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ABSTRACT

This study investigated the effects of informative feedback on a matching task with three combinations of verbal feedback and three levels of task complexity. The three types of feedback were right wrong (RW), nothing wrong (NW), and right nothing (RN). The three levels of task complexity were defined in terms of number of irrelevant stimulus dimensions. Subjects were 180 first grade pupils presented with nonsense shapes serving as the stimuli. The RW condition yielded significantly better performance than the other feedback conditions, and in addition, NW resulted in a faster rate of learning than RN. The findings have implications for programmed learning regarding the merits of right and wrong feedback signals. Furthermore, the results imply that wrong signals are less ambiguous on four response problems than right signals. (Author)

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THE EFFECT OF INFORMATIVE FEEDBACK ON PROBLEM-SOLVING

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Knowledge of results or informative feedback is a special case of reinforcement which was first demonstrated to effect performance in the classical experiments of Thorndike (1933). Psychologists have studied extensively various dimensions of knowledge of results as it determines performance during the learning of simple perceptual-motor skills. However, very few experiments have explored the ramifications of informative feedback as it relates to more complex learning tasks or problem-solving in which concepts are involved.

In one study, Bourne and Pendleton (1958) compared two conditions of feedback completeness in concept identification problems which required Ss to sort geometric forms into four categories. In the first condition Ss were told on each trial whether their response was correct or incorrect. In the second condition Ss were, in addition, shown the correct response whenever they made an error. The results showed that feedback completeness was an effective variable with the condition wherein the correct response was indicated on every trial being significantly superior to the correct-incorrect condition.

Buss and associates (Buss, Braden, Orgel and Buss, 1956; Buss and Buss, 1956) have carried out related experiments. In the latter study the researchers used basically the right-wrong feedback arrangement described above. However, for some Ss feedback signals were provided only after correct responses called the "right-nothing case" (R-N); for others, feedback was given only after incorrect responses, the "nothing-wrong case" (N-W). In order to serve as a control, still other Ss were given feedback on all trials (the R-W case). One would expect that the R-W condition would yield significantly better performance than either the R-N or N-W because of the greater completeness of information provided Ss. However, both R-W and N-W have been demonstrated to be superior to R-N and not to differ from each other. Buss ascribes the effect to a proposed greater "reinforcing" value for W signals relative to R. Bourne (1966), on the other hand, points out it is equally plausible to argue that the effect is due either (a) to the more frequent occurrence of W in the trial sequence - which results from the use of the four-response problems wherein the probability of an error is three times as great as the probability of a correct response - or (b) to the greater ambiguity of R signals - a correct response (followed by a R signal) can occur by chance even if S has not grasped the concept; but, an error signal tells S he is definitely on the wrong track, for if he "had the concept" no errors would be made.

These findings require further elucidation. It is important to determine what differences might be obtained if R and W signals were equated in frequency across conditions. The present study attempts to

answer this question by use of a two-response problem, the matching task, in which R and W signals are equated in frequency. The matching task is a multiple sign problem, described by Harlow (1942) which is similar to the more familiar oddity task, requiring Ss to attend to two or more cues for correct solution

Thus, the major purpose of the present experiment was to determine the best feedback combination for optimal performance in problem-solving with R and W signals equated in frequency across conditions of the task. A second aim was to investigate if differences in feedback combinations are constant over levels of task complexity.

Method

Subjects.--The Ss were 180 first grade children. They were matched for sex and assigned at random to each of nine groups. There were 10 boys and 10 girls in each group.

Stimuli.--The stimuli used in the present study were three sets of 12 "metric" shapes constructed by a technique developed by Fitts, Weinstein, Rappaport, Anderson and Leonard (1956). The figures were drawn on 6 1/2" x 14" cardboard cards, so designed that one figure (model figure) was set off to the left, conspicuously separated from the remaining two figures, which were spaced closely together.

