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TEMPORAL FACTORS AND RETEST EXPECTATIONS IN AN OBSERVATIONALLY ACQUIRED SIMPLE CONCEPT

by

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I hereby recommend that this dissertation prepared under my direction by Richard Wallace Hanson

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ABSTRACT

Recent studies have indicated that abstract, rule-governed behavior can be acquired and modified as a result of modeling or observational learning. The present study examined 1) temporal factors in recall by imposing a delay between exposure to a modeled task and actual performance of the task, and 2) the effect of retest expectations on imitation performance.

Fifty-four kindergarten and 54 first grade children were randomly assigned to one of nine groups with an equal number of males and females in each group. During a baseline phase all subjects were shown a Chinese checkerboard and asked to make something with marbles that corresponded with a series of colored discs. The subjects then observed a silent model play the same marble game and demonstrate a simple, novel equivalence rule. One-third of the subjects were asked to perform the modeled task immediately after observation, another one-third one day later, and the final one-third one week later. Retest expectations were manipulated by the amount of information given to the subjects just prior to observing the model. Three expectation levels were compared. One-third of the subjects were not told that

they would be retested. Another one-third were told that they would be retested, but the actual time was not specified. The final one-third were told that they would be retested and the time was specified (immediately afterward, one day, or one week later). After being retested for imitative learning, all subjects were immediately presented with a new series of disc stimuli to see if they could transfer the equivalence rule to a set of stimuli different from those used in baseline, modeling, and imitation retest. Thus, the basic design consisted of two age samples, three delay conditions, and three retest expectation conditions which were then compared across three phases.

The results indicated a highly significant ($p < .001$) trials effect. During baseline, the subjects performed essentially at a zero level, indicating that the novel equivalence rule was not already present in their repertoires. During the imitation retest phase, both age groups significantly ($p < .01$) improved their performance over baseline, indicating that observational learning had occurred. Performance at the third phase (generalization) dropped significantly ($p < .01$) from imitation retest to a level which was still significantly ($p < .01$) above baseline. Thus, subjects were able to partially transfer the equivalence rule to a new set of stimuli. During both imitation retest and generalization phases, the first graders performed significantly ($p < .01$) better than the younger sample.

As predicted, a one day delay between observation and imitation retest resulted in a significant ($p < .01$) drop in performance as compared to the no delay group. Contrary to prediction, however, the performance of the one week delay group was not significantly below that of the no delay group. The retest expectation effect was not significant. It is possible that the information given the subjects did not significantly influence retest expectations. Several unusual interaction effects were found.

INTRODUCTION

Interest in observational learning (also called imitation or modeling) as a research topic in psychology has greatly increased in the past few years. Psychologists concerned with social learning have recognized that the two most widely accepted paradigms for conceptualizing learning, operant and classical conditioning, do not adequately explain how people learn in everyday life. Bandura (in press) points out that people often encounter situations in which an error or mistake would lead to dangerous or disastrous consequences. As a result, it would be a great mistake to rely solely on differential reinforcement of trial-and-error behaviors to teach people how to avoid making such mistakes. He contends that it makes much more sense to provide a model to demonstrate acceptable modes of behavior.

Probably one of the most important developments in social learning has been the realization that modeling is not confined to reproducing discrete responses which have been observed. Evidence is now beginning to mount that abstract, rule-governed behavior can be acquired through observation. Most of the initial evidence suggesting this, however, has involved the _modification_ of abstract rules already present in the child's repertoire. Starting with moral judgments (Bandura and McDonald, 1963) and self-imposed delay of reward (Bandura and Mischel, 1965) this research has recently moved into the area of language behavior. Bandura and Harris (1966) and Odom, Liebert and Hill (1968) were partially successful in modifying syntactical structures in children using modeling and reinforcement. Carroll, Rosenthal and Brysh (in press) were able to successfully modify the tense and structure of sentences as well as the content using modeling alone. These findings were successfully replicated in a study in which the experimenter served as her own model (Rosenthal and Whitebook, 1970). Liebert, Odom, Hill and Huff (1969) have shown that children (particularly older ones) can <u>acquire</u>, via modeling and reinforcement, an arbitrary non-grammatical rule which they can use to generate sentences congruent with the novel rule. These studies have important implications for understanding language acquisition. When children are exposed to models speaking language, they can learn basic grammatical rules. These grammatical rules can then be used to generate an unlimited number of novel sentences (Bandura, in press).

