DOCUMENT RESUME

ED 097 983 PS 007 544

AUTHOR Zimmerman, Barry J.
TITLE Modeling and Corrective Feedback Effects on Children's Acquisition, Generalization and Retention of a Conservation Rule.
PUB DATE Apr 74
NOTE 14p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, Illinois, April 15-19, 1974)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS *Cognitive Processes; *Conservation (Concept); Developmental Psychology; *Feedback; Generalization; Intellectual Development; *Kindergarten Children; Nonverbal Tests; *Observational Learning; Retention; Social Behavior; Socialization

ABSTRACT

The effects of modeling and corrective feedback on the conservation of equalities and inequalities were studied with items spanning three stimulus dimensions (length, number, and two-dimensional space). Observation of a model, correction training (joining positive feedback with verbal rule provision), and the combination of observation and correction were all successful in producing learning and, without further training, transfer and retention of conservation. Unlike the controls (who also never correctly answered any equality items), the trained experimental groups gave evidence of spontaneously generalizing their new learning to a task that required nonverbal behavior to manifest conservation. (Author)

MODELING AND CORRECTIVE FEEDBACK EFFECTS ON CHILDREN'S ACQUISITION, GENERALIZATION AND RETENTION OF A CONSERVATION RULE

Barry J. Zimmerman

University of Arizona

A paper presented at the American Educational Research Annual Meeting at Chicago, Illinois, April, 1974.

Piaget (Flavell, 1963) has presented an elaborate account of children's development of intellectual functioning based on a series of stages which were deduced from the response of children of varying ages to a series of ingenious conceptual tasks. These tasks were deduced in part from a symbolic logic model and reflected varying degrees of logical complexity. The results of children's response to these tasks were interpreted according to a biological growth model. Children's intellectual growth was depicted as going through a series of semi-discrete stages much the same way a caterpillar goes through a series of pronounced changes enroute to becoming a butterfly. Piaget suggested that intellectual growth was not simply a matter of biological unfolding but also involved "experience" of the child. Experience was depicted in Hegelian fashion as involving some combination of two reciprocal forces: assimilation and accommodation. Again Piaget's emphasis on logical and biological models was evident. Experiences which were congruent with prior experiences were assimilated into the child's intellectual structure while those which were discrepant required the child's structure to change in much the same fashion that animals are compelled to grow hair when a climate suddenly becomes colder. However, as Baldwin (1968) has pointed out, a child's ability to profit from experience is dependent according to Piaget on the child's stage of development. This assumption has led many psychologists such as Bruner, Olver, and Greenfield (1966) to conclude that biological maturation plays a rather major delimiting role in Piaget's theory of intellectual development.

An alternate point of view suggested by Bruner as well as social learning theorists such as Zimmerman (1973), Siegler & Liebert (1972) and Bandura (1971). The general position advanced here is that indices of intellectual development such as children's manifestation of conservation responses are a form of socially mediated rule learning and as such, share properties with other forms of rule learning. Some of these properties have been described in a recent review (Zimmerman & Rosenthal, 1974). Children can learn a conservation rule when it is displayed for them in a fashion which permits its unconfounded abstraction, just like other forms of rule learning. According to this interpretation, cultural and social factors play a large role in influencing acquisition and utilization of logical rules. (Price-Williams, Gordon, & Ramirez, 1969; Bruner, et al., 1966). It is beyond the scope of this paper and the time limitation on this presentation to present a social learning account of some of the consistently reported facts concerning conservation such as the lengthy period of nonconservation, the existence of horizontal decalages, lack of success in training children to conserve in prior studies and so forth. These topics have been addressed in prior papers (Zimmerman, 1973; Zimmerman & Lanaro, in press).

