1
2 When in A <sub>3</sub> & A' <sub>3</sub> how - did -				1
have - drink? (W)				
1 7				<u> </u>
3 How much did you re A <sub>3</sub> →B <sub>4</sub> ?				
(W)			1   1	}
4 How much did you re A'3→				
1 ;				1
B' <sub>1</sub> ? (W)				
5 If A <sub>3</sub> =A' <sub>3</sub> and all A <sub>3</sub> → B <sub>4</sub> and			+	<del></del>
, , , , , , , , , , , , , , , , , , , ,				1.
only some $A'_3 \rightarrow B'_1$ how can	_		1 1 1	
B <sub>4</sub> =B' <sub>1</sub> ?	_		1 1 1	1
[4 2 1]				1
6 You left some for B', in A'3	:		111.	
				<u> </u>
7 How much would an older child				ł
pour from A' <sub>3</sub> to B' <sub>1</sub> ? (W,W)				
				<del></del>
b l That's right (R)				
2 How can - be same when B			1.	
1 1 + 1			1 1	1
than B <sub>4</sub> ? (R)				
				1
3 Does B'₁=B₄ because 7 and ←→				1
• • • • • • • • • • • • • • • • • • •				
(R)				
4 Can - tell me why B'1*B4				1
when B' 1 7 B <sub>4</sub> (R,R)				
<b>.</b> .				
1 Elastic on levels of B4 and				T
1 t '				
B' <sub>1</sub>				<u> </u>
1 If $B_4 \rightarrow C_{1,2}$ and $B'_1 \rightarrow C'_{1,2}$ will				1
and C! hours come or more			[	1
C <sub>12</sub> and C' <sub>12</sub> have same or more				1
in one			<del>       </del>	
] ]				
1 1			No.	1
1 1			1	
				1
			3	
] [				
• •			1 1 7	1
<b>!</b> ]			1 1 11	

Answer (NQ, MA or Verbatim) X	• 48.6		·······
Answer of the state of the stat	ne_		
Answer   Conflict Symbol  An = No Question   E = Explanation (	9		
## No Answer   R = Red Chip   explanation   for X)   C = Change of J = Judgement ( √or X)   W = Wnite Chip   explanation   H = numning   F = Facial expression   F = Facial e	s	ide	
B's Request or Question  B's Response  Answer (NQ, NA or Verbatim)  Answer (NA)  A	ls		
B's Request or Question  B's Response  Answer (NQ, NA or Verbatim)  Answer (NA)  A	juag	gewen t	or
S's Request or Question   S's Response   Answer (3Q,NA or Verbatim)   X	a		
S's Request or Question   S's Response   Answer (3Q,NA or Verbatim)   X	ragg	itane	(from
B's Request or Question  Answer (NQ,NA or Verbatim)  Answer (NQ,NA or Verbatim)  J  Let B <sub>4</sub> C <sub>12</sub> and B' <sub>1</sub> C' <sub>12</sub> Do we have same, more, less? (R) Why? (R,R)  Do we have same, more, etc?  You answered like a young child (W)  Joid juice in B <sub>4</sub> = B' <sub>1</sub> ? (W)  When B <sub>4</sub> C <sub>12</sub> & B' <sub>1</sub> C' <sub>12</sub> what happened?  Does C' <sub>12</sub> = C <sub>12</sub> ?  Could B <sub>4</sub> = B' <sub>1</sub> then? (W)  What about juice here A' <sub>3</sub> If A' <sub>3</sub> B' <sub>1</sub> and B' <sub>1</sub> C' <sub>12</sub> would C' <sub>12</sub> = C <sub>12</sub> ? (W)  Let A' <sub>3</sub> B' <sub>1</sub> C' <sub>12</sub> The own both have same? (R)  What is the difference between the younger & older girls' way of pouring A <sub>3</sub> B <sub>4</sub> & A' <sub>3</sub> B' <sub>1</sub> ?		2011	(110mm,
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2 Why? (R)  3 What is the difference between the younger & older girls' way of pouring A <sub>3</sub> >> B <sub>4</sub> & A' <sub>3</sub> >> B' <sub>1</sub> ?	++		<del> </del>
3 What is the difference between the younger & older girls' way of pouring A <sub>3</sub> ->B <sub>4</sub> & A' <sub>3</sub> ->B' <sub>1</sub> ?			