Set One stimuli consisted of three figures drawn in black ink, with two identical and one different in shape. Set Two stimuli consisted of three figures with two alike in shape and one different. However, all three figures were of different sizes. Thus, a second dimension of size was added. The third set varied along three dimensions: shape, size and color. All three figures were of a different color and size, with two alike in shape. A much more complete description of these types of stimuli can be found in Schroth (1968).

Design.--A factorial design was employed which involved three combinations of informative feedback and three levels of task complexity. The types of informative feedback were as follows. In the first condition, feedback signals were given on all trials (R-W case); in the second condition, feedback followed only incorrect responses (N-W case); the last condition consisted of feedback only after correct responses (R-N case).

The three levels of task complexity were defined in terms of number of irrelevant stimulus dimensions to problem solution. One level consisted of matching problems with stimuli varying in one dimension, shape (0 irrelevant dimensions). The second level consisted of problems with stimuli varying in two dimensions, shape and size (one irrelevant dimension). The third level consisted of problems with stimuli varying in three dimensions, shape, color and size (two irrelevant dimensions).

Informative feedback and task complexity conditions for the vari-

ous groups are outlined in Table 1.

Table 1
Summary of Conditions

Group	Condition	Stimuli
1 (R-W,1)	Right-Wrong, level 1	Set 1
2 (R-W,2)	Right-Wrong, level 2	Set 2
3 (R-W,3)	Right-Wrong, level 3	Set 3
4 (N-W,1)	Nothing-Wrong, level 1	Set 1
5 (N-W,2)	Nothing-Wrong, level 2	Set 2
6 (N-W,3)	Nothing-Wrong, level 3	Set 3
7 (R-N,1)	Right-Nothing, level 1	Set 1
8 (R-N,2)	Right-Nothing, level 2	Set 2
9 (R-N,3)	Right-Nothing, level 3	Set 3

The Ss in all groups were introduced individually to the matching problem by the following instructions.

We are going to play a game. It may be a new game for you, but it is really easy to play. In this game, I will show you three pictures on a card, and you must point to one.

The right picture is one of these two over here (E pointed to the two spaced closely together). However, in order to know which of these two it is, you must look at this one over here (experimenter pointed to the offset figure on the left side of the card).

After Ss responded to one of the figures on a stimulus card they received immediate feedback. Groups 1-3 (R-W condition) were told verbally they were "right" or "wrong"; Groups 4-6 (N-W condition) received no verbal feedback ("nothing") if the response was correct and were told "wrong" for incorrect responses; Groups 7-9 (R-N condition) were told "right" for correct responses and "nothing" for incorrect responses.

The experiment consisted of 48 trials (presentation of a card displaying three figures represented a trial) or number of trials required to reach the criterion of 9 out of 10 successive correct responses. A correct response consisted of choosing the figure that matches the model figure in shape.

Results and Discussion

Figure 1 shows the mean number of trials to reach criterion of 9 out of 10 successive correct responses for the nine groups on the matching problem. A two-way analysis of variance with informative feedback and task complexity as factors resulted in significant Fs (2,171) of 5.69 and 5.38, respectively, at the .01 level; interaction of types of informative feedback and task complexity was found to be insignificant

with an F (4,171) less than one. (Appendix A)

Further comparisons on treatment means were carried out by the use of Scheffe's test (Edwards, 1967). According to this analysis, R-W Groups performed significantly better than N-W Groups, $F (1,171)=3.98$, $p < .05$, and R-N Groups, $F (1,171)=8.03$, $p < .01$. N-W Groups outperformed R-N Groups, $F (1,171)=4.37$, $p < .05$. As expected, groups with the "one dimension" matching task solved the problem significantly faster than groups with the "two dimension" matching task, $F (1,171)=3.99$, $p < .05$, and groups with the "three dimension" matching task, $F (1,171)=9.01$, $p < .01$. Finally, the "two dimension" groups took significantly fewer trials to solve the task than the "three dimension" groups, $F (1,171)=4.04$, $p < .05$.

