ASSESSING MOTIVATIONAL AND INFORMATIONAL FUNCTION OF VICARIOUS REINFORCEMENT AND NUMBER OF OBSERVATIONAL TRIALS IN OBSERVATIONAL LEARNING

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To examine factors of success in observational learning, 132 second graders were assigned to three experimental groups, C-P, I-N and M-M. The C-P group observed the model's correct demonstration and was given positive reinforcement contingent on correct response. The I-N group observed the model's incorrect demonstration and was given negative reinforcement contingent on an incorrect response. The M-M group observed the model's correct or incorrect demonstration and was given positive or negative reinforcement contingent on a correct or incorrect response. Another experimental variable was the number of observational trials, four, eight and 16. It was found that the number of correct response in the I-N group was higher than the M-M group, but was lower than the C-P group. Because subjects in the C-P group consistently responded to the relevant cue regardless of the number of observational trial, they were the only group of subjects who significantly achieved observational learning. It is concluded that observing the model's correct demonstration and receiving positive reinforcement for correct responses are essential for success in observational learning.

Miller and Dollard (1941) first reported that imitation could be explained in terms of S-R theory. Since Bandura, Ross, and Ross (1961) studied the acquisition of aggressive behavior through observation, a number of experiments on observational learning have been conducted. One of many problems in observational learning has been the effect of vicarious reinforcement (Thelen & Rennie, 1972). Kobashigawa (1968) studied the effect of a model's demonstration and vicarious reinforcement

on observational learning in school children. It was suggested that the model's demonstration might be sufficient for the accomplishment of observational learning and that vicarious reinforcement was not necessary. On the other hand, when Sukemune, Toshima, and Inoue (1971) examined the effect of vicarious reinforcement and verbalization, they found that the effect of vicarious reinforcement was not necessarily negligible in accomplishing observational learning.

Hirakawa and Nakazawa's study (1977) examined the effects of vicarious reinforcement on discrimination shift-free behaviors with different dimensional stimuli, under conditions of simple task (two dimensions with two values) and complex task (three dimensions with two values), using school children. One of hypotheses was that in the simple task situation there would be no difference in the number of subjects

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TABLE 1
Experimental design and subjects in the present study

			Group					
			C-P		I-N		M-M	
Observational learning	Number of observational trials	4	Boys : 6 Girls : 6 8 : 05 (7 : 11-8 : 08)		Boys : 6 Girls : 6 8 : 05 (8 : 01-8 : 10)		Boys : 6 Girls : 6 8 : 04 (7 : 11-8 : 11)	
		8	Boys : 6 Girls : 6 8 : 04 (8 : 01-8 : 08)		Boys : 6 Girls : 6 8 : 06 (8 : 02-8 : 10)		Boys : 6 Girls : 6 8 : 04 (8 : 00-8 : 10)	
		16	Boys : 6 Girls : 6 8 : 05 (8 : 00-8 : 10)		Boys : 6 Girls : 6 8 : 04 (8 : 00-8 : 10)		Boys : 6 Girls : 6 8 : 07 (7 : 11-8 : 11)	
Direct learning			Boys : 12 Girls : 12		8 : 05 (7 : 11-8 : 10)			

who achieved observational learning in the vicarious and non-vicarious reinforcement conditions, while in the complex task situation the number of subjects who learned in the vicarious reinforcement condition would be more than the number of subjects who learned in the non-vicarious reinforcement condition. They found that in the simple task, most of the subjects who observed the model's demonstration under the non-vicarious reinforcement conditions achieved observational learning as well as subjects under the vicarious conditions. However in the complex task, almost half the subjects of the non-vicarious reinforcement condition were unable to achieve observational learning while most of the subjects in vicarious reinforcement condition were able to do so. Thus, it might be inferred from these results that the effectiveness of vicarious reinforcement in observational learning is due to the degree of the task complexity.

From the above, the question may be raised as to the kind of functions vicarious reinforcement might have. Bandura (1965, 1971a, 1971b, 1977) classified functions into five categories—informational, motivational, emotional learning, valuation and influenciability. He especially emphasized the informational and the motivational functions of vicarious reinforcement.

The primary purpose of the present

study is to examine the motivational function of vicarious reinforcement. If vicarious reinforcement has this function, it would be expected that subjects who observed a model reinforced positively would be more motivated than subjects who observed a model reinforced negatively. Similarly, subjects who observed a model reinforced both positively and negatively would be more motivated than the subjects who observed the model punished.

