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ABSTRACT

The effects of observing a model and of providing a response rule on the learning, transfer, and retention of a dial-reading, numerical concept were studied in 144 third-graders. Different experimenters conducted the immediate learning procedures versus the measurements of retention. No extrinsic reinforcers were promised or dispensed. The children profited both from modeling and from rule-provision, with the strongest learning, transfer, and retention displayed by the group that watched the model and also received the rule summary. Sequence of presenting the sets of retention stimuli (including a series of novel generalization items not previously encountered) did not influence the strength of concept retention six weeks after training. (Author)

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CONCEPT ATTAINMENT, TRANSFER, AND RETENTION THROUGH OBSERVATION AND RULE-PROVISION

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Abstract

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CONCEPT ATTAINMENT, TRANSFER, AND RETENTION THROUGH OBSERVATION AND RULE-PROVISION[1]

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Current research on social learning phenomena has been increasingly directed to the cognitive realm. One main thrust has involved the modification of children's language responses, and here modeling has been shown to affect the formation of simple sentences (Carrol, Rosenthal, & Brysh, in press; Rosenthal & Whitebook, 1970), more complex sentence rubrics (Harris & Hassemer, in press; Rosenthal & Carroll, in press), the production of rule-consistent types of questions (Rosenthal & Zimmerman, in press a; Rosenthal, Zimmerman, & Durning, 1970), and the use of selected constructions, such as prepositional phrases, both natural (Bandura & Harris, 1966; Odom, Liebert, & Hill, 1968) and ungrammatical (Liebert, Odom, Hill, & Huff, 1969) in form. In certain of these experiments, the children not only "imitated" the model's usages but, without any additional training, transferred the rule-consistent pattern to new stimuli.

A second main concern has dealt with concept-formation. The observational learning and transfer of conceptual responses has been demonstrated with multidimensional conservation tasks (Rosenthal & Zimmerman, in press b), with a simple equivalence problem (Rosenthal, Moore, Dorfman, & Nelson, 1971), and with a much more demanding stimulus discrimination problem

(Zimmerman & Rosenthal, in press). All these studies assessed short-term effects. A necessary next step is to examine relationships between observational learning and later memory. One must determine if vicariously-instated responses maintain stability well after training has been completed.

In a previous experiment, Rosenthal, Alford, and Rasp (in press), using a complex clustering task, found that modeling created substantial immediate concept acquisition and transfer. After several weeks' delay, the children were retested and retention proved to depend on the combination of modeling and simultaneous verbal coding which they had witnessed earlier. Although evidence of retention was obtained, concept maintenance required both observation of the model's cluster and stronger mnemonic verbal coding during her demonstrations. The children who only observed the model perform silently did not significantly exceed their baseline mean when reassessed. It thus seemed important to confirm that, by itself, observation of a model can produce retention of an abstract paradigm.

In the previous design, the effect of providing a rule to guide response was not wholly separated from verbal coding as the model executed her response demonstrations. Although children who both observed a strong verbal code and later received a summary rule showed the best immediate learning and transfer, their performance declined after delay, relative to the strong code, no rule group. However, control children given the rule with no other training did show some later concept retention. Therefore, it seemed desirable to study rule-provision, with and without modeling, when the additional influence of mnemonic codes was eliminated. It was predicted that modeling and rule-provision would each assist learning, with the strongest effects occurring when the two procedures were combined.

Several other features of the present operations merit attention as steps to expand the applicability of conceptual social learning. The prior study used two stimulus sets to assess both immediate learning and retention. If a concept (e.g. telling time) has been learned and retained with some stability, a child should be able to utilize his knowledge when new dial-surrounds are encountered, as with clock faces that differ in color, shape, and spatial proportions of dial, hands, and numerals. For this reason, along with the sets of stimuli used in immediate learning, the present retention tests included a new set of stimuli whose concept-irrelevant visual details were very different from those previously presented. Indeed, the social learning viewpoint assumes that conceptual paradigms are abstracted which, through judicious selection and inference, then guide response to specific stimulus instances (e.g. Rosenthal & White, in press). In contrast, a more mechanical view of "association" would, presumably, expect that prior pairing should establish decidedly stronger response strengths to the initial training stimuli, and to the order of stimulus presentation that most closely approximated the initial conditions of learning (see Melton, 1963). Thus, the sequence of administering the three sets of retention stimuli was systematically varied, and the effect of differences in order was analyzed.

