ATTRIBUTIONS INDUCED BY FOUR FEEDBACK CONDITIONS DURING ACQUISITION TRIALS ON A NOVEL MOTOR TASK

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Attributional preferences were elicited throughout a series of trials on a psychomotor task. Four different types of feedback were administered to observe if any departure from the usual success and failure experimental treatments would alter perceptions of causality. Attributions did change throughout the experience with perceptions of personal ability differing most between the treatment groups.

Several attribution theorists (Heider, 1958; Kelley, 1967; Weiner, 1974) have investigated the individual's perceptions of causality, or the personal judgement of why a particular performance occurred. Based on Heider's (1958) naive psychology, performance is perceived to be determined by both personal and environmental forces, with attributions to these factors being made following success and failure. In general, successful subjects attribute their performance to personal factors of ability and effort, while failure or unsuccessful performance have been rated as due to task difficulty or to luck. To use Rotter's (1966) terminology, following success attributions are internalised, while attributions are externalised following failure.

Several experimenters (Weiner and Kukla, 1970; Frieze and Weiner, 1971; Kun and Weiner, 1973) asked subjects to act as judges to determine those factors that affected performance in fictitious groups. Ascriptions were attributed to high ability or task ease when successful past performance was known, while task difficulty was more prominent among the attributed causes of failure than success. According to Frieze, the data convey "a positive, rational image of man". (Frieze 1973, p. 101).

The majority of studies which set out to examine the performer's attributions have used cognitive tasks as the main experimental medium (Feather and Simon, 1971; Frieze and Weiner, 1971; Kun and Weiner, 1973; Luginbuhl and Crowe, 1975; Weiner and Seirad, 1975). Few researchers have used psychomotor tasks to elicit attributions, although it has not been firmly established that different types of tasks are perceived and reacted to in a similar manner. Attributions elicited during the motor task may differ in both degree and salience from those obtained after a covertly expressed perception of a cognitive performance.

Other procedural matters also need scrutiny. The usual method for obtaining attributions has been to provide a *post hoc* analysis following the particular cognitive task. (Feather and Simon, 1971; Fontaine, 1972; Frieze, 1973). In most cases, only a single analysis of preferred

attributions has been collected. Also, few researchers have noted changes in attributions over repeated trials, even though it is possible that attributions may change throughout a performance sequence on the same task, especially where subject's perception of task difficulty may alter.

Furthermore, all studies reviewed have used only success and failure as independent variables. Few real life tasks are encountered where persistent success or failure are the main outcomes. Rather, success and failure are often experienced on a random basis, while in some tasks, for example during learning, feedback regarding these external outcomes is often delayed and is ineffective at that time.

In this investigation these experimental anomalies were examined, in an attempt to determine if performance on psychomotor tasks caused different attributions to those commonly encountered with cognitive material. In addition, different types of feedback were administered (success, failure, a random schedule of success and failure, and a condition where no feedback was delivered), and attributions were obtained repeatedly during a set of performance trials.

A further aim of the experiment was to see if performance alone is altered when groups are repeatedly given success, failure, or random success/failure feedback. The underlying rationale is that repeated success would lead to internalised attributions of ability and effort inducing feelings of competence which might facilitate and improve performance on the task. Failure however might be debilitating, causing the subjects in this group to make more mistakes on the relatively "fine" motor task.

METHOD

Subjects

Sixty female second-year psychology students attending Florida State University during the Spring quarter, 1975, were randomly placed in experimental groups. All were novices at the psychomotor task.

Apparatus

The basic mirror star tracing task (Marietta Apparatus Co., model 14-15 MS.) was slightly modified to allow for the collection of more data than the usual error count obtained with this apparatus. Whenever the stylus made contact with the copper sides of the star an electrical circuit was completed. These errors were recorded on an error counter located on the experimenter's side of the apparatus. Time for the completion of the mirror star tracing task (two circuits) was recorded. Thus three dependent measures were calculated: errors, time, and the product of time and errors, which could be collected over fifteen trials.

Different types of feedback were given to the four experimental groups after every three trials on the star tracing apparatus. One group received feedback indicating success in relation to established norms, one failure, one random success and failure, and the control group

received no indication of relative performance. Success and failure was indicated to the subjects by means of a green (success) or red (failure) light, to which they responded by turning off the light source.