3 What is the difference between the younger & older girls' way of pouring A <sub>3</sub> >> B <sub>4</sub> & A' <sub>3</sub> >> B' <sub>1</sub> ?	+-}-		<b></b>
between the younger & older girls' way of pouring $A_3 \rightarrow B_4$ & $A'_3 \rightarrow B'_1$ ?	1		
between the younger & older girls' way of pouring $A_3 \rightarrow B_4$ & $A'_3 \rightarrow B'_1$ ?			1
older girls' way of pouring A <sub>3</sub> B <sub>4</sub> & A' <sub>3</sub> B' <sub>1</sub> ?	11		<del> </del>
pouring A <sub>3</sub> ->B <sub>4</sub> & A' <sub>3</sub> ->B' <sub>1</sub> ?	1		1
			1
(W,W)	1		1
	T		
	1 5		
	25.0		]
	3		
	1		1
	3		
	3		
	1 1		

	Glass	Beaker 8	essions	<b></b>	W			
7h30	5 Cycle 1 Sheet 1 of 2 Glass	Appara	tus	Tape		rge		
Subje	imenter	A <sub>3</sub> A' <sub>3</sub>		Start		e		
			r@ 100 for	A Stop	Time			
		ים ני	78 200 for	A' Reel_		S	ide	
		Legen	F@ 2000 for	Conflict Sy	mbol:	8		
NQ	= No Question E = Expl	snation	( * or X)	C = Change			ewen t	or
MA	= No Answer R = Red			explana				
. 3	= Judgement ( or E) W = Wnit	a chip		H = numing F = Facial		201	ions	(from.
				looking	EWA	y)		
. 1	E's Request or Question		S's Respon	ប្រធន	100	1	.H.F.	Chips
2 2		Answe	or (NO.NA or	Verbetim)				W, R
50					-121	R I	Tict	w, R
1	E pours 100 ml into A3 and 400						1	
	ml into A'a						1	
	3					+		
<u>b</u>	Do these both contain the same							ĺ
	amount or does one have more?					$\perp$		
2 1	Let A <sub>3</sub> →B <sub>3</sub>							ł
2	When we let A'3 78'3 will we		***************************************			$\sqcap$		
	both have the same amount or					. 1		1
	will one have more? [(R) when							1
1.	rightJ					$\Box$		
3,	Which one?							1
<del>,  ,</del>	7.00 A1 -> B1	<del> </del>			-+	Н		<del> </del>
1	Let A'3→B'3					H		<del>                                     </del>
4 1	Were you right when you said ——? [(R)when right]							
2	Why? [(R) if S says "Because						:	
}	they were more up above"and	-					i	[
1	(RR) if he says B' <sub>3</sub> is higher							
	than B3	1			1		İ	
5 1	Is the juice in B'3 different	1			$\neg$	$\Box$		1
- 1	in any way from the juice in B3	3						1
1		,					Í	1
٠,	Is it higher? [(R) if right on4. If not (W)]	7			- 1			<b>I</b>
- 2	Is juice in B', the same in any	1			$\neg \top$	П		T
	way as B <sub>3</sub> ? Is it just as fat?				1			1
	·							1
	[(R) or (W)] Do you think that because the	<del> </del>			-	+		1
۲	Juice is higher in B'3 than in							
	B <sub>3</sub> but just as fat as B <sub>3</sub> that	1					1	
							3	
	this is why B' <sub>3</sub> has more? [(R) or (W)]	1						
	Now can you tell me why B' has					T		
	more than B <sub>3</sub> ? [(RR) or (WW)]						l	
	3. 5					1	1	
1							1	1
		l					1	
1								1
			•				1	
- 1					1	1		
- 1						į	4	1
							200	
ļ							3	
1					1		Ž,	
1					1	-	ő	1
ļ	·				1	Ì		
T	1	l			-1		9	1
- 1	3	- (			1	•	8	3
			•				Ą	

Phi Jul	asa bje	act Sheet 2 Of 2	Apparatus	Tape Date	Poot	age	
		imenter	A <sub>3</sub> A' <sub>3</sub>	Start	Tin	16	
0be	<b>206</b>	AGE	B3 B'3 F@ 100 for	A Stop	Time	:	<del></del>
						Sid	e
			C <sub>12</sub> C' <sub>12</sub> F6 200 for . Legend	Conflict Sy	mbo?	. 2	
	MQ	= No Question E = Exp	lamation ( wor X)	C = Change			ant or
	NA	R = Red = Judgement ( or X) W = Wni	Chip	explana			
	J	= Judgement ( / or X) W = Wni	ta Chip	H = nemming			
				F = Facial	expi	essio	ns (frown,
	_		<del>, , , , , , , , , , , , , , , , , , , </del>	looking			·····
2	+	E's Maquest or Question		nga			.F. Chips
STEP	at		Answer (NQ, NA or	Verbetim)			- W. R
<u>·</u>	M				ᆛᅬ	RETT	ct WW, RR
6	1	If we let $B_3 \rightarrow C_{12}$ and $B'_3 \rightarrow C'_{12}$				į	
						1	
	1	will we both have the same or will one have more? (R)				1	- 1
_	12	Tet B > C and B' > C'					
	口	Let $B_3 \rightarrow C_{12}$ and $B'_3 \rightarrow C'_{12}$			$\perp \perp \perp$		
7	1	Were you right when you					
_	니	said? (R)			$\bot$		
	2	Why? [(R) if he says "Because				1	
		there was more in B'3"(RR) if					
		he says "Because C' <sub>12</sub> is				.	1
		<del></del> -					
_	Ц	higher than C <sub>12</sub> but just as fat			44		