Unlike the previous clustering concept (which emphasized the object class of stimuli), the present concept required the child to coordinate the color and dial-position of an arrow to the color and number of response items, thus giving more prominence to a variable, numerical attribute.

Finally, all the retention data were collected by an experimenter who did not know the design or hypotheses of the study, who was unaware of the children's scores during original learning, and who was a stranger to the children. The retention data were thus freed from any putative expectancy effects on the part of the experimenter (e.g. Rosenthal, 1969), from dependence on the personalities of particular adults, and from the sorts of subtle context effects discussed by Postman (1968), in which presumably-negligible constancies, like the same experimenter, can sometimes become attached as discriminative stimuli that partly maintain response strength.

METHOD

Subjects and Experimenters

From third grade classes at three schools serving middle-income Anglo-American areas of Tucson, 72 boys and 72 girls were randomly drawn and assigned to each factorial combination of treatments. The children ranged in age from 7.5 to 10.5 years, with a mean age of 8.6 years. A female graduate student served as experimenter and a male graduate student served as the model during immediate learning procedures; a different female experimenter collected the delayed data. All adults were Anglo-Americans in their twenties, with no striking departures from average characteristics.

Task Materials

Three sets of stimulus cardboards were prepared. The first set, which was used in baseline, for training, and for the immediate and delayed imitation phases, comprised 2 X 2 in. square outlines drawn in black india ink on white cards. From the border of the square base a perpendicular, one in. arrow was drawn in one of four positions: up, down, left, or right. These arrows occurred in three colors, blue, red, or yellow (BRY), and the combination of colors X positions thus created 12 BRY-squares stimulus cards. The response materials were 18 sewing spools, six being painted in each of the BRY colors. The rule required coordinating the arrow-position to a number, with up = 1, left = 2, down = 3 and right = 4, analogous to a dial with four counter-clockwise positions to specify the number of spools to be used. The arrow's color denoted the color for spool selection. Thus, with a red arrow in the up position, one red spool was the correct response; with a blue arrow in the left position, two blue spools was the correct response; and with a yellow arrow in the right position, four yellow spools was the correct response, etc. The second set of stimulus cards, (BRY-circles), was used for immediate and delayed transfer. These stimuli had circular bases of one in. radius from which projected arrows ½ in. long in the same four positions, and blue, red and yellow colors as above. The response materials (BRY spools), and the rule relating arrow-position and color to correct response were identical.

The third set of stimuli was used only for a delayed test of stringent generalization, in which the colors of both stimulus and response materials, as well as the basal shape of the stimuli, were varied. The stimulus bases were "diamonds" (rhomboids) of one in. radius from which, in the same four positions, projected two in. arrows in the colors green, orange, and purple (GOP). The rule for correctly coordinating arrow color and position to response was the same, but the response spools for the GOP stimuli were painted in the green, orange, and purple colors.

Thus, although the basic relation of dial position and color to spool-selection remained constant, the task materials varied in the basal shapes of the stimuli, in the length of the arrow (equal to the radius of BRY-squares; one-half the radius of BRY-circles; twice the radius of GOP-diamonds), and in the arrow and spool colors between the BRY and GOP materials. All stimuli were drawn on 8 X 8 in. white cards which were mounted in ring-binders.

Procedure and Design

Immediate learning and transfer. The child was taken individually from class to a test room by the experimenter, introduced to the model, and was directed by the experimenter as follows: "We're going to play a game of picking spools. First, I'm going to show you a set of picture cards, one at a time. For each card, you try and guess how many spools are the right answer. Sometimes the right answer is just one spool, but most of the time the right answer needs more than one spool. Here's the first card; now you pick one or more spools, and put your spool-guess here (on a sheet of paper). Now put your spools back in the box and I'll show you the next card, etc."