As for informational function, in the 2-choice simultaneous discrimination task, observing a model who chose one stimulus and then was reinforced negatively would provide the information that the other stimulus must be the correct one. According to this assumption, therefore, the subjects who observed the model reinforced positively would be theoretically equal to those who observed the model reinforced negatively in terms of the information quantity on relevant cue in a 2-choice simultaneous discrimination. Similarly, the subjects who observed the model reinforced both positively and negatively would be equal to the other groups in terms of the information quantity on relevant cue.

Three groups were used in the present study (see Table 1). A first group observed a model making a correct response and then being reinforced positively with the word "good" (C-P group). A second

group observed a model making an incorrect response and then being reinforced negatively with the word "wrong" (I-N group). A third group observed a model making a correct or an incorrect response randomly, and then being reinforced accordingly to the response (M-M group).

The task was a 2-choice simultaneous discrimination, with the informational function on the relevant cue being equal for all three groups. However, of the three groups, C-P group would have the highest number of positive vicarious reinforcements, which could effect the motivational function of vicarious reinforcement. The M-M group would be to the C-P group and the I-N group would be third on the number of positive vicarious reinforcement. It is expected that the number of correct responses would differ among the three groups such that the C-P group would receive the highest number of correct responses on the test trial, the M-M group would receive the next highest and the I-N group would receive the lowest.

Another purpose of this study is to examine the number of observational trials to accomplish observational learning. There have been few studies which examine the number of trials for observational learning to occur (Haruki, 1965). Since a single observational trial which has been predetermined by the experimenter has been employed in most studies of observational learning, there has been no determination as to when observational learning has occurred. Under such experimental conditions, when a model's demonstration was finished, some subjects might over-learn while others might not have achieved learning. To investigate this problem, in the present study, number of observational trials is used as an experimental variable. By this experimental variable, whether a few or many observational trials are required for observational learning to occur will be made clear. At the same time, whether or not

the number of observational trials affects the C-P, I-N and M-M groups differently can be examined.

METHOD

Subjects

The subjects were 66 male and 66 female second-grade children in Hiroshima and Kagoshima. They ranged from 95 to 107 months in age, with a median age of 101 months (see Table 1). None of the subjects had ever participated in an experiment of this kind. The subjects were assigned at random to each of the three experimental groups.

Models

Six male undergraduate students, who were trained for the purpose, played the role of model for the subjects.

Task

The same task was used in both observational and test trials. The task consisted of three dimensions with two values and were 2-choice simultaneous discrimination tasks. The three dimensions were color, form and frame. The two values for color were red (hue 5R, chroma 12, value 4) and blue (hue 10B, chroma 10, value 4). The values for form were circle (11 cm in diameter) and triangle (12 cm in base line, 10 cm in height, sham size was equal to circle). For frame, the value were solid and dotted.

Two stimulus materials containing three dimensions with two values were presented on a single card consisting of 35.5×17 cm white

FIG. 1. An example of stimulus pairs.

square (see Fig. 1).

Experimental Design

Firstly, subjects of direct learning group (control group) were tested until they reached a criterion of eight consecutive correct responses. They were equally assigned to receive one of six cues—red, blue, circle, triangle, solid and dot frame. Models chose each cue corresponding to the relevant cue of each subject. The subjects were reinforced contingently with “good” or “wrong” by the experimenter. If the subject did not become aware of the relevant cue, direct learning was discontinued at 40 trials. It was found that for the six cues, there was no significant sex difference on the number of trials to a criterion. The mean number of trials to criterion in the direct learning group (which contained trial to a criterion) was 23.67 ($SD=12.25$). It was determined that they responded eight consecutive correct responses from the 17th trial.

Based on the finding that the direct learning group expended 16 trials to find the relevant cue, the number of observational trials was set at 16 trials. Moreover, on the assumption that observational learning was more economical than direct learning, eight and four observational trials were also added as experimental variables.

In the M-M group, models demonstrated 50% correct and 50% incorrect responses according to the Gellermann (1933) series and immediately were rewarded or punished contingently on the grounds that 16 trials to criterion in the direct learning group contained (about an equal number of) correct and incorrect responses.