3	1	Is the juice in C' <sub>12</sub> different					
		in any way from C12? Is it				- 1	1
						1	
		higher? [(R) if right on 7.1			11	- [	ł
-	1,1	If not (W)]	<del> </del>	· · · · · · · · · · · · · · · · · · ·	<del>- - </del>	-1	
1	[4]	Is the juice in C' <sub>12</sub> the same				1	1
1		in any way as C <sub>12</sub> ? Is it	•			1	t
		just as fat? [(R) or (W)]				1	
7	3	Do you think that because the			$\top$	1	
- 1		juice is higher in C'12 than				}	1
						1	
1		in C <sub>12</sub> but just as fat as C <sub>12</sub>				l	1
-		that this is why C' <sub>12</sub> has			•	1	
Į		more? [(R) or (W)]					1
	4				77	1	
- 1							
Ì		has more than C <sub>12</sub> ? [(RR) or				1	
		(HW)					
						1	1
							1
1			·			Š	
-					j	}	1
į							1
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-						1	
1						id id	
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١						3	]
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J							1
- 1							[
•		•					
		<u>'</u>				1	1

;	Pha Sul	age oje	5 Cycle 2 Sheet 1 Of 2		Apparatus A' F <sub>10</sub> @80		Tape Fo				-
	Ope Ext	er	Ver	В,	B' F10@120 forA',	•	Start Stop To	lui	a -		
		ok ak L	= No Question E = Ex = No Answer R = Rec = Judgement ( or X) W = Wat	pla d C ite	2 C'12 Legend nation ( for X) hip Chip	C = Ci 83 H = ht		f ; io: kp:	jud n	sions	or (frown,
_	0	I	E's Request or Question	n	S's Respon	90		0		C.H.F.	Chips
	STEP	.1		T	Answer (NQ, NA or	Verbat:	m)	X	X	Con-	W, R
-	n	#		+				J	E	flict	WW, RR
	1	1	E pours 80 mls into A <sub>1</sub> and 120 mls into A' <sub>1</sub>	)							
		2	Do these both contain the same amount or one more?				· · · · · · · · · · · · · · · · · · ·	-			· · · · · · · · · · · · · · · · · · ·
	2		Let A <sub>1</sub> flow into B <sub>1</sub>								
		2	When we let A' <sub>1</sub> flow into B' <sub>2</sub> will we both have the same amount or will one have more?								
	3	1	Let A' <sub>1</sub> flow into B' <sub>2</sub>	+				-			
when	ıļ	1	Were you right when you said ? [If S says yes (R)]				; ;				
<u>S</u> righ	t	2	Why? [If S says because he ha more to begin with (R,R)]	d		>			·		
when S		1	Were you right when you said ? Now you've answered								
wron	g		like a young child. Let's see if we can find out more about the problem.		·						
			When juice was in A <sub>1</sub> & A' <sub>1</sub> did we both have the same amount? (W)								
		3	Why do you think they both look the same now?								
•		4	Is the juice in B' <sub>2</sub> different in any way from B <sub>1</sub> ? [i.e., width (W)]								
		5	Is the juice in $B'_2$ the same in any way to $B_1$ ? [i.e. in height (W)]								
٠		6	Do you think that because B' <sub>2</sub> is wider it makes B <sub>1</sub> and B' <sub>2</sub> look the same amount when actually B' <sub>2</sub> has more? (W)								

90.4		5 card 2 cm	Beaker Sessions			
		5 Cycle 2 Sheet 2 Of 2	Apparatus		tage	
	-	int	<sup>A</sup> 3 <sup>A'</sup> 3	Date	70	
		AST.	B <sub>1</sub> B 2 F <sub>10</sub> @80	Stop Time		
		***************************************	B <sub>1</sub> B' <sub>2</sub> F <sub>10</sub> @80	W	0/1	***************************************
			C <sub>12</sub> C' <sub>12</sub> F <sub>10</sub> @120 for Legend	A' 1		
	320	= No Question E = Expl	lanation ( or X)	C m Change of	18 1d.co	
		. w No Answer R = Red	Chin	C = Change of ; explanation		or
	3	= No Answer R = Red = Judgement ( or X) W = White	te Chip	H = Humming		
	_	· · · · · · · · · · · · · · · · · · ·	- Cul-F	F = Facial exp	ressions	(from.
				looking awa		
- a	1	E's Request or Question	S's Respons	10 d	VC.H.F.	Chips
STEP	1		Answer (NQ, NA or N			W, R
69				J	E flict	WW, RE
	7	Now for 2 chips can you tell				
		me what the problem is? (W,W)				
5	u	E marks levels B, & B', with				
	1 5	± -			<b> </b>	
6	1	elastic bands When we let $B_1 \rightarrow C_{12}$ and $B'_2 \rightarrow$				
_	1 1					
		C* 12 will we both have the				
	Ц	same amount to drink?			$\sqcup$	
	2 9	Were you right when you said		1		
when		? (R) Good, you answered			1 1	
<u> </u>		like an older child.				