After baseline, the no-model, no-rule control group was instructed as follows: "Now that you have had a chance to get to know the game better, we'll give you another turn with the same pictures. Here's the first card; put your spool-guess on this paper, etc." The BRY-squares were then readministered. These same directions were also given to the no-model, with rule-provision group which also received the following rule information before responding to the stimuli: "Now, before your next turn, let me give you a good rule for playing this game. The arrow moves like a backward clock and tells you how many spools to pick. When the arrow is up, you need just one spool; when the arrow is left, you need two spools; when the arrow is down you need three spools; when the arrow is right you need four spools. The color of the arrow tells you which color of spools to pick to be correct."

Modeling groups were instructed after baseline as follows: "Okay, this man is going to show you a good way to play this game. You watch him carefully and you'll have another turn later." The model then selected the correct numbers and colors of spools for each card while the child observed.

The model performed silently throughout and received neither praise nor feedback from the experimenter. Subsequent to the model's demonstration, the BRY-squares task was again given to the model, no-rule group. The experimenter provided the same rule directions (as above) to the model plus rule group, before readministering the BRY-squares task.

Next, with no further training, the BRY-circles were introduced, and all children were instructed as follows: "Now we'll play the game with some new pictures. For each card, you try to guess or figure out how many spools are the right swer. Here's the first card; pick the number of spools you think are right and then put them on this paper, etc." Upon completing this first transfer task, the child was thanked, praised for his performance, and returned to class. Thus, for immediate learning, the design involved a 2 (rule, no-rule) X 2 (modeling, no-modeling) X 3 (baseline, imitation, and transfer trials) factorial with 18 boys and 18 girls in each cell.

Delayed retention and generalization. After some six weeks, the second (new) experimenter returned to the school and reassessed the children in roughly the same order in which they were initially studied. The new experimenter was naive with respect to the nature of the rule (and simply recorded each child's actual spool choices per card), to the prior experimental treatment given the child, and to his previous performance. The sequence of presenting the BRY-squares, the BRY-circles, and the new, GOP-diamonds was systematically varied so that, by random assignment, 3 boys and 3 girls from each condition of original training were exposed to each of the six possible orders of presenting the three sets of delayed phase stimuli.

Whatever the order of stimulus presentation, the experimenter introduced the first set of stimuli as follows: "Okay, you probably remember that a few weeks ago you played a game of picking spools. Today we're going to play that same game again; probably some of the pictures you see today will be familiar to you; other pictures will be new. Anyway, you remember that I will show you a set of picture cards, one at a time. For each card, you try to remember, or figure out, how many spools are the right answer. Here's the first card; now you pick one or more spools from this box (pointing) and put your spools here (on a sheet of paper), etc."

Both the BRY and GOP spools were visible to the child, but in separate boxes, and the experimenter pointed to the spools of the same color as the stimuli in giving her instructions. After the first delayed trials, the second and the final sets of stimuli were each introduced by the experimenter as follows: "Here are some other cards; keep on picking spools from this box (pointing), etc."

The design compared the original baseline scores to performance on the delayed tasks, across presentation sequence, for the modeling and rule variations in a 2 (rule, no/rule) X 2 (modeling, no/modeling) X 6 (sequence) X 4 (trials) factorial design. For both immediate and delayed data, all _post-hoc_ comparisons (e.g. comparing baseline performance to the scores on the BRY-squares, BRY-circles, or GOP diamonds, independent of their order of presentation) were made with Tukey HSD tests (Kirk, 1968). Orthogonal comparisons by a multiple _t_-test (Kirk, 1968) were used to assess the performance of the model, no-rule versus the rule, no-model groups, and to compare the average of these groups with the performance of the strongest, model _plus_ rule group, on all trials after baseline.

RESULTS[2]

Immediate Data

For all phases, the means for each treatment group, and for subjects combined on the basis of modeling and rule variations, are presented in Table 1.

Insert Table 1 about here

From the overall analysis of variance, there was found a significant trials effect showing increased concept-attainment from baseline to imitation and to transfer phases ($F = 118.70$; $df = 2/280$; $p < .001$). Significant main effects for modeling ($F = 19.03$; $df = 1/140$; $p < .001$) in favor of children who had observed the model perform, and for rule-provision ($F = 37.30$; $df = 1/140$; $p < .001$) in favor of children who had received the rule, also were obtained.

