DOCUMENT RESUME

ED 055 643 PS 002 484

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TITLE Cognitive Synthesis, Conservation and Task Analysis.
INSTITUTION Syracuse Univ., N.Y. Dept. of Psychology.
SPONS AGENCY Office of Economic Opportunity, Washington, D.C.
REPORT NO OEO-4120
PUB DATE [69]
NOTE 13p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Cognitive Processes; *Conservation (Concept); Evaluation; Feedback; *Preschool Children; Readiness; *Task Analysis; Testing
IDENTIFIERS Farnham Diggory Cognitive Synthesis Task

ABSTRACT

Neurological immaturity, cognitive stages or lack of readiness may be erroneously inferred from young children's task performance. An alternative hypothesis suggests that an inadequate analysis of the criterion task may, in fact, account for children's inability to perform successfully. To support this thesis, investigators examined the four-part Farnham-Diggory cognitive synthesis task (behavioral translations of logographic sentences) used in assessing maturational readiness and correlating positively with conservation. Two validation studies were undertaken and yielded evidence that (1) children succumbed to a response set because feedback and reinforcement were omitted from task administration procedures and (2) children reacted to each individual word in all sentences because some logographic sentences (directions to do something) were ambiguous. Also, an unspecified but mediating variable such as the amount of reading training might be the source of relationships attributed to cognitive synthesis and/or conservation skills. Developmental psychologists are urged to pursue traditional viewpoints which require specification of antecedent conditions when dealing with performance tasks involving young children since traditional research focused more on the capabilities of young children than on their limitations. (WY)

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Cognitive Synthesis, Conservation and Task Analysis

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One of the difficulties often encountered when the inability of young children to perform a specific task is used as evidence for neurological immaturity, cognitive stages or lack of readiness is the heavy reliance on normative or correlational data. This always leaves open the alternative possibility that the failure of a certain sample of Ss to exhibit mastery on the task is due to the Ss lack of experience or the testing procedure rather than the Ss lack of capacity. More specifically, E may have miscommunicated to the S what the criterion task requires. A similar phenomenon has already been demonstrated by the present authors for discrimination tasks (Caldwell and Hall, in press) where they argued that an inadequate analysis of the criterion task may account for a number of false positives in that area.

The purpose of the present paper is to illustrate with empirical data how these problems in communication have left open the possibility of alternative hypotheses concerning inferences made from young Ss performance on a pseudo-reading task. It is hoped that the relevance of this data for other tasks will also become evident.

Pseudo-reading Task. The pseudo-reading task mentioned above was designed to measure the ability of children to translate logograph sentences (which direct them to do something) into actions. The published findings (Farnham-Diggory, 1967; Farnham-Diggory and Bermon, 1967, 1968) report that normal children under seven (brain damaged under 13) are unable to correctly perform the task but instead respond in a "disjointed" manner. From this data the authors concluded "the results strongly suggest that children must achieve a state or stage of neurological 'readiness' for conceptual

synthesis of the type under investigation her (Farnham-Diggory, 1967, p. 229)." In addition, it was found that conservers synthesized significantly better than nonconservers. Thus, the authors suggested that "At least some of the operations involved in conservation-of-liquids response, then, appear to be also involved in this particular form of 'experimental'[1] reading (Farnham-Diggory and Bermon, 1968, p. 224)."

The cognitive synthesis task is divided into four parts (described in greater detail in Farnham-Diggory, 1967). The first three are designed to measure the three representational modes postulated by Bruner (1964). The enactive task consisted of asking the child the following questions to demonstrate that the children comprehend the meanings of the eight words below. This all Ss were able to do.

Show me how you can jump.

Now show me a walk.

Put a block on the floor right there (blocks were available).

Now jump over the block.

Walk around the block.

Clap your hands.

Shake hands with teacher. I'm your teacher (the experimenter held out her hand.)

During the second part the children are shown 8 pictographs on individual cards and told that each one stands for a word. The reason for this second procedure is somewhat vague other than to go through Bruner's second stage since the relationship between words and pictographs is only used to see if the child can recall what the pictographs stand for after one presentation. The present Es interpretation of what this contributes will be discussed later.

The third part consists of presenting 8 new cards (called logographs) which represent the same 8 words but are somewhat more ambiguous in shape. Again the child is presented with the symbols once and asked to recall

which words they represent.

Finally the E places the logographs in units (overlapping the cards) to form two and three word sentences. The child is asked to read the sentences and then the E says "All right, now let me see you do it." The Ss were given no contingent feedback on their performances as the "E merely said in a neutral, friendly voice, 'all right now this one' and displayed the next set of cards (Farnham-Diggory, 1967, p. 228)." As mentioned earlier, it was found that children under seven responsed to each word rather than responding to the sentence as a whole. The scoring of the synthesis task consisted of one point for "synthesizing" responding to the sentence as a whole and 0 for a disjoint response. The sentences are shown in order below.

1. Clap hands.
2. Jump over block.
3. Clap over block.
4. Clap around teacher.
5. Walk around teacher.
6. Jump around teacher.
7. Walk over block.
8. Clap around block.