right		now for 2 chips can you tell me			<del>                                     </del>	
		why you have more? If S says				
	1	because he had more in A', or				
		•				
		B' <sub>2</sub> (R,R)				
	1.1:	Were you right when you said	•			
when		2		ĺ		
<u>s</u>	1					
wrong		was analysis of little a second			1-1	
	1	you answered like a younger child, didn't you? If S agrees			j	
	1	(w)]				
	1		<del></del>		<del></del>	
	3	Let's see if we can find out				
	L	more about this problem				
	4	Were A, & A', the same amount		)		
		to drink? That's right (W)			1 1	
	╁	*				
	13	Were B <sub>1</sub> & B' <sub>2</sub> the same amount				
		or did one have more to drink?				1
	Ļ	[If S says more (W)] Now does C' <sub>12</sub> have the same	<u> </u>		+	<b> </b>
	6	Now does C' <sub>12</sub> have the same				
		or more than C <sub>12</sub> (W)				
		ř			11	ļ
	17	Now for 2 chips can you tell				1
		me what an older child would		Ì		
	1	have said about how much would				1
		be in C <sub>12</sub> & C' <sub>12</sub> when he				}
		passed the juice from $B_1$ & $B'_2$				
			•			İ
	T					
		No.	}			-
			1			
	1				1 3	1
	1			•	1	
		¥		-		1
		<b>}</b> .		•	1	1
	1	1			1	
		•		T. ST.	1	1
•			1	1		,
	-		+			

hase	e 5 Cycle 3 Sheet 1 02 1	Apparatus	Tape Foo		<u> </u>	
	rimencer A3 rver B3	A' 3	Start T	ime		
	rver B <sub>3</sub>	B', F, 20250	Stop Ti	ne		
		ئے د ام	Reel		Side	
N	Q = No Question E = Expl. A = No Answer R = Red J = Judgement ( vor X) W = Wnit	12 Cill Legend anation ( vor X) Chip e Chip	Conflict Symbol C = Change of explanati H = Humming F = Facial explosing as	jud on pres	sions	
	Nie Sterner in Breakfarl	Cla Barra	TOOKING A	7 7	C U E	Chips
	E's Request or Question	E's Respor	Vanhandan		Con	W, R
		Answer (NQ, NA or	verbatin)		£1:01	WW, RR
				-   -	11766	ww, na
.   1	Pour F in A <sub>3</sub> and A' <sub>3</sub>					
2 1	Do A <sub>3</sub> & A' <sub>3</sub> have the same amount?		į			
	If A3 B3 and A'3 B'3 will					
			į			
- 1	B <sub>3</sub> & B' <sub>3</sub> have same amount? (R)					
12	Why? (R,R)		1			
1	1		1			
$\bot$						<del></del>
4 1	S lets A3 B'3 and A'3 B'3					
- 1						
•	Does B <sub>3</sub> = B' <sub>3</sub> or does one have		1		1	
	more? (R) Why? (R,R)					
2	Why? (R,R)		í	1		
			!			
٠,	175 P 30 and Pl 30! :::11			-		<u> </u>
	If $B_3 \rightarrow C_{12}$ and $B'_3 \rightarrow C'_{11}$ will			-1		
- 1	C <sub>12</sub> and C' <sub>11</sub> have same amount?					İ
- 1	(R)	-				<u> </u>
12	Why? (R,R)					
			,			1
						ļ
7 1	$\underline{S}$ lets $\underline{B}_3 \rightarrow \underline{C}_{12}$ and $\underline{B}'_3 \rightarrow \underline{C}'_{11}$					
82 1	Does C <sub>12</sub> = C' <sub>11</sub> or does one have					
	1			-		
	more and one less? (R)			-		<del> </del>
12	2 Why? (R,R)					
- 1						
٠+,	like a young child			-		
p ] ]	You answered like a young child didn't you? (W)				1	1
er	drain e your (n.				i	
ng						
1 2	Can you tell me what the				}	
	problem is? (W,W)				1	1
4					}	<del> </del>
3	When juice was in B3 and B'3			İ	}	1
	did we both have the same?	•		}	•	1
$\perp$	That's right (W)				<del> </del>	
	4 Did we let all the juice out of				l	
1	B <sub>3</sub> and B' <sub>3</sub> ? That's right (W)					<del>  ·</del>
	5 Now if B3=B'3 and we let all the				1	
	juice out of B3 and B'3 won't				ş	
-1	1 - 1					1
	C <sub>12</sub> and C' <sub>11</sub> have the same				]	
	amount?			$\vdash \bot$	<b>!</b>	<u> </u>
T	6 Now for two chips, can you tell				1	
	me what the problem is? (W,W)				1	1
						1
+					ĝ	1
	,				100	
					B	
į					1	1
	}			1 1		,

,	se <sup>5</sup> Cycle <sup>4</sup> Sheet <sup>1</sup> Of <sup>4</sup>	Beaker Sessions		
Pha	ie 5 Cycle 4 Sheet 1 Of 4	Apparatua	Tape Footag	<u></u>
Sub	erimenter A3	Apparatua A 3	Date	
Ops		B' <sub>1</sub> F <sub>10</sub> @125		
• • • • • • • • • • • • • • • • • • • •	-2	- 1 -10	Stop Time Reel	51de
	•	C'8 Legend	Conflict Symbols	
•	NQ = No Question E = Exp	lanstion ( v or X)	C = Change of jud	gement or.