A significant modeling X phases interaction term ($F = 12.92$; $df = 2/280$; $p < .001$) was found. Analysis of this interaction by Tukey tests revealed that the treatment conditions had not differed in baseline, and each variation increased its scores from baseline to imitation and to transfer phases (all ps < .01), with no significant decline from imitation to transfer. However, the modeling subjects outperformed non-modeling subjects in the imitation and the transfer phases (both ps < .01).

Similarly, rule provision interacted with phases ($F = 33.52$; $df = 2/280$; $p < .001$). The rule and non-rule variations did not differ during baseline, and each condition increased its scores significantly from baseline to imitation (both ps < .01). The rule-provided subjects also incrased from baseline to transfer ($p < .01$), with no significant decline from imitation to transfer phases; in contrast, non-rule subjects did not significantly exceed their baseline mean during transfer, and declined significantly ($p < .05$) from imitation to the transfer phase. Further, the rule-provided subjects surpassed the scores of their non-rule counterparts in the imitation and transfer phases (both $ps < .01$). The three-way interaction term failed to approach significance.

Orthogonal comparisons disclosed no difference between the rule, no-model and the model, no-rule treatments during imitation. However the model plus rule group significantly surpassed ($p < .01$) the average of the two foregoing conditions. In the transfer phase, the rule, no-model subjects outperformed the model, no-rule subjects ($p < .01$), but the model plus rule group again significantly surpassed ($p < .01$) the average of the two other groups.

Delayed Data

The phase means for the several treatment combinations are also presented in Table 1. The overall analysis of variance revealed a significant trials effect ($F = 47.94$; $df = 3/359$; $p < .001$), showing that scores had increased from baseline to the delayed phases. Significant main effects were again obtained for modeling ($F = 10.14$; $df = 1/120$; $p < .002$) with children who had observed the model scoring higher, and for rule-provision ($F = 16.20$; $df = 1/120$; $p < .001$) in favor of children who received the rule statement. The sequence of presenting the stimulus sets (BRY-squares, BRY-circles, and GOP-diamonds) failed to create a main effect ($F < 1.0$, NS) or significant interactions (largest $F = 1.89$; $df = 5/120$; $p = .10$), suggesting that the children's information-processing capacity was robust enough to overcome differences in the order of presenting the delayed stimuli.

A significant modeling X phases interaction term ($F = 4.33$; $df = 3/359$;

p < .006) was found. Both the modeling and the non-modeling subjects (who had not differed at baseline), displayed significant increases from baseline to each of the three delayed phases (all ps < .01). Further Tukey tests revealed that the modeling subjects outperformed the non-modeling subjects in each of the delayed phases considered seperately (all ps < .01).

Similarly, a significant interaction was found between rule-provision and phases (F = 11.06; df = 3/359; $p < .001$). Both the rule-provided and no-rule subjects (who had not differed at baseline) increased significantly from baseline to delayed imitation and to stringent generalization phases (all ps < .01). However, whereas the rule-provided children also surpassed their baseline mean in delayed transfer ($p < .01$), the no-rule subjects failed to significantly exceed their baselines in the delayed transfer phase. Further Tukey tests also supported the superiority of the rule-provided children, who surpassed the no-rule condition in each of the three delayed phases (all ps < .01). Excluding the sequence of presentation data, already discussed, no other interaction terms approached significance (all Fs < 1.0, NS).

Orthogonal comparisons were applied to retention results. No differences between the model, no-rule, no-model groups were found in any of the delayed phases. However, the model plus rule group outperformed the average of both other groups with the imitation ($p < .01$), the transfer ($p < .01$), and the stringent generalization ($p < .05$) stimuli.

DISCUSSION

To our knowledge, this is the first demonstration that from observation alone, unaided by other means of conveying information, a concept can be retained and generalized to novel stimuli after a substantial elapse of time. Similarly, providing a correct verbal rule was an even briefer, and hence more efficient, method for producing concept learning, transfer, and retention in third-graders under the present conditions. Empirically, modeling and rule-provision were not redundant operations: the children who received both procedures performed best in every phase; no interactions involving the alternative operations jointly, nor their combination with any other variate, were found. It cannot be argued that either training method merely elicited readily available concept discriminations because, in such a case, modeling, rule-provision, or their sum should have created response strengths near asymptote, in contrast to the actual findings.

