Degree of training and the novelty transfer effect*

DAVID A. TAYLOR

Rockefeller University, New York, New York 10021

and

ARNOLD BINDER

University of California, Irvine, California 92664

Four groups of 40 Ss were given transfer tests following 2, 4, 6, or 8 14-trial blocks of paired-associate training with unequal stimulus frequencies and then retested after a further training period in which the same compound stimuli were presented at equal frequencies. The novelty effect, in which Ss respond to new combinations of training components by giving the response associated with the least frequent component, was obtained in every transfer test. It was concluded that the novelty effect is a mode of responding that is produced by differential frequencies during early learning and which, once adopted, is retained by Ss regardless of whether the frequency differential is maintained.

The transfer phenomenon referred to as the novelty effect has been demonstrated by Binder and Estes (1966), Binder (1968), and Binder and Taylor (1969). Following paired-associate training with compound stimuli, most Ss in these experiments responded to test trials containing new combinations of training components by giving the response associated with the component which had been presented least frequently during training.

Binder and Estes (1966) proposed a negative recency process, in which Ss responded to the less recently presented component, to account for the observed pattern of responses. However, a study by Taylor and Binder (1970) indicated that recency had little, if any, influence over Ss' responses to transfer compounds. Hence, the novelty effect must depend somewhat more directly on the differential frequencies of the training components included in transfer tests.

The current experiment was concerned with the manner in which these differential frequencies give rise to the novelty effect. Specifically, two questions were of interest. Firstly, at what point during training does the novelty effect appear? If it appears only in the later stages of training, then it may be due to some form of stimulus satiation or task boredom, while its appearance very early in training would suggest that the effect is a product of the learning process. Secondly, is the novelty effect, once established, dependent on continued unequal frequencies, or would it remain in evidence even if the frequency differentials were eliminated? The answers to these questions were sought by testing four groups of Ss after different amounts of training with unequal frequencies and then retesting each group after a period in which the training stimuli were presented equally frequently.

The current study was also designed to provide further evidence against the recency interpretation of the novelty effect. Taylor and Binder (1970) showed that the effect is not obtained when recency is varied while holding frequency constant. In the current experiment, frequency was varied while recency was balanced across tests, with the expectation that the novelty effect would still be observed.

METHOD

Subjects

One-hundred and sixty students participated in this experiment to fulfill a requirement for an introductory course in social sciences. Up to four Ss were run in each experimental session. The sessions were assigned to four experimental conditions in rotating order (i.e., Ss in the first session were assigned to Group I, Ss in the second session to Group II, etc.) until 40 Ss had been run in each condition.

Apparatus

Stimuli were presented on IEE (Industrial Electronics Engineering) rear-projection display devices, and responses were entered on a row of numbered buttons located below the display units. The experiment was executed by an Iconix timing and controlling system, and responses were recorded on paper tape. The apparatus is described more fully in the Binder and Taylor (1969) report.

Stimuli

The stimuli for each of the four groups of Ss were composed from a random sample of six of each of the following syllables: VOP, GAK, FUH, TEF, CYQ, ZIR, QAR, BYM, and KEC. The digits 1-4 served as responses, and a different random assignment of responses to stimuli was used for each group.

Procedure

The structure of the initial training list was identical to that of Binder and Taylor (1969) and may be described as 2ab-i. 1ac-j. 3de-k. and 1df-l. where the letters a-f represent nonsense syllables and the letters i-l represent digits. Each of the four

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Table 1
Error Rates by 28-Trial Blocks

Double Block	Group				Mean
	I	II	III	IV	
1	.305*	.273	.272	.233	.271
2	.137	.039*	.035	.023	.058
3	.031	.030	.014*	.006	.020
4	.012	.017	.025	.014*	.017
5	.011*	.014*	.008*	.016*	.013

*Ss were tested at the end of this block.

combinations of syllables was presented both in the order shown (e.g., ab) and with the location of the syllables on the display screens reversed (ba). The number to the left of each combination indicates the frequency with which each order of that combination was presented in every block of 14 training trials, i.e., each block contained two ab-i trials, two ba-i trials, one ac-j trial, etc.