Immediately following the feedback all subjects completed an attribution questionnaire, (McCaughan, 1976). Subjects rated 12 statements on a 7-point scale, the score of 7 representing a highly perceived attribute and a score of 1 a lowly perceived attribute. Each of the attributes were represented by three statements. Scores were obtained by averaging the responses from these statements for each attribute.

Instructions were read to the subjects when they entered the testing station, the main points of which are as follows: "The test you are about to perform is a test of your motor aptitude. It has been shown to be an excellent test to assess learning capabilities in motor skills. Students already tested in another University have provided some performance norms for comparison. The purpose of this session is to see if performance scores from an American sample are lower, higher or similar to a New Zealand sample, then to determine if cultural variables influence motor skill acquisition".

Subjects were then given instructions regarding the mirror star tracing task, told the number of trials and what to do about the feedback lights, and shown the attribution questionnaire.

"After every three trials I will let you know if you have succeeded or failed in relation to scores already obtained, that is, if your performance score (the time to complete the circuit multiplied by the errors) is better than, or worse than the sample I already have. A red light will mean you have failed, a green light will indicate a success. Remember, red means you have performed worse than the average score of the other group and green means you have performed better. Do you have any questions?"

RESULTS

Attributions

A Multivariate Analysis of Variance (MANOVA) was conducted on the attribution data which were collected after each of three trials for each feedback condition (see Table 1). The significant MANOVA for the between conditions main effect represents differences among the four groups when all attributions are considered together, that is, the significant F indicated that the group vectors differed. This analysis does not reveal which attributes differed between groups, only that there are significant group differences.

To identify which attribute (luck, effort, ability, or task difficulty) was most influential in distinguishing between the groups, a stepwise discriminant analysis was performed with attributes acting as the dependent variables. Step-down F's were calculated for these dependent variables beginning with the most important as identified in the discriminant analysis.

TABLE 1
Multivariate Analysis of Variance for Attributions Between Feedback Conditions.

Source	Log (Generalized Variance)	U Statistic	df	Approximate F	df
Conditions (G)	19.95	.20	4,3, 224	38.98**	12,585
Trials (T)	18.64	.76	4,4, 224	4.05**	16,675
S (G)	23.45	.01	4,56,224	10.19**	224,885
GT	18.66	.74	4,12,224	1.43*	48,853

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

The U statistic and approximate F reported in this table are derived from the BMD 12V-computer programme, and is based on Rao's (1959) development.
The approximate F reported is from an approximation to the distribution of U, based on the F-distribution. (Rao, C.R., Some problems involving linear hypotheses in multivariate analysis. *Biometrica,* 1959, 46, 49-58).

The stepwise discriminant analysis was performed on the feedback main effect (see Table 2). The dependent variable shown to discriminate most between the four feedback conditions was ability ($F(3,56) = 13.91$). Step-down F's were then calculated for the four attributes. With ability covaried out, luck, effort and task difficulty were found to be nonsignificant in discriminating between the four groups.

A univariate analysis was then conducted on all attributes between the four feedback conditions with the result that only the ability attribute reached the required level for significance. A Duncan Multiple Range test between the means for the ability attribute revealed that the group receiving failure feedback differed significantly from all other feedback conditions.

Subjects who received failure feedback attributed lower ability as a cause of task performance more than any other group.

TABLE 2
Stepwise Discriminant Analysis for Attributions

Source	Order Stepped In	F to enter	Approx F	df
Attributions	1. Ability	13.91	13.91*	3,56
	2. Luck	2.09	7.23*	6,110
	3. Difficulty	1.23	5.13*	9,131
	4. Effort	.51	3.89*	12,140

* $p < .01$

The step-down F's in this table are derived from the BMD O7M computer programme.

As a check on these analyses plots of the four attributes between the four feedback conditions were made (see Figure 1). The plot for the

ability attribute readily demonstrates the effect of failure feedback. Other plots for effort, task difficulty and luck do not reveal such disparity between the feedback conditions, and indeed, no significant differences were found in the preceding analyses.

The previous analysis was performed between groups. A further ANOVA was conducted to indicate the relative order of ascriptions within each feedback condition. Significant differences were found in this ANOVA for the main effect of attributes for each of the four feedback groups, that is, subjects rated attributes differently within each condition. (See Table 3).

