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ABSTRACT

Low (conjunctive), medium (disjunctive), and high (biconditional) level concept attainment problems were used to assess whether high level versus low and/or medium difficulty concept rules yield less positive transfer for observers than models. Direct learning and transfer of models was compared with vicarious learning and transfer of observers. Subjects in the latter condition observed yoked models solved the initial problem before solving the intrarule transfer task themselves. Conjunctive results were similar for models and observers with efficient solution occurring for both. However, greater positive transfer was apparent for models than observers in the biconditional task. Significant positive transfer occurred for both models and observers attaining the disjunctive rule. (Author)

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Abstract

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It is apparent that across repeated problems of the same rule type, a learning-to-learn effect occurs (DiVesta & Walls, 1969; Haygood & Bourne, 1965). Further, concept rules appear to range in difficulty from simple affirmatives and conjunctives to biconditional concepts. Bourne (1970) suggests, when primary bidimensional rules are used, that a truth table problem solving format may be used to represent attribute and dimensional relationships. That is, the conjunctive (Red $\cap$ Square) is exemplified only by the TT or True-True stimulus class where both red <u>and</u> square are present; TF, FT, and FF are negative instances. The disjunctive (Red $\cup$ Square) is exemplified by TT, TF, and FT where either red <u>or</u> square is present. The biconditional is a complex concept ($R \leftrightarrow S$; $[(R \cap S) \cup (\bar{R} \cap \bar{S})]$) exemplified by TT and FF. In the biconditional, red patterns are examples <u>if and only if</u> they are square. Not-red -- not-square are also positive instances.

In the classroom students are often expected to acquire simple and complex concepts through demonstrations, films, attribute naming by teacher and peers, or other vicarious processes. Although "higher order" forms of acquisition and generalized novel combination learning can be transmitted to observers through exposure to modeling cues, imitation theory predicts greater difficulty in modeling more complex behavioral sequences (Bandura, 1965). When concept attainment requires the use of complex strategies or rules by the model, the solution cues apprehended by the observer may not constitute a sufficient sample to permit both rule and attribute attainment (Bandura & Walters, 1963).

The purpose of the experiment reported here was to examine the hypothesis that concepts requiring more complex combining rules are less easily learned vicariously, than directly.

Method

Design

There were two between subjects factors (Learner and Concept) and one within subjects factor (Problems) in the 2X3X2 mixed design. The Learner factor included subjects designated as models who solved two concept problems involving the same rule but different attributes, and observers who solved only the second problem, after observing attainment of the initial concept. The three levels of Concept difficulty were conjunctive (low), disjunctive (medium), and biconditional (high), thus making a Learner x Concept x Problems design. The original and transfer repeated Problems constituted the within subjects factor, although subjects serving as observers during original learning were yoked to their respective models. That is, observers were assigned the same original learning scores as their models for computation of transfer effects.

Subjects

A total of 60 volunteer subjects (28 males and 32 females) participated in this experiment. The subjects were summer school students enrolled in graduate educational psychology courses at West Virginia University. They were randomly paired into model-observer dyads; these pairs were assigned to one of the three concept conditions with the restriction of equal numbers of subjects in each condition.

Procedure

The stimulus materials were standard 3 in. x 3 in. cards from the Wisconsin Card Sorting Test. A 54 card deck was composed of two identical

sets of 27 cards. The 27 cards were selected to represent three stimulus dimensions (color, shape, and number) with three attributes each (red, yellow, blue; circle, triangle, star; and 1, 2, 3, respectively). Each problem required attainment of a concept with two relevant attributes (e.g., red-circle) (Bourne, 1970). There was one irrelevant dimension in each problem.

The observer was seated to the model's left at a table; the experimenter was seated opposite the model. The observer was instructed to,..."observe carefully what we do, and learn as much as you can..." The model was given standard reception learning instructions. The dimensions and attributes were described, and the model was told that only two attributes would be relevant and that the presence or absence of a particular attribute/s could be important. A correction procedure required the model to shift incorrect sorts, face up, to the opposite pile. Following solution (27/27 correct) of the original problem by the model, the transfer phase was begun. The models and observers were counterbalanced so that half of the models were presented the transfer task immediately after attainment of the initial concept, and half waited outside the experimental room while the observer solved the transfer problem. Subjects were instructed that the transfer task would involve two new attributes related in the same way as in the former problems, i.e., by the same rule.

Results

Performance was measured by trials to criterion (including 27/27 criterion run) and the number of errors. These means and standard deviations are reported in Table 1. A one-way analysis of variance indicated that immediate versus delayed solution of the transfer problem (counterbalancing) was not a significant factor ($F = 0.01$, $df = 1/58$, $p > .05$ for trials and $F = 0.02$, $df = 1/58$, $p > .05$ for errors). Accordingly, this factor was collapsed

for subsequent analyses.

Insert Table 1 about here

A one-way analysis of variance was computed of the difficulty for models on the initial problem (original learning). This analysis yielded $F = 61.82$, $df = 2/27$, $p < .01$ for trials and $F = 14.73$, $df = 2/27$, $p < .01$ for errors. Duncan multiple comparisons indicated that the biconditional did not differ significantly from the disjunctive for trials ($p > .05$) and for errors ($p > .05$). The disjunctive was more difficult than the conjunctive for trials ($p < .01$) and for errors ($p < .01$). Conjunctive of course was also different from biconditional for trials ($p < .01$) and errors ($p < .01$). As may be noted in Table 1, the trials means for conjunctive, disjunctive, and biconditional were 54.70, 164.50, and 184.40 respectively.