Subjects of the C-P group observed the model demonstrating correctly, and then being rewarded with the word “good” from the experimenter. Subjects of the I-N group observed the model demonstrating incorrectly, and then being punished with the word, “wrong.” In the M-M group, subjects observed him demonstrating correctly or incorrectly and then being rewarded or punished contingently. Thus, the experimental design in the present study was a 3×3 factorial design

with the number of observational trials (four, eight and 16) and the contents of model's demonstration and receiving vicarious reinforcement (the C-P, I-N and M-M groups).

General Procedure

Observational trial. Subjects were assigned randomly to each condition with the restriction of equal numbers of males and females. The subjects were brought individually to the experimental room and given the following instruction. “Now, let's begin a guessing game. Before you begin to choose, he (the model) will first demonstrate the choosing of cards. If his choice is correct, I will say ‘good.’ If his choice is incorrect, I will say ‘wrong.’ After he finish, you must choose the relevant cue. Look for what kind of cues are the right ones.”

The model demonstrated the choosing response according to each subject's conditions and was reinforced contingently. The models were equally assigned to each of six relevant cues.

Test trials. The subjects were told the following, immediately after observing the model's demonstration and receiving vicarious reinforcement: “Now, it's your turn. At this time, after you finished, I will teach you the number of your correct choices. Do your best to get many correct answers.” Test trials consisted of 16 trials without reinforcement.

RESULTS

The main measures employed here were the number of correct responses and the number of subjects who succeeded in observational learning.

The Number of Correct Responses

The number of correct responses for all conditions in 16 trials are presented in Fig. 2. An analysis of variance of the effects among the three groups on the number of correct response was significant ($F=10.55$, $df=2, 99$, $p<.001$).

A comparison of two group pairings showed that the C-P group was highest among the three groups in the number of

TABLE 2
The number of subjects who accomplished observational learning

		Group			Total
		C-P	I-N	M-M	
Number of observational trials	4	7 (58.3)	3 (25.0)	1 (8.3)	11 (30.6)
	8	7 (58.3)	5 (41.7)	0 (0)	12 (33.3)
	16	9 (75.0)	4 (33.3)	6 (50.0)	19 (52.8)
Total		23 (63.9)	12 (33.3)	7 (19.4)	42 (38.9)

Note. () = %

correct responses (C-P vs. I-N, $t=2.56$, $df=70$, $p<.02$; C-P vs. M-M, $t=4.40$, $df=70$, $p<.001$). Next was the I-N group, with the M-M group lowest among the three (I-N vs. M-M, $t=1.78$, $df=70$, $.05<p<.10$).

Each of the three groups, C-P, I-N and M-M was analysed on the number of observational trials, four, eight and 16. There were no significant differences for the C-P and I-N groups. The mean number of correct responses in the C-P group was about 13 for each observation. It was clear from a binominal test that only the C-P group consistently chose the relevant cue regardless of the number of observations. In the M-M group, the number of correct responses was at a chance level for four and eight trials of observation, but in the 16 trials, it increased significantly to 12.0 (16 trials vs. four trials, $t=2.40$,

$df=22$, $p<.05$; 16 trials vs. eight trials, $t=3.21$, $df=22$, $p<.005$). In the I-N group, the mean number of correct responses for eight trials was greater than that for the means of four and 16 trials, but these differences were not statistically significant.

Subsequently, comparisons were made with the three groups for each trial of observation. For both the four and eight trials, the C-P group was highest in terms of the number of correct responses. I-N group was next and M-M was lowest (C-P vs. M-M in four trials, $t=3.03$, $df=22$, $p<.01$; C-P vs. M-M in eight trials, $t=3.86$, $df=22$, $p<.001$; I-N vs. M-M in eight trials, $t=3.86$, $df=22$, $p<.001$). For 16 observational trials, similarly, the C-P group was highest with next highest M-M, and the I-N group was lowest (C-P vs. I-N, $t=2.15$, $df=22$, $p<.05$).

FIG. 2. The number of correct responses in test trials.

Subjects Achieving Observational Learning

Table 2 represents the number of subjects who chose consistently relevant cue more than 13 trials in 16 test trials. They were true subjects who achieved observational learning according to a binominal test. Sixteen observational trials were most among the three (four, eight and 16) but statistically there was no significant ($\chi^2=9.57$, $df=2$, $p<.01$). Test between pairs of groups by the Ryan method showed that achievers of observational learning in the C-P group were significantly higher

in number than those of the M-M group at the 5% level.