Other modeling studies demonstrating the modification of rule-governed behavior have been reported by Rosenthal and Zimmerman (in press) concerning the production and non-production of conservation responses, and by

Rosenthal, Zimmerman and Durning (1970) concerning the categories or styles of question asking behavior. Rosenthal, Moore, Dorfman and Nelson (1971) have recently demonstrated that young children can acquire via modeling a simple, but arbitrary equivalence rule which was not previously present in their repertoires. All of these studies, demonstrating the acquisition or mofication of abstract rule-governed behaviors through modeling, have greatly extended the potential contribution of observational learning to human learning in general.

According to Bandura (1969; in press), four interrelated components are involved in modeling. The first component involves attentional processes. A number of model characteristics (e.g., age, status, power, attractiveness) can affect this component as well as the incentives provided for attending to and learning the modeled behaviors. Retention processes form another modeling component. According to Bandura's theory, retention is facilitated by both rehearsal processes (overt and covert) and symbolic coding operations. Modeled behavior may be coded and stored by means of two representational systems. One system involves the formation of cognitive images of the modeled stimuli, whereas the other consists of verbally coding the stimuli. Supporting evidence for these coding processes has come from a study by Bandura, Grusec and Menlove (1966) and a study by Gerst (1971). The third primary modeling component involves motoric reproduction processes. This involves translating the symbolically coded representations into overt behaviors. An important factor in this regard is the availability of the response components in the individual's repertoire. The final modeling component concerns reinforcement and motivational processes. Incentive factors are primarily concerned with determining the actual performance of modeled behaviors (Bandura, 1965). However, incentives can indirectly affect acquisition in that they influence the degree to which a person attends to the modeled cues. Also, incentive variables can affect retention because modeled behaviors which have some importance to the individual are more likely to be rehearsed and symbolically coded.

Given the idea that individuals actively code and store information conveyed by models, one might ask how long these symbolic representations are maintained in the absence of overt rehearsal before they start to decay and result in subsequent performance deficits. Obviously, retention may be facilitated through covert rehearsal; however, unless the modeled responses are of much importance to the individual, it is unlikely that he would continue to rehearse them for days, weeks, or months. In other words, if an individual acquires a novel response pattern through relatively brief exposure to a model, what will be the effect on performance if overt performance is delayed for varying periods of time?

In the present study, young children, ages 5 to 7, were exposed to a simple motor task involving an arbitrary, novel conceptual rule. One-third of the subjects were asked to perform the modeled task immediately following observation. Another one-third were asked to perform it one day later, and the final one-third a week later. It was predicted 1) that there would be a performance decrement if a subject did not perform the modeled task immediately after observing it, and 2) that despite delay, the subjects would exceed their baseline performance when retested.

One variable which may interact with delayed performance following modeling is the individual's expectation that he will have to perform the task himself at some later time. A strong expectancy that an observed task will need to be performed at a later time may affect attention to the model, covert rehearsal of the modeled behavior and symbolic coding and storage of the information. All of these processes resulting from a strong expectancy of later performance should, in turn, enhance actual accomplishment. The present study attempted to establish three levels of performance expectancy by varying the information conveyed to subjects just prior to modeling.

METHOD

Subjects

Fifty-four kindergarten and 54 first grade children from an elementary school in Tucson, Arizona served as subjects, with an equal number of boys and girls in each grade level. The mean age of the younger group was five years, eight months, while that of the older group was six years, nine months. Most of the children came from lower-middle or working-class families. Subjects in the kindergarten and first grade groups were randomly assigned to one of nine groups with three males and three females in each group.

Design

Three observation-performance temporal relationships were compared. One group performed the modeled task immediately after they observed it; another group 24 hours after they observed it; and the final group had a performance delay of one week. Three levels of retest expectations were also compared. Retest expectancies were manipulated by the amount of information given to the subject just prior to observing the modeled task. The weak expectancy group was simply told to carefully observe the model. The medium expectancy group, in addition to being told to carefully observe the model, was also told that they would have to perform later (time not specified). The strong expectancy group was told to carefully observe the model and was informed when they would be asked to perform the task (i.e., immediately afterward, one day later, one week later).

The design also involved three phases. All children underwent baseline, imitation-retest and generalization phases. In baseline, the subjects were asked to respond to a set of colored discs by making something with marbles on a Chinese checkerboard. No further direction was given in this phase. Next, children were given the expectancy instructions after which they watched a model demonstrate the correct way to "play the game." In the imitation-retest phase the subjects were asked to respond to the same set of discs with which they were presented in the first phase. In the generalization phase all subjects were asked to respond to a new arrangement of discs without further modeling.

The design thus involved two age samples and two variables, each having three levels which were then compared across three phases as repeated-measures trials. This resulted in a 2 x 3 x 3 x (3) design with 18 cells and three boys and three girls per cell.