The water conservation task used in the Farnhma-Diggory and Bermon (1968) study began by presenting two glasses containing equal amounts of water. The E then used the water in one of the glasses for three sequential transformations (a taller thinner glass, three small glasses arranged so that the water level remained equal with the other glass after the water was poured into them and a lower fatter glass). The Ss were given two points for each transformation. One point was rewarded if the S said that the two amounts were the same after each transformation and one point if the S indicated that the two amounts of water would be the same if the water were poured back into the original container (this question was asked before the water was

poured back). Thus a total of six points were rewarded. An S was designated as a conserver if he acquired five points.

Alternative Interpretation. The present authors felt there were several possible reasons, unrelated to maturation, for the poor showing of the younger Ss using the Farnham-Diggory procedures. First, the second and third parts of the task gave the Ss a "set" for responding to the words individually rather than to whole sentences. In additon, since the children received no feedback which would indicate they were doing the synthesis task incorrectly the only cue they had for knowing exactly what the E wanted were the overlapping cards and the E saying "now do what the sentences say." If the S doesn't know what the word "sentence" means (which was not checked and highly doubtful before second grade) he might tend to respond to the words individually. The Ss also could interpret the "warm friendly voice" as meaning they were doing the correct thing on the first trial and thus continue to perform incorrectly. The possibility remains that if they were given contingent reinforcement they would have eventually learned to perform correctly.

Second, the sentences in the first part may not sufficiently determine whether the children comprehended the sentences used in synthesis. For instance, while there is only one meaning which could be attached to "Walk around the block" there are two meaning which could be attached to "Clap around the block." This is also true for sentences 3, 4, and 6 in the synthesis task. Much less ambiguity is involved in simply reacting to each individual word. It also might seem quite silly to try reaching around the teacher if they misperceived sentence 4 (one S in a pilot study after initially stating he did not know what to do, did indeed try to embrace the E while clapping).

With regard to the relationship between conservation performance and synthesis the possibility is always present that a third variable

is mediating a given correlation and there by supporting a spurious inference. In the present case the fact that the nonconservers in the Farnham-Diggory and Bermon (1967) data were most kindergarteners and over a full year younger (6.42 versus 7.78) left the possibility that the underlying variable might be reading training. In any event there were two ways to further validate the Farnham-Diggory and Bermon inference. First, the E could train the Ss in one of the tasks and see if there was any transfer to the other. Stage theorists have been looking for such tasks which would be predicted on the basis of thought operations rather than specific information for some time. Second, Ss could be equated on reading training and see if the relationship between conservation and synthesis still held. The following studies included both techniques.

Study One

The purpose of the first study was to test the alternative hypotheses presented above concerning the poor performance on the synthesis task and also determine whether children trained to synthesize would now conserve significatnly better than a control group.

Subjects. Subjects included 40 randomly selected nursery school Ss (23 males) ranging from 3-9 to 4-11 (except one child was 5-7). This was a nursery school in a lower middle-class neighborhood financed by the National Laboratory on Early Childhood Education through the U.S. Office of Education. The Ss were than randomly assigned to four experimental groups described in the next section.

METHOD

Four separate conditions were used in the first study. (1) A training condition explained below, (2) replication of Farnham-Diggory's procedure, (3) presenting the logographs in sentences initially without any warm-up, (the Es then checked in the Ss knowledge of individual logographs), (4) simply asking the Ss verbally to do what the sentences

said. Conditions one and three were to test the "set" hypothesis while condition four was used to ascertain whether the Ss had trouble understanding the sentences.

The training consisted of two five minute sessions. E brought each S into a small room and said "This is going to be a game which will teach you how people read. Here are some symbols which stand for words. I have put them together so they tell us what to do. I will give you one candy for each one you do correctly." The logographs for the training sessions consisted of the words around and clap from the Farnham-Diggory list along with new logographs for hop, spoon, table, and car (a toy car was used). The E then merely started putting the logographs in sentences, pointed to each one as he pronounced the word it stood for and asked the S to perform. When the S did what the sentence said incorrectly or asked the E what he should do, the E would not give him a candy. The E would also demonstrate what he expected.

Testing in all four groups was done by the two Es who did not participate in training and were unaware whether specific Ss belonged to group one or two. At least two days (ranging to two weeks) passed between training and testing. The only differences between the Farnham-Diggory procedures in the first two groups were that four noncontingent candies were rewarded for "doing a good job" in all four groups and Ss were given either 0 or one in all tasks. Farnham-Diggory gave a score of .66 for those who missed the pictograph or logographs once, .33 for those who couldn't recall what it meant the second time and 0 if they forgot three times. The candies were used to hold the Ss attention. After testing, groups one and two were given the Farnham-Diggory conservation task. The only modification here was to begin by asking the child to choose from four classes the two which had the same amount of water in them. This was done to determine if the children knew the meaning of same and different.