Consistent with this social learning account, prior research by Rosenthal & Zimmerman (1972) has found that four- to six-year-old children could acquire and transfer multi-dimensional conservation response through observation. In a second experiment in this series, children who initially conserved during baseline testing, were exposed to an adult model who exhibited non-conservation responses. A significant reduction in number of conserving judgments was found with these children during both acquisition and generalization phases. In a third experiment, observing a model was greatly superior to providing equivalent information through instructions alone in teaching bilingual disadvantaged children to conserve. In a final experiment, four-year-olds were exposed to a conserving adult model to determine whether children this young could profit from vicarious training. A special alternation procedure in which the model and child responded in turn on each item was effective in creating imitative conservation, a skill which transferred to unfamiliar generalization items. This series of studies revealed that observational learning procedures were effective in modifying conservation response.

Critics of this modeling research have argued that these results do not necessarily reflect "true" conservation because several alternative explanations for these findings are tenable. These alternative hypotheses can be grouped in three general categories: children who were considered to have learned to conserve instead (1) had acquired only a simple rote response set "same" to conservation phenomena, (2) were acquiescing to momentary social influences but did not alter their method of cognizing conservation phenomena in any relatively permanent fashion, (3) were simply mimicking the model's choices and did not acquire a transferable rule.

The present experiment was addressed to these issues. Each set of conservation items sampled the categories of length, number, and two dimensional space but half of all items required the maintenance, after transformation, of the initial stimulus inequality. In addition to the main data based on verbal judgments (and explanations) of stimulus equality and inequality, a task was given after training to determine if the children could spontaneously display manual evidence of understanding, by returning the transformed stimuli to their initial status. A retention phase, after a week's interval or longer, was included.

The sample for this study was composed of 48 kindergartners from a lower middle class anglo residential area. The children ranged in age from 5.1 to 6.4 years with a mean age of 5.7 years.

Three sets of stimuli were developed on the basis of items from the Goldschmid-Bentler test (1968). Within each set which were used during different experimental phases, 12 items were presented, 4 items from each of three stimulus dimensions: length, number, and two dimensional space. The four items measuring each type of conservation were in turn composed of two equality items and two inequality items. On conventional equality items, the child was first presented with a pair of stimulus members (e.g., two rows of six poker chips), and one was transformed to appear perceptually discrepant. With inequality items, initially unequal stimuli were presented and the larger was designated for the child. Next the experimenter transformed the spatial format of the larger or smaller member and the child was asked to make a judgment. Inequality items tested whether the child could maintain initial stimulus differences when one member had undergone transformation. Thus three sets of 12 stimuli were used with each set involving different stimuli (e.g., chips versus square tiles) and different transformations. Set I stimuli were used during baseline and retention testing, Set II stimuli were used during training, and Set III stimuli were used during generalization testing. During all procedures, the experimenter screened the stimuli from the child as she returned transformed stimuli to their original formats so that reversibility cues were eliminated.

All children were taken individually from class to a testing room and tested with Set I items using the same instructions developed by Goldschmid and Bentler (1968). Each child was randomly assigned to one of four experimental conditions: modeling only, correction only, modeling plus correction, or a no model control group. In the <u>modeling</u> condition, the child watched an adult female model give correct judgments and explanations for her judgments. The model explained her conserving judgments according to an invariant quantity rule "because they were both the same length (had the same amount) in the first place." On inequality items, the model explained "because it was longer (or had more) in the first place." In the <u>verbal correction</u> procedure, the child was simply tested with Set II stimuli and was told if she was correct or incorrect and given a statement of the invariant quantity rule if incorrect. In the <u>modeling plus correction</u> condition, the children first observed the model perform on each item, and then attempted to imitate her and was given feedback in identical fashion to the verbal correction procedure. <u>Control</u> subjects were simply tested with Set II stimuli without observing the model or receiving feedback.