	iA = do Answer R = Red J = Judgement ( or X) W = Whi	Chip	explanation	
	J = Judgement ( ✓ or X) W = Wni	ite Chip	H * Humming	-1/5
			P - Parial expres looking away)	alona (Irown,
	E's Request or Question	5's Respon		C.H.F. Chips
SYEP		Answer (10, NA or	Verbatim)   X   X	Con- W, R
Š			JE	flict WW, RR
1	Pour F in A3 and A'3			
2	Do A3 and A'3 have same amount?			
3	If $A_3 \rightarrow B_2$ and $A'_3 \rightarrow B'_1$ will			
	B <sub>2</sub> and B' <sub>1</sub> have same amount?(R)			
	Why? (RR)			
	ł			
4	Pour A <sub>3</sub> →B <sub>2</sub>			
	Pour A'3 B'1, just so			
	Same to drink			
	I That's right (R)			
II IIXIL	2 How can - be same when B'17			
	than B <sub>2</sub> ? (R)			
,	3 Does B'1" B2 because 7 and (-)(F	<u></u>		
Go to	4 Can - teli me why $B'_1 = B_2$	•		
5b 14	when B'1 B2 (RR)			
5b	1 You did it like a young child			
If wrong	2 What about the juice up here?			
	You left some of the juice for			
	B' up here. Does B' really			
	B or is it less? [(W) if			
	S says no			
	3 Can you tell me what the			
	problem is? Why did you miss			
	a chip when you were deciding			
	about how much would be in			
	B <sub>2</sub> and B' <sub>1</sub> ? (W)			1
	4 When in A <sub>3</sub> and A' <sub>3</sub> how - did -			and the state of t
	have drink? (W)  5 How much did you re A <sub>3</sub> > B 2			
	(w)			***************************************
	6 How much did you re A'3→B'	1?		DVE
	(W)			-
	(W) $7 \text{ If } A_3 = A_3 \text{ and all } A_3 \rightarrow B_2 \text{ and}$			n va
	only some A'3>B'1 how can		! !	19. Tal
	B <sub>2</sub> = B' <sub>1</sub> ?			
			1	1
			2	THE CO. LEWIS CO
				100
• .			{	3 1

Exper	s 5 Cycle 4 Sheet 2 Of 4 set A3	A Apparatus A 1 B' F 0125	Tape Pootage Date Start Time				
NQ = No Question E = Expl NA = No Answer R = Red J = Judgement ( or X) W = White		Legend lanation ( or X) Chip te Chip	Stop Time Reel Side  Conflict Symbols  C = Change of judgement or explanation  H = Humming F = Facial expressions (frown looking away)				
<u>e</u> †	E's Request or Question	S's Respo	nse Verbatin)	100	Y	C.H.F. Con-	Chips W. R
STEP		ALLEWEL (MY)-UN OI	VELDECIM				WW, R
8	You left some for B', in A',			П			
	How much would an older child pour from A'3 to B'1? (WW)			<del> </del>	-		
1d	Would older child be right? (W)			T			
( (	Should we let all A'3 B'1? (W)			+	-		<del> </del>
	Now do B <sub>2</sub> and B', have the			+	┝		
,,	same to drink or does one have more? [(W) if right. If wrong, you answered like a younger child and missed a chip"] Let's see if we can find out						
	more about this problem.			1	<u> </u>		
P.4	Is the juice in B <sub>2</sub> and B' <sub>1</sub> different in any way? ((W) or			-	-		
15	(R) Is there another way the juice is different in B <sub>2</sub> and B' <sub>1</sub> ?	-			-		
	[(W) or (R)]			- -	-	ļ	<del> </del>
10	Do you think that B <sub>2</sub> and B' <sub>1</sub> have the same because A <sub>3</sub> and A' <sub>3</sub>				-		
	had the same and B' <sub>1</sub> is taller and skinnier than B <sub>2</sub> ? [(W)or(R)]						
1.7	Now can you tell me why we know that B <sub>2</sub> and B', have the				1		
	same to drink? [(R) if he says same above and (RR) if he gives				-	All a control of the	
6 1	compensation rule.]  If $B_2 \rightarrow C_9$ and $B_1 \rightarrow C_8$ will			$\dagger$	t	1	1
	C <sub>9</sub> and C' <sub>8</sub> have same amount?(R)						
	Why? (RR)			+	+		<del> </del>
-							
- 12	S late 8 20 and B! 20!			+	+	}	
7- 1-	S lets $B_2 \Rightarrow C_9$ and $B'_1 \rightarrow C'_8$			+	+	-	
7a   1 ight	That's right (R)					and Table	
2	How can - be same when C's			T	T	1	
	than Cq? (R)			1		a de la composition della composition della comp	
	Does C' <sub>8</sub> = C <sub>y</sub> because ∧ and ↔(R)			+	+	}	1
	8 9			_ _	-	ļ	<u> </u>
				İ		ACTION CO.	