RESULTS

Table one gives the results of the synthesis portion of the experiment. It can be seen that condition one out performed condition two in all four parts of the task. With regard to synthesis a one way analysis of variance was computed. There was a significant difference between the performance of the four groups ($F = 7.9$, 3'36, df, $p < .01$). Table 2 shows the performance of all four groups on each sentence. In addition, a Scheffe test indicated that the differences between conditions two and three and two and four were also significant at the .05 level (Scheffe between conditions one and two significant at .01 level).

With regard to conservations, one S conserved in condition two. The synthesis score of this S was 1.

Insert Tables 1 and 2 here

Study Two

Study two was done to determine the relationship between conservation and synthesis performance when formal reading training is controlled. The Ss consisted of twenty first graers in a surburban middle-class school district. These Ss were randomly selected from 110 Ss in four classrooms (11 boys). The testing was done in November and formal reading training had begun. The mean ages of the two groups were: conservers - 6 years 7.6 months and non-conservers - 6 years 5.3 months.

METHOD

Each S was presented with first the synthesis task and then the conservation task just as Farnham-Diggory had done. Each task was presented by a separate E who had no knowledge of how well the S had done on the other task.

RESULTS

Table 3 shows the mean performance and standard deviations of the conservers and nonconservers. The correlation between the scores on the

two tasks was .11 ($p < .05$). There were 10 subjects in each category. There was, of course, no significant difference between the two groups.

Insert Table 3 here

DISCUSSION

With regard to the first study the Es feel they have at least demonstrated that antecedents unrelated to neurological immaturity are responsible for poor performance on cognitive synthesis. It also appears that some of these antecedents have been specified. The synthesis scores on conditions two and three suggest that the initial set is extremely important. Further evidence for this position can be seen in the logograph performance on condition three. If other Es has started with the synthesis task they might well have speculated that children can synthesize but can't recall individual parts (a Gestalt interpretation might have been in order). It is also evident from performance on condition four that sentence meaning was a problem. This is substantiated by the fact that all groups (including the first graders) had difficulty with the same sentences. It is interesting that on the one hand it is stated that young Ss lack the capacity to synthesize but on the other hand are expected to understand and act out ambiguous sentences correctly.

The evidence that there is some similarity between the operations necessary for conservation and synthesis seems tenious at best. It looks like amount of reading training may have been the source of the relationship found elsewhere. At the very least it must be admitted that when age is controlled the relationship is gone. Failure of Ss trained in synthesis to exhibit superior conservation performance further questions the hypothesized relationship between the two tasks.

Finally, the Es feel that the most important point being made by this paper may not be that alternative interpretations of earlier synthesis

data are possible. It is rather to suggest that developmental psychologists may be in too big of a hurry to look for and label stages or limitations in young Ss. A different viewpoint which may have more utility for understanding the abilities of young children is to merely acknowledge, when we find a task that young Ss perform incorrectly on, that the necessary antecedent conditions are as yet unknown. This leads to the view that more effort should be placed on determining what we can teach young Ss, and that we should focus more on learning their tremendous capabilities rather than concentrating on their limitations in specific settings. This approach should in turn teach us more about new optimum conditions for training. Although this is not a new viewpoint it is one which may now need new emphasis when stage theorists are so much in vogue.

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FOOTNOTES

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The authors would like to acknowledge the assistance of Mr. Fred Maziarz of the Jamesville-Dewitt School system. This research was supported in part by the National Laboratory in Early Childhood Education.

Table 1

Means and Standard Deviations of Four Groups in the Present Study and Farnham-Diggory's Data on A Similar Age Group

N = 10 in the present study and 25 for the Farnham-Diggory Data[X]

	Groups	Enactions	Pictographs	Logographs	Synthesis
1.	$\bar{X}$	8.0	6.6	5.7	6.5
	S.D.	0	1.43	1.41	1.50
2.	$\bar{X}$	7.3	6.0	4.9	2.0
	S.D.	2.18	1.49	2.18	2.05
3.	$\bar{X}$			2.5	4.9
	S.D.			5.38	2.8
4.	$\bar{X}$				4.8
	S.D.				2.0
Farnham - Diggory[XX]	$\bar{X}$	8.0	7.6	6.4	2.4

X The differences in the Pictograph and Logograph data between the present study and the Farnham-Diggory may be due to a slightly different scoring system used which is explained in the text.

XX S.D. - not given

Table 2

Number of correct responses by sentences and condition on the synthesis task

	Condition					
Sentence	1	2	3	4	1st Graders[X]	Total
1	7	10	10	8	19	54
2	3	10	8	7	19	47
3	0	5	5	3	13	26
4	1	7	6	2	15	31
5	3	9	7	6	18	43
6	2	9	7	5	15	38
7	4	10	8	8	16	46
8	2	5	6	4	13	30

X This refers to the second study

Table 3

Means and Standard Deviations on Synthesis Tasks for Conserving and Non-Conserving First Graders

N = 10 for each Group

	Conservers	Non-Conservers
Synthesis $\bar{x}$	6.3	6.5
S.D.	2.9	1.64