Trials and errors for the transfer task were analyzed by a 2 (model, observer) by 3 (conjunctive, disjunctive, biconditional) analysis of variance. Again, there was a significant Concept main effect ($F = 18.70$, $df = 2/54$, $p < .01$ for trials and $F = 24.98$, $df = 2/54$, $p < .01$ for errors). There were multiple comparison differences between biconditional and disjunctive for trials ($p < .01$) and errors ($p < .01$). Biconditional also differed from conjunctive for trials ($p < .01$) and errors ($p < .01$). Disjunctive did not differ from conjunctive for trials ($p > .05$) or errors ($p > .05$). Other effects were nonsignificant. Thus, the disjunctive means shifted markedly from original learning to transfer.

Separate one-way within subjects (original to transfer) analyses of variance were computed for each of the six conditions to determine if positive transfer occurred. These analyses yielded significant positive

transfer for models attaining the biconditional ($F = 8.41$, $df = 1/9$, $p < .05$ for trials and $F = 6.50$, $df = 1/9$, $p < .05$ for errors). Observers, however, did not show significant transfer ($F = 3.88$, $df = 1/9$, $p > .05$ for trials and $F = 0.56$, $df = 1/9$, $p > .05$ for errors). Models yielded significant positive transfer with the disjunctive ($F = 9.47$, $df = 1/9$, $p < .05$ for trials and $F = 26.90$, $df = 1/9$, $p < .01$ for errors) as did the observers, ($F = 36.98$, $df = 1/9$, $p < .01$ for trials and $F = 29.93$, $df = 1/9$, $p < .01$ for errors). Neither models nor observers produced significant transfer with the conjunctive rule ($p > .05$). This latter finding is apparently due to the low number of initial trials and errors, allowing little room for improvement.

Discussion

These results considered with the means reported in Table 1 indicate the following. Conjunctive, disjunctive, and biconditional solution rules differ in task difficulty in that order. This finding is in agreement with former studies (Bourne, 1970). Low level or easy concepts are attained rapidly by both models and observers. Greatest positive transfer occurs with concept classes of intermediate initial complexity, such as disjunction. Observers may even show greater positive transfer than models at this level. Although models produced significant positive transfer for biconditional trials and errors, observers did not. These findings are in accordance with the hypothesis. The less pronounced transfer for biconditional as compared to the disjunctive may be in part a function of the fact that several models did not reach criterion within 192 trials in the biconditional. There may thus have been greater transfer as a group if complete mastery had been required in original learning. However, since no learning criterion was required of observers in original learning, a constant number of trials (i.e., 192 trials) as a standard for termination appears advisable.

Other investigations have demonstrated large positive transfer effects with disjunctive rules (Bourne, 1970; DiVesta & Walls, 1969). While observers reduced mean errors by a small amount (54 to 45) with the biconditional rule, the disjunctive mean was reduced from 45 to 7 errors. In the paired-associate paradigm, Simin, Ditrichs, and Martin (1969) found model-observer differences to be more pronounced in the A-B, A-B′ condition than A-B, C-D warm-up or A-B, A-C classical interference. The A-B, A-B′ format is similar in some respects to repeated concept examples in which the rule remains the same and the attributes vary within the same dimensions (DiVesta & Walls, 1967).

Bourne (1970) likens acquisition of the truth table strategy to "4:2 paired-associates tasks." Bandura and Walters (1963) suggest that acquisition of larger segments or entire behavior patterns rather than strengthening of stimulus-response subunits typically occurs when a model is provided. However, when the model uses complex strategies or rules, sufficient solution cues may not be sampled by the observer. Solution may indeed by more difficult when the structural, hierarchical model of concepts (Bourne, 1970) is entered at the rule level than when prerequisites at the attribute level are provided to facilitate transition through exemplar and class levels to rule attainment.

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Footnote

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Table 1

Means and Standard Deviations

for Trials[a] and Errors to Criterion

Learner	Rule		Trials		Errors	
			Original	Transfer	Original	Transfer
Model	Conjunctive	M	54.70	48.80	7.50	4.10
		SD	19.30	16.55	2.69	2.38
Model	Disjunctive	M	164.50	98.60	45.80	16.40
		SD	36.13	58.82	18.40	13.49
Model	Biconditional	M	184.40	137.00	54.20	43.20
		SD	20.57	55.55	26.95	26.80
Observer	Conjunctive	M	54.70[b]	54.40	7.50[b]	5.20
		SD	19.30	20.43	2.69	4.99
Observer	Disjunctive	M	164.50[b]	58.90	45.80[b]	7.00
		SD	36.13	28.36	18.40	5.81
Observer	Biconditional	M	184.40[b]	143.40	54.20[b]	45.00
		SD	20.57	55.89	26.95	28.72

[a]Trials include 27/27 criterion run.

[b]Yoked scores same as model.