Materials and Scoring Criteria

The experimental task was originally developed by Rosenthal, Feist and Durning (in press) and Rosenthal et al.

(1971). The stimulus materials consisted of white, blue, red, and black plastic discs. During baseline, modeling and imitation-retest, the discs were presented in the following order of color and number: one white, one blue, one red, one black, two whites, two blues, two reds, two blacks, three whites, three blues, three reds, and three blacks. In the generalization phase, subjects were presented with two discs of unlike colors on each trial. The following left-right positions were sequentially presented: white-blue, white-red, white-black, blue-red, blue-black, blue-white, red-white, red-blue, red-black, black-white, black-blue, and black-red. Thus each phase consisted of 12 trials.

For each trial, the child had to select marbles from a tray of white, blue, red, black, green, and yellow marbles and place them on a Chinese checkerboard. The equivalence rule consisted of making a triangle on the board using three contiguous marbles. The triangles had to match in number and color the discs which were presented. Thus, if one white disc was presented, the proper response was one white triangle; if two blue discs were presented, the proper response was two blue triangles, etc.

Each trial was scored as entirely correct or incorrect; thus, each subject's score consisted of the number of trials per phase in which correct responses were given.

Procedure

Each child was seen individually in a testing room. An adult male served as experimenter and another adult male served as model. The child was seated at a table which contained the Chinese checkerboard and tray of marbles.

The child was shown the first disc stimulus and asked to "make something (with the marbles) that goes with this (disc) and put it here (on the board)." The succeeding stimuli were then presented with each trial prefixed by, "Now, make something that goes with this." After the baseline phase, the children were given the expectancy instructions. In the weak expectancy condition the child was told, "Now, I'm going to play the game with the man and show you the right way to play it. I want you to watch carefully." The medium expectancy subjects were told, "Now, I'm going to play the game with the man and show you the right way to play it. I want you to watch carefully because I'm going to have you play the game later." The strong expectancy subjects were told, "Now, I'm going to play the game with the man and show you the right way to play it. I want you to watch carefully because I'm going to have you play the game (right afterward, tomorrow, next week)." The experimenter and model then demonstrated the trial-by-trial stimulus-response coordinations demonstrating the equivalence rule such that triangles matched the stimuli presented in number and color. The experimenter presented the disc(s) and the model made the appropriate marble responses. No verbal praise was directed to the model's productions.

The imitation-retest phase followed and was introduced with, "Now, I want you to play the game again." The 12 trials were presented in the same order as in the baseline and modeling phase. The no delay group was retested immediately after modeling, the one day delay group was retested approximately 24 hours afterward, and the one week group was retested approximately 168 hours after baseline and modeling. The generalization phase followed immediately after imitation-retest for all subjects. This phase was introduced with, "Now, let's try these." After this phase was completed, the subject was thanked, praised for his (her) performance and returned to the classroom.

RESULTS

The number of correct trials per phase was computed for each subject. Since each series consisted of 12 trials, the scores for each subject ranged from 0 to 12. In the baseline phase all subjects received a score of 0 with the exception of one subject who scored 1. The mean number correct for each of the groups in the imitation-retest phase is presented in Table 1. The means for the generalization phase are presented in Table 2.

The data were subjected to a five way analysis of variance with four between subject variables (delay, retest expectations, sex, and grade level) and one within subject variable (trials). A summary of this analysis of variance is presented in Table 3.

A significant trials effect is clearly evident. Using Tukey's multiple comparison method (Myers, 1966), it was found that post-modeling performance increased significantly from a near zero baseline level ($A = 6.45$, with $A = 1.11$ required for $p \leq .01$), and then dropped significantly from the imitation-retest to generalization ($A = 2.32$). The generalization performance was still significantly above baseline ($A = 4.13$). It is also clear from Table 3 that the two age

TABLE 1

MEAN NUMBER OF CORRECT RESPONSES IN THE IMITATION-RETEST PHASE

Sample	Retest Expect.	Delay					
		No Delay		One Day		One Week	
		Male	Female	Male	Female	Male	Female
Kindergarten	Weak	3.67	6.33	4.67	1.33	3.33	0.00
	Medium	4.00	8.33	0.00	0.67	3.33	6.67
	Strong	9.33	3.33	8.67	4.33	2.67	2.33
First Grade	Weak	10.67	12.00	0.00	12.00	11.67	5.00
	Medium	8.00	8.67	7.33	3.67	9.33	12.00
	Strong	9.33	3.33	8.67	4.33	2.67	2.33