After training Set III was introduced to measure generalization according to the same testing procedures used during baseline. Immediately after

Set III items were presented, the experimenter introduced an additional novel conservation of length equality item and the child was asked to make a judgment; if he conserved, the child was asked, "How would you show a friend that the sticks were still the same length?" This procedure was included to see if the children could spontaneously reverse logical operations. This was usually done manually by realigning the rods. The child was then returned to class. After a delay of seven to ten days, the experimenter returned and retested each child with Set I stimuli to measure retention.

The children's responses to each stimulus set were scored as the number of correct judgments and also the number of correct judgments plus rule using Goldschmid and Bentler's criteria.

The major statistical analysis was conducted using a repeated measures analysis of variance procedure and the results of the reversibility test were analyzed using chi square procedures. The means for each treatment group during each experimental phase are presented in Tables 1 and 2.

Very briefly, the children displayed practically no conservation at all during baseline response. The few items that were passed were inequality items on which the size illusion was consistent with the actual size of the stimuli (see Table 4). This occurred as a result of counterbalancing procedures. Both modeling procedures ($\underline{F}$ (1/40) = 5.79, $\underline{p} < .02$) and feedback ($\underline{F}$ (1/40) = 28.67, $p < .001$) separately enhanced acquisition of conservation judgments and judgments plus rules ($\underline{F}$ (1/40) = 5.40, $\underline{p} < .03$; $\underline{F}$ (1/40) = 13.22, $\underline{p} < .001$, respectively). According to both conservation criteria, significant generalization and retention of the rule over the delay interval were noted (smallest $\underline{p} < .05$) for all groups exposed to either modeling or corrective feedback.

A reversibility analysis revealed that the frequency of reversibility responses differed among experimental groups (χ^2 (3) = 11.26, $p < .02$). Examination of Table 3 reveals that this result was largely created by the failure of control children to give any correct reversals.

What do these . .a suggest? Since modeling and feedback procedures produced significant acquisition on both equality and inequality stimulus items, it is no longer possible to discount these results on the basis of a rote response set (of same) hypothesis. These children necessarily had to discriminate the comparability of the stimuli prior to transformation and to respond in one of two different ways after the stimuli were transformed.

With regard to the question raised concerning the relative permanency of vicariously-induced conservation response, significant retention of conservation response was noted after a seven to ten day delay. Since the items used during retention testing were never used during training, simple recall of prior discrete responses could not account for these results. These data support the interpretation that modeling procedures were not simply exerting momentary social influences, but rather were effective in providing the children with a relatively permanent conceptual rule that could be used to cognize conservation phenomena.

This evidence tends to rule out a mimicry interpretation for modeling effects. There is a rather substantial body of research which indicates that even children as young as three can vicariously acquire general rules (Zimmerman & Rosenthal, 1974). The transfer findings reported in this and previous studies are consistent with the interpretation that generalized conservation rule had been acquired. In all studies, we have found that the conservation skill generalizes to different item instances within the same classes studied. In addition, we found generalization of conservation responding from a verbal to a nonverbal response mode. In this study, the children in training groups were exposed to a model who used an invariant quantity explanation to justify his conservation judgments. After training, the children who learned to conserve on length items were asked how they would show a friend the accuracy of their judgments. These children displayed significantly higher incidence of nonverbal reversibility responses than untrained children. It should be pointed out that Piagetions classify invariant quantity and reversibility explanations as qualitatively different types of response.

In conclusion then, the results revealed quite clearly that brief modeling techniques and corrective training could teach a conservation rule to children whose baseline conservation was nil, and the present control group continued to fail every equality item in later phases. Learning to conserve does not seem immutably dependant on the child's attaining some maturational, age-related cognitive stage. The position advanced here doesn't discount the importance of developmental factors in influencing children's response; it does, however, argue against discrete stage theories of development and maintains that children as young as five years can learn abstract conceptual rubrics which can be generalized and retained over time. Finally, the question of the influence of social factors in the conceptual development of children transcends any single group of studies. However, the effectiveness of social variables in the present study does suggest that greater attention be addressed to these issues in future research.