To reveal which attributes were influential in creating these differences, Duncan Multiple Range tests were run between the means for each attribute within each feedback condition. Under the success feedback condition significant differences occurred between the luck ascriptions and those of effort and ability. No other differences occurred between attributes in this condition (see Figure 2). In the failure condition significant differences occurred between the luck ascription and those of effort and task difficulty. Differences were also located between ability and both effort and task difficulty within this condition. Under the no feedback condition, differences occurred between luck and both effort and task difficulty and between ability and effort. When the significant F for random conditions main effects was analyzed by the range test, no differences were located.

TABLE 3
ANOVA for Attributions Within Each Feedback Condition

	d.f.	MS	F
Attributions	3,42	73.02	14.96*
Trials	4,56	0.17	.43
AT	12,168	1.06	2.67*
Failure			
Attributions	3,42	111.57	21.22*
Trials	4,56	.21	.52
AT	12,168	1.25	3.49
Random			
Attributions	3,42	56.76	7.93*
Trials	4,56	.39	.54
AT	12,168	1.14	1.76
No Feedback			
Attributions	3,42	81.27	31.97*
Trials	4,56	1.36	1.51
AT	12,168	1.60	5.55*

* $p < .05$

Performance

When the MANOVA was conducted on the four feedback conditions with the product of time and errors assessed over each trial, no sig-

nificant differences were found. To see if any other dependent measures might prove significantly different between the feedback conditions, further multivariate analyses were conducted. No significant differences were located using time as a dependent measure or when error was the dependent measure (see Table 4).

Performance was not significantly affected by the experimental conditions.

TABLE 4
Multivariate Analysis of Variance for Performance Trials on Mirror Star Tracing Task Considering Dependent Variables of Time, Errors and the Product of Time and Errors.

Condition	Source	Log (Generalized Variance)	U Statistic	df	Approximate F	df
Time	Conditions (G)	58.85	.77	5, 3, 56	.94	15,143
Errors	G	54.19	.79	5, 3, 56	.82	15,143
Product	G	94.38	.81	5, 3, 56	.77	15,143

DISCUSSION

The initial MANOVA analysis for attributions indicated significant differences between the group profiles and this was found to be due to the influence of the ability attribute. When this attribute was covaried out, no other significant predictions to group placement occurred. Thus the major differences between the four feedback conditions was in the perception of ability and beliefs regarding the salience of this attribute following success and failure experiences.

Plotting the ability attribute for each feedback condition (see Figure 1) revealed decreasing attributions following failure and increasing attributions following success, that is, subjects perceived themselves to have high ability given success feedback and little ability after failure. The random and no feedback conditions did not differ significantly from the success condition on this attribute. Thus, it would appear that some success feedback is a necessary condition for maintaining personal feelings of ability. Persistent failure on the other hand is singularly responsible for lowering beliefs of personal ability.

What is evident however is the relatively higher ratings to effort and task difficulty than to luck over the four groups. Throughout all conditions luck was considered as being much less important in performance than either effort or the difficulty of the task. Thus it may be stated that in a motor task requiring some skill to master, luck is perceived to play a minor role in performance.

In the within-groups analysis, the four feedback conditions also resulted in different ascriptions being allocated. In the success feedback condition (see Figure 2) significant differences occurred between the luck ascription and those of effort and ability. Given success, subjects perceive that ability and effort were primarily responsible, rating the