TABLE 2

MEAN NUMBER OF CORRECT RESPONSES IN THE GENERALIZATION PHASE

Sample	Retest Expect.	Delay					
		No Delay		One Day		One Week	
		Male	Female	Male	Female	Male	Female
Kindergarten	Weak	3.00	0.00	0.00	0.00	2.67	0.00
	Medium	4.00	1.00	0.00	2.00	0.00	5.67
	Strong	3.33	0.00	5.00	2.67	0.00	3.67
First Grade	Weak	11.00	11.67	0.00	11.00	6.67	2.33
	Medium	7.00	2.33	2.33	0.00	10.33	11.00
	Strong	9.00	6.33	3.33	7.67	10.67	3.33

TABLE 3

SUMMARY OF ANALYSIS OF VARIANCE FOR DELAY, RETEST EXPECTATIONS, SEX, AND GRADE LEVEL

Source of Variance	df	MS	F
Between Subjects	107		
Delay (A)	2	95.95	5.79**
Retest Expectations (B)	2	18.79	1.13
Sex (C)	1	.61	.04
Grade Level (D)	1	796.49	48.08***
A x B	4	46.02	2.78*
A x C	2	24.78	1.50
A x D	2	40.60	2.45
B x C	2	11.95	.72
B x D	2	11.08	.67
C x D	1	4.94	.30
A x B x C	4	45.68	2.76*
A x B x D	4	20.68	1.25
A x C x D	2	66.15	3.99*
B x C x D	2	42.26	2.55
A x B x C x D	4	27.31	1.65
Error	72	16.56	
Within Subjects	216		
Trials (E)	2	1153.90	158.85***
A x E	4	31.27	4.31**
B x E	4	7.34	1.01
C x E	2	2.61	.36
D x E	2	196.97	27.12***
A x B x E	8	14.18	1.95
A x C x E	4	18.96	2.61*
A x D x E	4	15.60	2.15
B x C x E	4	5.05	.70
B x D x E	4	4.78	.66
C x D x E	2	7.45	1.02
A x B x C x E	8	14.33	1.97
A x B x D x E	8	15.54	2.14*
A x C x D x E	4	20.11	2.77*
B x C x D x E	4	16.73	2.30
A x B x C x D x E	8	9.30	1.28
Error	144	7.26	

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

samples differed significantly ($p < .001$). The means for the two groups across trials are presented in Table 4. Post hoc comparisons indicated that the first graders performed significantly better than the kindergarten subjects at imitation retest ($A = 4.78$, with $A = 1.75$ required for $p \leq .01$) and at the generalization phase ($A = 4.61$). These comparisons also indicated that both groups improved significantly from baseline to imitation-retest (kindergarten - $A = 4.07$; first grade - $A = 8.83$) and then dropped significantly from imitation-retest to generalization (kindergarten - $A = 2.24$; first grade - $A = 2.41$) to a level which was still significantly above baseline (kindergarten - $A = 1.83$; first grade - $A = 6.42$).

As predicted, there was a significant effect ($p < .01$) for delay. The subjects who were tested immediately after modeling performed the best. The one day delay resulted in a significant drop in performance as determined in post hoc comparisons ($A = 1.85$, with $A = 1.67$ required for $p \leq .01$). This effect took place in both the imitation-retest phase ($A = 3.52$, with $A = 2.34$ required for $p \leq .01$) and generalization phase ($A = 2.06$, with $A = 2.02$ required for $p \leq .05$). However, contrary to expectation, the performance of the one week delay group was not significantly below that of the no delay group. There was also no significant difference between the one day delay and one week delay groups.

TABLE 4

MEAN NUMBER OF CORRECT RESPONSES FOR THE TWO AGE SAMPLES ACROSS TRIALS

Grade Level	Phases		
	Baseline	Imitation	Generalization
Kindergarten	.00	4.07	1.83
First Grade	.02	8.85	6.44

Also contrary to prediction, the retest expectation variable was not significant. This variable did, however, interact significantly with delay ($p < .05$). There was a significant delay effect only within the medium expectation level (subjects informed that they would be retested with actual time not specified). Oddly enough, the medium expectation one week delay group performed significantly better than the one day delay group (A = 3.50, with A = 3.09 required for $p \leq .05$). The mean performances of all three expectation levels were poorer in the one day delay condition than in the no delay condition; however, the differences did not reach significance.