						Version 1	
					1	Ž.	
1				İ		N. S. S. S. S. S. S. S. S. S. S. S. S. S.	
- 1							
						i i	1

	Obs	er	verB	3 A'1 2 B'1 F <sub>10</sub> @125 2 C'a	Tape Foo Date Start Ti Stop Tim Reel	e		
		ok An L	= No Question E = Expl = No Answer R = Red = Judgement ( or K) W = Wnit	Legend Anation ( for X) Chip Le Chip	Conflict Symbo C = Change of explanatio H = Humming F = Facial exp looking as	jud n res	sions	
	_	1	E's Request or Question	S's Respon	nse e	V	C.H.F.	Chips
	STEP	Ţ		Answer (NQ,NA or	Verbatim) X	X	Con-	W. R
Go 7b	to		Can - tell me why C' <sub>8</sub> = C <sub>9</sub> when C' <sub>8</sub> T C <sub>9</sub> (RR)			-	11160	WW, RR
	7ь		You did it like a young child			+		
£ wi	gao	^	Tou did it like a young child					
			What about the juice up here? You left some of the juice for C' <sub>8</sub> up here. Does C' <sub>3</sub> really • C <sub>9</sub> or is it less? ((W) if S says no)					
			Can you tell me what the problem is? Why did you miss a chip when you were deciding about how much would be in C <sub>9</sub> and C' <sub>8</sub> ? (W)					
•		4	When in A3 and A'3 how - did -				•	
		L	have drink? (W) How much did you re A 3 C9		<u> </u>	- -	<del> </del>	
		3	How much did you re A 3 Co			1		
		1	How much did you re A' <sub>3</sub> ->C' <sub>8</sub> ?					
		7	If $A_3 = A'_3$ and all $A_3 \rightarrow C_9$ and only some $A'_3 \rightarrow C'_8$ how can $C_9 = C'_8$ ?				ed to action and the	
		8	You left some for C'g in A'3			T	•	
			How much would an older child bour from A' <sub>3</sub> to C' <sub>8</sub> ? (WW)					
		10	Would older child be right? (W)				<del>-</del>	-
			Should we let all A'3->3'8' (W)			+	1	<u> </u>
		1	same to drink or does one have more? [(W) if right. If wrong "you answered like a younger child and missed a chip"]					
		1	Let's see if we can find out				ì	
		+	more about this problem.			+	1	
							A TOTAL SECTION OF THE PROPERTY OF THE PROPERT	
•	•	***************************************	1		!	ļ	1	1

Subje	5 Cycle 4 Sheet 4 Of 4	Appara	LUB	Tape Uate			
ixper	imenter A3	A' <sub>1</sub>		Star	Tim	e	
	verB <sub>2</sub>	В', Г	10 @125	Stop	Time	Side	
	C.	C'-		Reel		Side	
	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	C' 8	1	Conflict Sy	yabo1	B	
МО	■ No Question E = Exp.	Lanation	( or X)	C = Change			nt or
NA	= No Answer / R = Red	Chip		explan	_		
ز	= No Answer R = Red = Judgement ( or X) W = Wni:	te Chip		H = Hummin			
		•		F = Facial	expr		s (frown
				lookin	B BWE	y)	
	E's Request or Question		S's Ras	ponse	1	VC.H.	F. Chips
325		Answ	er (NQ,MA c	or Verbatim)	X	X Con-	W. R
G 0					J	E flic	t WW. R
	*- *b- 11 in C and C!	ļ -			- 1 1	İ	1
14	.Is the juice in Cg and C'8	1				1	1
- 11	different in any way? (W) or				11	1	
	(R)]						
15	Is there another way the juice					-	
	is different in C <sub>9</sub> and C' <sub>8</sub> ?					- 1	
	[(W) or (R)]	1					L
16	Do you think that C9 and C'8					1	
		1				1	
	have the same because A3 and A13	*				1	
	had the same and C's is taller						1
]	and skinnier than $C_9$ ? [(W)or(R)]	İ			1		
	and skinnier than og. [[","ork,"]					<del></del>	
1.7	Now can you tell me why we					1	
ı	know that C <sub>9</sub> and C' <sub>8</sub> have the	1					1 1
	same to drink? (R) if he says						
	same above and (RR) if he gives						
	compensation rule.						
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Phase 5 Cycle 5 repeats Phase 5 Cycle 2.

Phase 5 Cycle 6 repeats Phase 5 Cycle 4 with different apparatus.

Phase 5 Cycle 7 repeats Phase 5 Cycle 2.