The results of the present experiment demonstrate that R-W information feedback is the most effective condition in facilitating performance on the matching task with N-W being superior to R-W across all levels of task complexity. This can be explained as due to the greater completeness of informative feedback of the R-W condition. These findings, in part, conflict with those reported by Buss and his associates (Buss, et. al., 1956; Buss and Buss, 1956) as they found no significant differences between R-W and N-W. This one discrepancy in the results might be attributed to the different nature of the tasks involved and different ages of the Ss. Buss and associates used concept identification problems and neuropsychiatric patients while the current study involved the matching task and much younger Ss, first grade children.

An important finding in agreement with the studies of Buss and associates is that N-W feedback yielded superior performance to R-N. Thus with R and W signals equated in frequency, unlike in the earlier studies, N-W feedback still proved to be superior to R-N. Consequently, one theoretical interpretation of the findings of Buss et. al. can be dismissed, which is that the results are due to the use of four-response problems wherein the probability of an error is three times as great as the probability of a correct response.

The results taken together, alluded to above in the present study, support the theory that the informative feedback effects of the earlier studies can be attributed to the lesser ambiguity of W signals in comparison with R signals as opposed to the alternative explanation by Buss of a "greater reinforcing value" of W cues relative to R cues. For the latter interpretation to be correct R-W would not have been expected to result in better performance to N-W since both conditions contain the same proportion of W signals.

These findings and interpretations are related to Bruner, Goodnow and Austin's (1956) work in concept development and discrimination in which they found that Ss can not use indirect cues, similar to the "nothing" feedback signals, as opposed to direct cues, such as the "wrong" signals, because of their greater ambiguity. This means, in addition, that in the current study the Ss tended to ignore the absence of confirmation (nothing) and did not regard it as an indication that they were wrong.

From both theoretical and practical viewpoints the present results have implications for programmed instruction. Many advocates of this teaching device claim that knowledge about the right response constitutes reinforcement besides its pure informative function; the data contradicts this theory. According to the results the main function of feedback is to give the S as much information as possible, keep him informed as to what he has to watch out for when he is wrong, not just to give him a "good" feeling because he is right.

Conclusions

The results of this experiment demonstrated that R-W informative feedback is the most effective feedback condition in improving performance on the matching task (a multiple sign problem) across all levels of task complexity. This is explained as due to the greater completeness of informative feedback of the R-W condition in comparison to the other feedback conditions. Another important finding of the current study is that N-W feedback yielded superior performance to R-N.

These results taken together support Bourne's theory on information feedback that W signals are less ambiguous than R signals on problems that contain four possible responses and thus better facilitate performance. In addition, these findings coincide with Bruner, Goodnow and Austin's work in a related area of research, concept development and discrimination. They found, as in the present study, that Ss have difficulty using indirect cues such as "nothing" feedback signals, in contrast to direct cues, such as "wrong" signals. This means that Ss tend to ignore the absence of confirmation (nothing) and do not consider it to mean that they are wrong.

The present results can be put to practical use in programmed instruction. For example, the data contradicts the beliefs of some advocates of programmed instruction that knowledge about the right response constitutes reinforcement or reward in itself besides its pure informative function. Those who use programmed instruction should concentrate their efforts on giving Ss as much information as possible, keep them informed as to what they have to watch out for when wrong, not merely give them a "good" feeling because they are right.

Summary

The effects of informative feedback were investigated on a matching task with three combinations of verbal feedback and three levels of task complexity. The three types of feedback were right-wrong (R-W), nothing-wrong (N-W) and right-nothing (R-N). The three levels of task complexity were defined in terms of number of irrelevant stimulus dimensions. One hundred and eighty first grade children were Ss for the study in which nonsense shapes served as stimuli. R-W condition yielded significantly better performance than the other feedback conditions, and in addition, N-W resulted in a faster rate

of learning than R-N. These results were consistent over all three levels of task complexity and were interpreted as support for a hypothesis on information feedback proposed by Bourne. Furthermore, the results have implications for programmed learning in regard to the relative merits of right and wrong feedback signals. The findings imply that wrong signals are less ambiguous on four-response problems than right signals.