DISCUSSION

Analysis of variance on the number of correct responses indicates a significant main effect for the three experimental groups of C-P, I-N and M-M. That is, the C-P group was highest, next was I-N and lowest was M-M. According to the binominal test, the subjects of the C-P group were the only subjects who achieved observational learning, regardless of the number of observational trials. There was no statistically significant main effect among the four, eight and 16 observational trials. Similar results were also found from an analysis of the number of subjects who achieved observational learning.

These findings suggest that observing a model's correct demonstration and the model's receiving positive reinforcement are the main factors in observational learning, and that the number of observation is not.

Analysis of the number of observations for each of the three groups suggests that the 16 trials in the M-M group (where both information of "good" and "wrong" was given randomly) received significantly higher correct responses than the four or eight trials. From these results, it is suggested that the number of observations was an important factor for observational learning in the M-M group.

In the C-P group, since many had achieved observational learning in four trials, as well as for eight or 16 trials of observation, it is concluded that observational learning did not occur progressively, but suddenly. This was also the finding of Haruki (1965).

The results of the present study will now be considered from the Bandura viewpoint of the motivational and the informational function of vicarious reinforcement. Since the task in the present study was a 2-choice simultaneous discrimina-

tion, the quantity of information on the relevant cue would be theoretically equal among the C-P, I-N and M-M groups. From the viewpoint of the motivational function, however, the C-P group would be most highly motivated because of 100% positive reinforcement; next would be M-M group with 50% positive reinforcement; and lastly would be the I-N group with no positive reinforcement. This expectation regarding the motivational function was confirmed among the three groups on 16 observation trials. However, the total number of correct responses actually scored for each group differed from the expectation noted above. The C-P group was highest among the three followed by I-N and then M-M. That is, the number of correct responses for I-N and M-M was reversed. This result cannot be explained, therefore, from the point of view of the motivational function of vicarious reinforcement. Rather, it would be more profitable to consider the result in following way. Information in terms of either "good" or "wrong" in the C-P and I-N groups was given. While in the M-M group information of both "good" and "wrong" was randomly given. Now, even if information is negative, in the I-N group it would be important to observe the model's constant demonstration and reinforcement. Whereas, the subjects of the M-M group would be confused with random information of both "good" and "wrong". For example, in the case of four trials of observation where the circle is relevant, when the stimulus card of Fig. 1 was presented in order a, b, c and d, subjects of the M-M group were given the information on the cues, as seen in Table 3. (The model's demonstration in the M-M group was correct on the first and third trials and incorrect on the second and fourth trials according to the Gellermann series.)

On the other hand, the subjects of the I-N group were given the information shown in Table 4. In this case, the circle

TABLE 3
Information on each cue in four trials for the M-M group

		Cues					
		Red	Blue	Circle	Triangle	Solid	Dot
Observational trials	1	○		○		○	
	2		×		×	×	
	3		○	○			○
	4	×			×		×

TABLE 4
Information on each cue in four trials of the I-N group

		Cues					
		Red	Blue	Circle	Triangle	Solid	Dot
Observational trials	1		×		×		×
	2		×		×	×	
	3	×			×	×	
	4	×			×		×

was the sole cue for which no negative information was given. For subjects of the M-M group, the cues were randomly given for both positive and negative information. They had to become aware of the fact that the relevant cue was the circle for which no negative information was given and only positive information was given.

From the viewpoint noted above, it would be concluded that constant information, even if negative, facilitates observational learning. It was easier for the I-N group in which constant information, despite its being negative, was given to find the relevant cue than for the M-M group which random information was given.

In 16 observational trials condition, the M-M group was higher than the I-N group on the basis of number of correct responses, although this difference was not statistically significant. This result suggests that the random information in the M-M group were arranged with many observations and the effect of positive vicarious reinforcement had been operating.

In the present study, it is clear that the

main factor in achieving observational learning is the model's correct demonstration and the positive reinforcement given to the model, and not simply the number of observations. The findings concerning the C-P group cannot be explained solely in terms of Bandura's notion of motivational function of vicarious reinforcement. Rather, the results of the I-N and M-M groups suggest that it is necessary to observe the constant information given, even if such information is negative. Clearly, Bandura's theory of the motivational function of vicarious reinforcement bears further examination.

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