Phe Sub		6 Cycle 1 Cheet 1 Of 3	,,eab L	Appa				Tape Date		34	<u></u>		
EXP	er	imenter		3 3 Start Time									
Observer													
				c' <sub>5</sub>									
				1.000	nd	,	Con	flict Sy	nabol	.8			
	NO	= No Question E =	Expla	matio	n (	vor X)	C =	Change			gewent	or	
								explana			•		
	J	= No Answer R = Judgement ( or X) W =	• White	a Chip				humming			3 -		
							Ъ m	Facial			sions	(frown,	
					-,			looking	AWS	ΥZ		(A) /	
9	+	E's Request or Ques	tion	A		S's Resp	onse	a t t = 1	- 5	Ÿ	C.H.F.	Chips W, R	
ķ	<u>"</u>			Ans	wer	(AQ, MA c	or verb	at im)				WW, RR	
7	<del>,  </del>	Dour P in A and A'							-15	Н	11100	WW. 144	
	۲	Pour F in A <sub>3</sub> and A' <sub>3</sub>							_				
2	1 - 1	20 A3 and A 3 nave bane and	nt?										
3	1	If A B and A' B' will											
		B <sub>3</sub> and A' <sub>2</sub> have same amount?	(8)										
	1	by and h 2 have been amount	```										
	2	Why? (R,R,)										·	
			1						ı				
						<del></del>							
4		Pour A <sub>3</sub> → B <sub>3</sub>	1										
	2	Pour A' 3 B'2, just so				·····							
	1 1	·	1						- }				
5 3	-	Same to drink You did it like a young chil	<del>a  </del>						$\dashv$				
Ja		iod did in iine a joung onei	-										
	2	When in $A_3$ and $A_3$ how - did	-										
	•											Ì	
	1	have drink? (W) How much did you re A <sub>3</sub> -> B	2(W)							+-			
•	1	now mach and you is ing / 2	3. ("/						- 1				
	4	How much did you re $A'_3$	B' 2?		-					1			
	1	(W)	- 1							1_			
	5	If $A_3 = A_3$ and all $A_3 \rightarrow B_3$ and	l [				•				Ì		
	•	only some A' 3 B' 2 how can	1							İ	i		
	1	1 -	-					•					
		B3 <sup>=B</sup> '2 <sup>?</sup>							_	1_	ļ	ļ	
	6	You left some for B' in A'	. 1										
_	7	How much would an older chil	.d							Т			
		pour from A'3 to B'2? (W,W)	Ì										
	Į									4-	<b>}</b>		
5b	1	That's right. (R)								1		1	
	2	How can - be same when B'	1								į		
		than B <sub>3</sub> ? (R)									ĺ		
		, ,								+-	<del>}</del>	<del> </del>	
	13	Does B'2= B3 because A and	(R)								1	1	
	1	Can - tell me why B'2= B3								$\dagger$	1		
	1	1 7									1		
		when B'2 A B3? (R,R)									1		
6	+,	TERAC and RIACI will							$\dashv$	十	1	<del> </del>	
٥	1	If $B_3 \rightarrow C_7$ and $B'_2 \rightarrow C'_5$ will									1	İ	
		C7 and C'5 have same amount	:? (R)						l		l	1	
	12	Why? (R,R)								Т			
			l								1		
	$\perp$									-	<b>!</b>	<del> </del>	
7	1	$S$ lets $B_3 > C_7$ and $B' > C'_5$	ĺ								1		
										$\perp$	<u> </u>	ļ	
	T								1		5		
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Pha	se	6 Cycle 1 Sheet 2 Of 3 Glace	Beaker Sessions	Tape P	aot	15.21	e.		
Sub	je	ct	A <sub>3</sub> A 3	Date					
Exp	er	imenter		Start Time					
ರಿಶಿಕ	er	ver	B <sub>3</sub> B' <sub>2</sub> F <sub>10</sub> @250 ml	Stop T Reel	lme	·			
			c <sub>7</sub> c' <sub>5</sub>	Reel			Side_		
			7 5	Conflict Sym	hal	٥			
	מזר	• No Question E = Expl	Legend ( ) or Y)	C = Change o			COMPT	07	
	11 V	= No Answer / R = Red	Chin	explanat			Semente	••	
	'nΛ	= No Answer R = Red = Judgement ( or X) W = White	curb	H = Humming	101	1			
	J	= 2008 Sment ( A of v) M - Mitt	re curb	F = Facial e			-1-000	/from	
				looking	AP 4	)	STONS	(LIUWIL)	
. —	<del>-</del>	No. 1	al- n-		77	2.4	CUP	Chips	
ď.	+	E's Request or Question	S's Respon	Nambanday)					
STEP	+		Answer (NQ, NA or	verbatim/			Con-	WW, RR	
-11	7				13	-	LIICL	MM, KK	
8a	1	Does C <sub>7</sub> = C' <sub>5</sub> or does one have							
	11	more and one less? (R)							
	Ш				4	_	ļ		
	2	Why? (R,R)							
					4			ļ	
86	11	You answered like a young child			1	1	į		
f		didn't you? (W)			1		1		
nswer	1				1	1			
rong	Ш				+		<del> </del>		
	2	Can you tell me what the problem	Ì		1		1	1	
,		is? (W,W)	1			1	ļ	1	
	Ļ		<u> </u>		+-	+-	<del> </del>	<del> </del>	
	31	When juice was in B3 and B12	j			1	1	1	
		did we both have the same?					ļ		
		That's right. (w)					Í		
	4	Did we let all the juice out of	1		Т	T			
	П	B, and B'2? That's right. (W)	1				l	İ	
•	П	3 2				1	l		