The results further suggested that children acquired and stored a mnemonic paradigm or cognitive rubric, rather than discrete links to particular physical stimuli. Thus, under short-term conditions, neither the modeling nor the rule-provision subjects declined significantly from imitation to transfer phases. Perhaps more striking, weeks later concept retention was unaffected by the sequence of presenting the original training, transfer, or the new--generalization--stimuli. If response were mediated by narrowly defined S - R "links", then the order of presentation closest to prior experience should have given the strongest retention, and presenting the novel stimuli first should have created some discernible interference. Put otherwise, in any system emphasizing stimulus features, generalization should drop off as the visible properties of test stimuli depart from those of training stimuli. In contrast, if organized relationships are abstracted and remembered, then learning should be relatively stable across a range of stimulus details if the rule-governed motif remains invariant, as in the present data. Certainly, without resort to inferential processes, one has difficulty explaining why the children who, after delay, first encountered the stringent generalization items were able to take them in stride. Based on color, shape, ratio of arrow to base, and before the more familiar items could "prop" recall of the concept, one might have expected markedly reduced scores with the new stimuli.

The foregoing argument is important for social learning theory because of Bandura's (1969, in press) views on acquisition through observation. He assumes a mediated contiguity position in which, without overt practice, stimulus-response chains are stored through covert, symbolic processes. When the model displays a high standard for self-reinforcement, or a vigorous attack on a hapless Bobo doll, what is crucial is the observer's reproduction of the behavior sequences demonstrated. However, when the model exemplifies rule-consistent, conceptual behavior, a paradox of sorts arises. Literal emulation ("imitation") by itself might result from copying of the motor and speech responses modeled. It becomes necessary to confirm, through tests of transfer, that symbolic paradigm has been learned. Having shown this, as in the present results and the experiments cited earlier, one seeks to explain it in the same mediated contiguity terms that Bandura has invoked for social learning generally. To do so, one must suppose that, at least in part, the child can abstract the governing idea of the concept series and recognize its relevance not only to the training stimuli, but to the transfer stimuli as well. Recourse to inference, then, was first required to maintain Bandura's theoretical viewpoint in the face of data showing conceptual transfer from observational learning. It is both interesting and encouraging that research partially aimed at defending a theoretical necessity has produced early evidence to favor an inferentially-mediated contiguity notion. Thus, the absence of a relationship between presentation-sequence and retention in the present study, results showing an increase in children's ability to give a correct response rule from observing a silent modeling procedure (Rosenthal & Zimmerman, in press b), and a variety of data questioning a mechanical conception of word association (Rosenthal & White, in press), all shared as original impetus the goal of maintaining in tact basic premises of social learning theorizing by expanding its conception of symbolic, covert mediation to admit inferential reasoning. It is also reassuring that the retention, and further generalization, of the dial-reading, numerical concept was obtained by a wholly-naive experimenter, who could hardly have exerted social influence or expectancy effects upon children she had never met before.

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Footnotes

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2. All tests of significance reported in this paper were based on two-tailed probability estimates.

Table 1

Means by Phase for Each Treatment Group and for

Combined Modeling and Rule Variation

Group	Immediate Data Phase			Delayed Data Phase		
	Base-line	Imita-tion	Trans-fer	Imita-tion	Trans-fer	General-ization
Separate Cells						
Model no rule	1.69	5.42	3.92	3.81	3.67	3.92
Model plus rule	1.89	8.25	7.36	6.19	5.78	5.44
Rule no model	1.39	5.92	5.69	4.64	4.11	4.25
No model no rule	1.81	2.28	1.58	2.42	1.86	1.97
Combined Subjects						
All Modeling	1.79	6.83	5.64	5.00	4.72	4.68
All nonmodeling	1.60	4.10	3.64	3.56	2.99	3.11
All rule	1.63	7.06	6.53	5.42	4.94	4.85
All nonrule	1.75	3.85	2.75	3.14	2.76	2.94