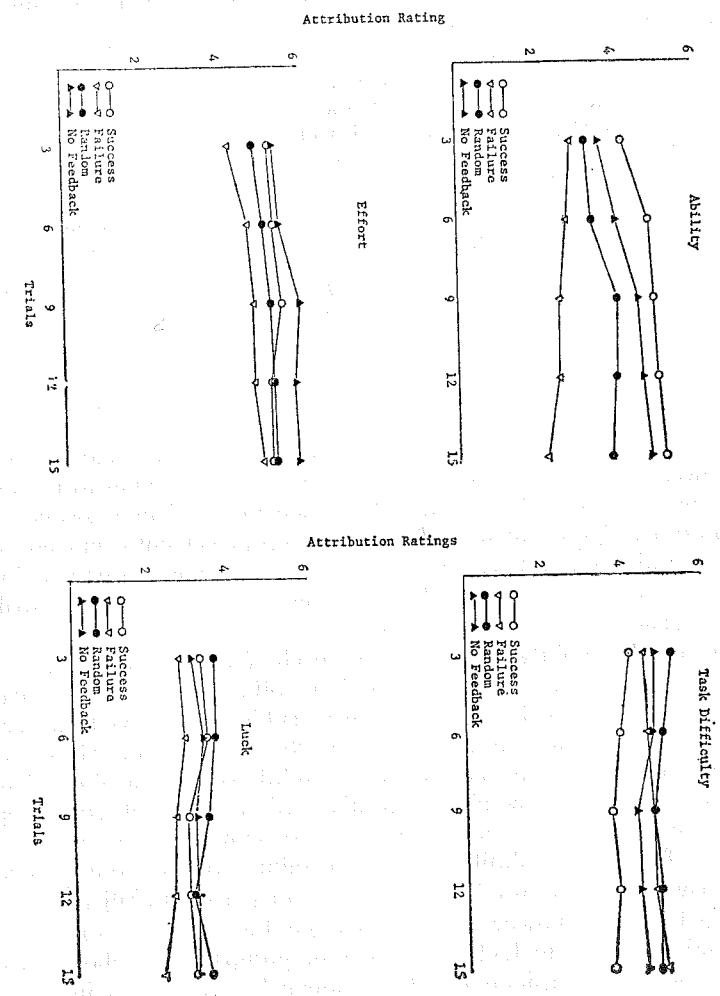

Figure 1. Subject's perceptions of the four attributes between each feedback condition.

difficulty of the task, and luck to be of less importance. Success is due to internal factors, which, to use Rotter's (1966) analysis, is skill oriented. Futhermore, with repeated success, attributions to ability continue to increase while those to luck and task difficulty decrease, that is, subjects perceive that success has been due to higher ability at the task, which at the same time makes the task seem easier.

Within the failure feedback condition higher attributions to task difficulty and effort were recorded together with lower ascriptions to ability and luck. These ascriptions are quite different from those allocated after success. Whereas success feedback induces feelings of high ability, failure feedback induces lowered beliefs in personal ability. Furthermore, these beliefs appear to become even more disparate with continual failure and success feedback.

The relationship between ability and task difficulty should be kept in mind in the failure conditions. Ascribing failure to task difficulty may be a rationalisation for a perceived lack of ability at the task. It is important to stress "perceived", as subjects did not receive actual performance scores in any of the four experimental conditions.

For the success group the task is perceived as becoming easier, while it becomes successively more difficult for the failure group. Feather and Simon (1971) found similar results. Expected success was related to ability, and expected failure was related more to lack of ability. Other research (Weiner and Kukla, 1970; Frieze and Weiner, 1971; Kun and Weiner, 1973) reveals similar relationships when subjects do not actually perform but act as judges instead. Thus, not only are persons able to rationalise the performance of others, but are also able to reason their own performance in the same conceptual manner.

Both random and no feedback groups (see Figure 2) show similar trends. The effort attribute is ranked highest in both groups with the task also being perceived as difficult. The gradual increase in ability ascriptions, as learning progressed over trials for both groups, suggests that ability estimates increase with an increase in perceived skill or competence at the task. As practice on the task continues and no persistent failure is experienced, subjects believe themselves to have increased ability at the task. It would appear that receiving success and failure on intermittant occasions, is little different from receiving no estimate of performance outcome, in order to maintain if not elevate self conceptions of ability. The level of task difficulty does not unduly influence these self perceptions.

In this psychomotor task then success appears to be internalised, while failure is attributed to the difficulty of the task (high ratings) and/or to lack of ability (low ratings). Attributing success to internal factors is a common occurrence in cognitive tasks and similar to Rotter's (1966) contention. Attributing failure to high task difficulty is also a usual occurrence in cognitive tasks but it could also be argued that failure was ascribed to low ability in this psychomotor task. While this distinction can not be fully explored it is likely that the performer