	15	Now if $B_3 = B'_2$ and we let all	-		T	Π		}	
			į	•		1	ļ	]	
		the juice out of B <sub>3</sub> and B' <sub>2</sub>					į	ł	
		won't C <sub>7</sub> and C' <sub>5</sub> have the same	1	•	1		1	1	
		, =			-		1		
	1	amount?	ļ		+-	╁╌	<del>                                     </del>	<del> </del>	
	6	Now for two chips, can you tell					1	1	
		me what the problem is? (W,W)					1	1	
	<del>  -</del>	tall as and again do			+-	+	1	<del>                                     </del>	
9	1	Can you tell me once again, do					1		
	1	C <sub>7</sub> and C' <sub>5</sub> have the same amount				1	1	}	
	1_	to drink? (W)				1	<del> </del>	<u> </u>	
	2	Why? (W,W)					Ì		
	ļ				1		ì	1	
	1		<u> </u>		_	4	!	-	
.s.10	q 1	But look at how high the juice				Ì	i	1	
		is in C'5. Doesn't that make it				ĺ	į	1	
		more? (R) if S says no	1				}	İ	
	1	Why? (R,R)	}			-	1		
	1					1	1	1	
	1				_	_1	1		
	13	If S says yes. You answered like			T	Ī			
	1	a young child. Can you tall me	1		ļ		1		
	1	what an older child would have					Ì		
		said? [(R,R) if S can answer					Ĭ		
		correctly.J	1			$\perp$	1		
	1	1			T	T			
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	1		<u> </u>		$\perp$	$\perp$	1		
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Phas	se 6 Cycle 1 Sheet 3 Of 3	Apporatus	Tapa	Footage						
	erimenter	A <sub>3</sub> A' <sub>3</sub>	uate_	Date						
	erver		O ml Start	Time	<del></del>					
		B <sub>3</sub> B' <sub>2</sub> F <sub>10</sub> <sup>025</sup>	Real	TimeSide						
		c <sub>7</sub> c' <sub>5</sub>		2106						
ï	IQ = No Question E = Exp	Legend	Conflict Sy	niols						
ì	NA = No Answer R = Red	Chin	explana	or judgement	or					
	VA = No Answer R = Red J = Judgement ( or X) W = Wni	te Chip	H = Humming	CION						
		•	F = Facial	expressions	(from					
			looking	away)						
STEP	E's Request or Question		ponse	C.H.F.	Chips					
7 4		Answer (10, NA	or Verbatim)	X X Con-	W. R					
- 1				J E flict	WW, RR					
10 3	If not									
	Let's see if we can find out what the problem is.									
-14	Did A <sub>3</sub> and A' <sub>3</sub> have the same	<del> </del>		++-						
	amount? (W) 5 When $A_3 \rightarrow B_3$ and $A'_3 \rightarrow B'_2$ did									
- 1	mien A3 × B3 and A 3 × B 2 and									
	B <sub>3</sub> and B' <sub>2</sub> have the same amount?									
- 1	(W)									
10	$\begin{array}{cccccccccccccccccccccccccccccccccccc$			<del>                                      </del>						
1	and B'2 C'5 would C7 and C'5									
- 1										
	have the same amount? (W)  Does the fact that C' is higher									
- 1										
1	really make it more than C7? (W)									
	Why not? (W,W)									
			•	1 1 1						
$\perp$			,							
١٤	But someone else told me that	•		1						
- 1	C' <sub>5</sub> had more than C <sub>7</sub> because it									
	was higher. Were they right or	,								
- 1	wrong? [(R) if S says wrong]	-								
- 1	Why? (R,R)		•							
- 1										
- 1 9	If S says yes. You answered like			<del> - -  </del>	· <del> · · · · · · · · · · · · · · · · ·</del>					
	a young child. Can you tell me									
	what an older child would have									
	said? (R,R) if S can answer									
	correctly.									
10	If not									
	Let's see if we can find out									
11	what the problem is. Did A <sub>3</sub> and A' <sub>3</sub> have the same			<del>                                      </del>						
-	amount? (W) When A <sub>3</sub> B <sub>3</sub> and A' <sub>3</sub> B' <sub>2</sub> did									
μ2										
	B <sub>3</sub> and B' <sub>2</sub> have the same amount?									
1										
13	If B <sub>3</sub> =B' <sub>2</sub> then when B <sub>3</sub> C <sub>7</sub>			<del>    <b> </b> -   -  </del>						
	and Ri Cl rould C and Ci									
ı	2 5 ***********************************									
<del></del> ,	have the same amount? (W)  Does the fact that C' <sub>5</sub> is higher									
μ4	•									
1	really make it more than C,? (W)									
	Why not? (W,W)									
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