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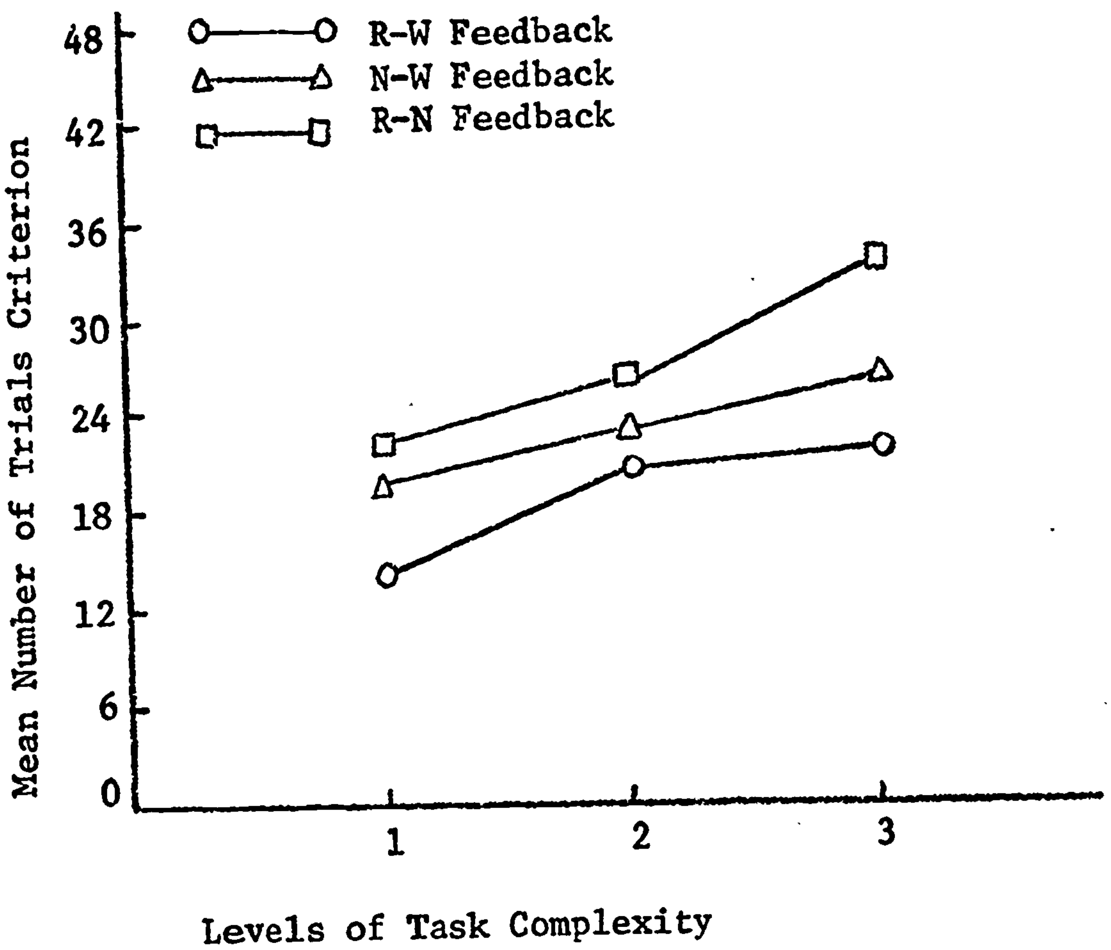
APPENDIX A



R-W Feedback
N-W Feedback
R-N Feedback
Mean Number of Trials Criterion
48
42
36
30
24
18
12
6
0
1
2
3
Levels of Task Complexity