REFERENCES

Baldwin, A. A cognitive theory of socialization. In D. A. Goslin (Ed.) Handbook of socialization theory and research. Chicago: Rand McNally, 1968. Pp. 325-345.

Bandura, A. Psychological modeling -- conflicting theories. Chicago: Atherton/Aldine, 1971.

Bruner, J. S., Olver, R. R., & Greenfield, P. B. Studies in cognitive growth. New York: Wiley, 1966.

Flavell, J. H. The developmental psychology of Jean Piaget. Princeton, N. J.: Van Nostrand, 1963.

Goldschmid, M., & Bentler, P. M. Manual: concept assessment kit, conservation. San Diego: Educational and Industrial Testing Service, 1968.

Price-Williams, D., Gordon, W., & Ramirez, M. Skill and conservation: a study of pottery-making children. Developmental Psychology, 1969, 1, 769.

Siegler, R. S., & Liebert, R. M. Effects of presenting relevant rules and complete feedback on the conservation of liquid quantity task. Developmental Psychology, 1972, 7, 133-138.

Rosenthal, T. L., & Zimmerman, B. J. Modeling by exemplification and instruction in training conservation. Developmental Psychology, 1972, 6, 392-401.

Zimmerman, B. J. Piaget's formulations on cognitive development: a critical examination in light of recent social learning research. A paper presented at the American Psychological Association annual meeting. Montreal, Canada, August, 1973.

Zimmerman, B. J., & Lanaro, P. Acquiring and retaining conservation of length through modeling and reversibility cues. Merrill Palmer Quarterly, in press.

Zimmerman, B. J., & Rosenthal, T. L. Observational learning of rule governed behavior by children. Psychological Bulletin, 1974, 81 (1), 29-42.

Table 1

Judgments Only Mean Responses by Phase for Intact Groups

and Treatment Combinations

Group	Phase			
	Baseline	Training	Transfer	Retention
Intact Groups				
Model no Correction	3.25	6.08	5.75	5.33
Correction no model	3.17	7.17	8.50	8.17
Model plus correction	3.67	9.08	8.08	8.92
Control	3.17	3.25	4.00	3.00
Treatment Combinations				
All modeling	3.46	7.58	7.42	7.13
All nonmodeling	3.17	5.21	6.25	5.58
All correction	3.41	8.13	8.92	8.54
All noncorrection	3.21	4.67	4.88	4.17
All boys	3.38	6.50	6.79	6.29
All girls	3.25	6.29	6.88	6.42

Table 2

Judgments plus Rule Mean Responses by Phase for Intact Groups and Treatment Combinations

Group	Phase			
	Baseline	Training	Transfer	Retention
Intact Groups				
Model no correction	0.25	2.25	1.33	2.25
Correction no model	0.03	3.03	3.33	3.92
Model plus correction	0.42	5.67	5.00	6.58
Control	0.00	0.00	0.08	0.16
Treatment Conditions				
All modeling	0.33	3.96	3.42	4.42
All nonmodeling	0.04	1.54	1.71	2.04
All correction	0.25	4.38	4.17	5.25
All noncorrection	0.13	1.13	0.96	1.21
All boys	0.21	3.13	3.17	3.79
All girls	0.17	2.33	1.96	2.67

Table 3

Reversibility Task Results by Group

Number of Children	Training Group			
	Modeling Only	Correction Only	Modeling Plus Correction	Control
Reversing Correctly	3	6	7	0
Not reversing	9	5	5	12

Table 4

Baseline Frequencies of Children's Inequality Judgments

Conservation Dimension	Inequality Item Response Categories			
	Passed Just Veridical	Passed Just Nonveridical	Both Types Passed	Neither Type Passed
Length	34	5	8	1
Number	43	1	4	0
Two dimensional space	37	2	8	1

Note: Veridical items were those on which the quantitatiely greater stimulus looked perceptually larger. On nonveridical items, the actually greater stimulus looked smaller.