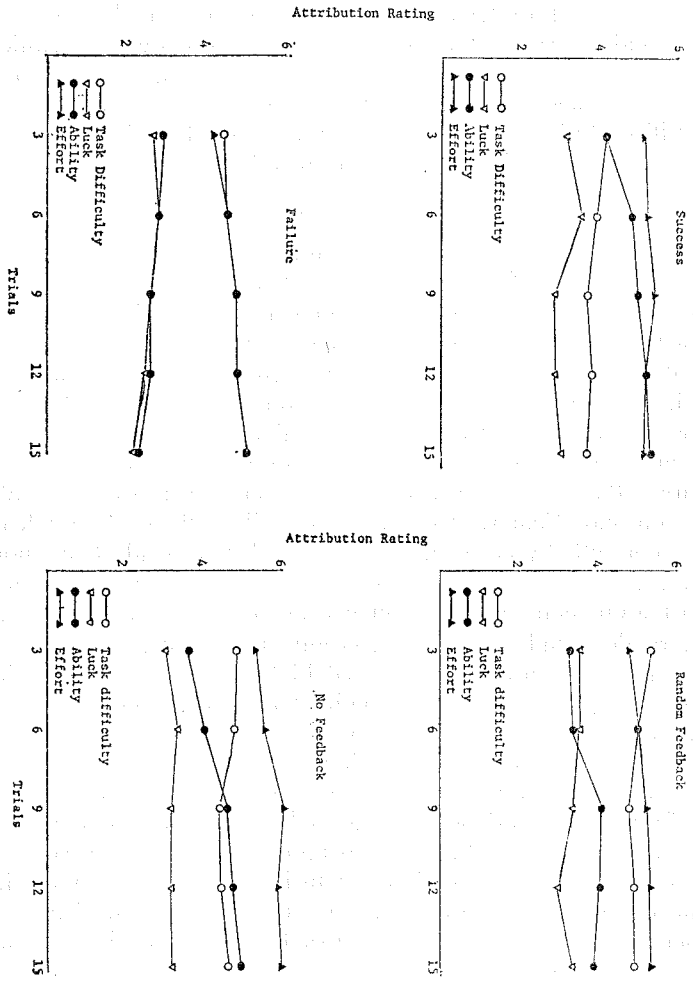

Figure 2. Attribution ratings recorded at five intervals within each feedback condition.

would rationalise toward a maintenance of self esteem by concluding that the task was too difficult.

High ascriptions to effort were also obtained in this psychomotor task. In most studies, effort ascriptions do not receive such high ratings. However producing high effort in performance does seem to be an acceptable ploy especially when failure is received. At least the subject tried, even if ability was not present. Studies by Frieze and Weiner (1971) and Weiner and Kukla (1970) have found such ascriptions where teachers and children respectively have been involved. Both groups ranked effort as a desirable attribute.

The inclusion of the random and no feedback groups in this study did not add any significant information regarding attributional ascriptions under these conditions. All four attributions were rated in a similar manner to those under the success condition therefore adding little to what could be gained from only providing a success feedback condition. The attributional ratings are quite different however from those given under failure conditions, where both ability and task difficulty ascriptions are reversed. Persistent failure appears to be particularly detrimental to maintaining feelings of ability.

It would appear that on future occasions success and failure conditions only need be applied to obtain attributional ratings of performance.

Performance

Performance scores were not influenced by the type of feedback received during the learning trials. In the raw data in this experiment there was a tendency for the success feedback group to have increasingly lower or better scores (time and errors) than the failure group, but this tendency was not significant.

With the mirror star tracing task subjects may employ different strategies throughout the learning trials. Some subjects may disregard time in order to reduce errors; others may perform the tracing as quickly as possible but commit many errors. It is possible that this task is not sensitive enough to reveal the influence of success and failure experiences when subjects are able to vary their strategy and possibly influence the final outcome for any one dependent measure. A task involving more fine motor control which requires even more cognitive elements such as cue detection and decision making may prove more helpful in eliciting any possible performance fluctuations.

This study has highlighted the potent effects of success and failure on individuals perception of performance outcome. Providing success experiences wherever possible may enable individuals to maintain or develop higher levels of perceived ability at the task and increased self esteem, rather than inducing feelings of lowered ability following failure. Indeed persistent failure appears to increasingly lower personal ratings of perceived ability, although in this study no psychomotor performance decrements were noted as a result. However, maintaining self confidence may influence the persistance and liking for that activity

and lessen the possibility of voluntary withdrawal from the task. As Locke and Bryan (1967) have pointed out, valence for a task is affected not so much by the deviation from a goal as from the success and failure experienced.

Another factor that has not been referred to in research studies involving an attributional analysis of performance is the individual's self perception. Instead of waiting for external reinforcement, such as knowledge of one's performance at a task, there may be personal standards or estimates of what is an acceptable outcome for that individual. If this is so, then perhaps two types of cognitive operations are salient within an achievement setting; one referring to external stimuli and their interpretation in future action, and the other to internal self perceptual information. In success experiences, both may be congruent—in failure experiences those perceptions may be incongruent. An instrument or design to measure these possible phenomena may be an exciting future project.

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