The main effect for sex was not significant, nor were there significant dual interactions between sex and delay, retest expectations or grade level. There was a significant delay x sex x trials interaction, however. A multiple comparisons analysis of this interaction indicated that within the imitation-retest phase, the no delay-males performed significantly better than the one day delay-males

(A = 3.72, with A = 3.43 required for $p \leq .01$), and the no delay-females performed significantly better than the one day delay-females (A = 3.33, with A = 3.09 required for $p \leq .05$). During the generalization phase, both the no delay-male and one week delay-male groups performed significantly better than the one day delay-male group (no delay-male vs. one day delay-male - A = 4.44, with A = 3.43 required for $p \leq .01$; one week delay-male vs. one day delay-male - A = 3.28, with A = 3.09 required for $p \leq .05$). There were no differences, however, among the female delay groups during generalization.

Another puzzling significant effect was the delay x sex x grade interaction ($p < .05$). A multiple comparisons analysis of this interaction indicated that only the first grade males showed a significant decrement after delay. The no delay and one week delay groups both performed significantly better than the one day delay group (no delay vs. one day delay - A = 4.38, with A = 4.37 required for $p \leq .01$; one week delay vs. one day delay - A = 4.75).

DISCUSSION

The present study provides additional support for the finding that abstract, rule-governed behavior can be acquired through modeling. An arbitrary equivalence rule which was not previously present in the subjects' repertoires was acquired as a result of observing a model demonstrate the rule without actually verbalizing it. Furthermore, subjects were able to apply this novel rule to a set of stimuli somewhat different from the training stimuli. The study also provides evidence that an imitation effect can be maintained for as long as one week after a relatively brief initial exposure.

As predicted, the length of time between exposure to a modeled task and the overt rehearsal of that task did affect imitation performance. A delay of one day between modeling and rehearsal resulted in a significant drop in performance. However, contrary to expectation, a one week's delay did not. At present, there is no known theory of memory and forgetting which could account for this unusual finding. It is highly unlikely that the consolidation hypothesis could explain this effect. According to this hypothesis, the so-called memory trace gets stronger and more resistant to forgetting as a consequence of the consolidation of the trace over time. It is generally believed that if such a process does take place in humans, it must occur very rapidly, i.e., in a matter of seconds (Kimble, 1967; Pribram and Broadbent, 1970). Thus an improvement in performance after 24 hours would not be predicted by any current theories of forgetting. Clearly, there is a need for more research varying the interval between exposure to a modeled task and the performance of the task to answer the question.

The hypothesis that performance is affected by an individual's expectation that he will have to perform the modeled task, was not supported. It is possible that the amount of information given the subjects in this study did not sufficiently result in varying retest expectations. Owing to the fact that subjects were drawn from two large classrooms, it is quite possible that subjects discussed the experimental task with one another and as a result, all subjects expected to be retested.

The results also indicated several puzzling interaction effects. For example, in the delay x grade x sex interaction a one day delay resulted in a significant drop in performance only for the first grade males. There is no apparent explanation for results such as this other than to attribute them to random sampling errors. The possibility for such errors is not unlikely in the multiple interactions given the small number of subjects per cell.

One somewhat striking result was the amount of difference in performance between the two age samples. Keeping in mind an age difference of one year, it is noteworthy that in the imitation-retest phase, 52% of the first graders performed the modeled task perfectly in contrast with only 7% of the kindergarten subjects. In the generalization phase, 27% of the first graders performed perfectly in contrast with only 2% of the younger children. It is thought by many (cf. White, 1965) that ages 5 to 7 is a transitional period in regard to cognitive growth. For example, it has been contended that in this age period children move from a simple, associational level of thinking to one which uses mediating concepts (Kendler and Kendler, 1962; Kendler, 1971). It is thus possible that the first graders' superior linguistic skills allowed them to verbalize and more efficiently apply the equivalence rule.

It was also noted in the present study that the modeling effect appeared to be primarily an all-or-none phenomenon. That is, subjects either performed correctly on most of the trials or performed incorrectly on all trials. The distribution of scores for the imitation-retest phase indicated that 39% of the subjects either scored correctly on all 12 trials or made a single error. Another 32% failed all trials. Thus, a total of 71% of the subjects apparently either learned the equivalence rule or did not. The same all-or-nothing phenomenon was evident in the generalization phase in that 75% of the subjects either failed all trials or made as few as one error. The same all-or-nothing effect occurred in the Rosenthal et al. (1971) study which used the same experimental task. In that study, 98% of the subjects made as few as one error or scored a maximum of one correct during the generalization phase. Apparently, if the child is able to discover the equivalence rule, he applies it in every trial.

In conclusion, it is clear that further research is needed to clarify the role of temporal variables in conceptual imitative learning. While it is likely that an imitation performance delay does result in some forgetting, considerable research will be needed to determine the temporal course of this forgetting.

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