The method of anticipation with correction was used, with a trial consisting of a .5-sec warning buzzer, .5-sec delay, 4-sec exposure of the nonsense syllables, 1.5-sec delay without exposure, 3-sec reexposure of the nonsense syllables together with the correct response, and 3-sec intertrial interval.

Group I Ss were shown one of the 14-trial training blocks described above. The order in which the various stimuli appeared was determined randomly with the restriction (on this block only) that different stimulus orders of the same combination (e.g., ab and ba) were shown on adjacent trials. This restriction was imposed to facilitate Ss' perception of stimulus order as irrelevant to determining the correct response.

At the completion of this first block, Ss were warned that they would be shown new combinations of the syllables they had just seen, and they were instructed to respond to each new combination with the digit which they considered to be "associated most closely with" that combination. The following block of trials contained the same 14 training trials as were shown in the first block plus 2 test trials: bc (or cb) and ef (or fe). Each test was immediately preceded by the 2 training trials relevant to that test—e.g., ab-i and ac-j for the test of the bc combination. Choice of stimulus order both for the tests (e.g., bc or cb) and for the immediately preceding relevant trials, the sequential order in which the two combinations were tested, and the ordering of the relevant trials preceding each combination were all balanced across Ss within the group. The 2 tests, together with their relevant training trials, comprised the last 6 trials of the block, and the remaining 10 trials in the block were distributed randomly. The trials containing test compounds were procedurally identical to training trials, except that no exposure was made during the correction interval.

Following the test trials, Group I Ss were given four 28-trial "double" blocks in which each of the four stimulus combinations was shown seven times. The sequence of trials within these blocks was determined randomly, except that the final block was constructed analogously to the block containing the initial transfer tests, i.e., the last 6 trials of the block contained further tests of bc and ef, and these tests were preceded by their relevant training trials balanced for stimulus order and recency.

Group II was run like Group I, except that these Ss were given four blocks of differential frequencies prior to the initial tests, followed by three double blocks of equal frequencies and the final tests. Group III was shown six blocks of differential frequencies and two double blocks of equal frequencies, and Group IV received eight differential and one equal. The overall design is apparent in the structure of Table 1. Each entry in this table represents the presentation of 28 training trials. In each group, Ss were tested at the end of the blocks marked by the

asterisk. Differential frequencies were employed through the first such block, and equal frequencies were used thereafter.

RESULTS AND DISCUSSION

For convenience in reporting error rates, successive pairs of 14-trial differential frequency blocks were treated as 28-trial "double" blocks. The resulting proportions are shown in Table 1. It should be noted that, although the error rates are satisfactorily low at the time of initial testing for Groups II, III, and IV, the corresponding rate for Group I is fairly high, so the results of the Group I initial tests should be regarded with some caution. It can also be noted that the error rates following the blocks in which the initial tests were administered are elevated in each of the four groups, attesting to the disruptive effect of test trials on training performance.

In evaluating the novelty effect in these data, only the relevant responses (i.e., Responses i and j for tests of the bc compound, k and l for tests of ef) were considered. The proportion of such responses appropriate to the less frequent cue (i.e., Response j for bc, l for ef) is shown, for each test and group, in Table 2. First, it may be noted that the lowest entry in the table is .647 and that the average of the entries is .748; it is clear that a strong novelty effect was consistently obtained in this experiment in spite of the balancing of the recency factor. Thus, the current results provide an independent refutation of the recency interpretation of the novelty effect.

Examining the entries for the initial tests, it is clear that the novelty effect appeared very early in training and tended to increase over the course of the experiment. The fact that the effect was quite strong in Group I, in spite of the high error rate at the time of testing, is most informative; it indicates that the novelty effect develops during the learning of the stimulus-response associations rather than some time after these associations have been mastered.

Table 2
Proportion of Responses Relevant to the Less Frequent Cue

Test	Group				Mean
	I	II	III	IV	
EF (3:1) Tests					
Initial	.731 (.087)	.795 (.065)	.861 (.058)	.865 (.056)	.819
Final	.648 (.078)	.657 (.080)	.794 (.065)	.775 (.066)	.722
BC (2:1) Tests					
Initial	.655 (.088)	.647 (.082)	.750 (.072)	.718 (.072)	.696
Final	.800 (.068)	.842 (.059)	.692 (.074)	.692 (.074)	.755

Note—Figures in parentheses are the standard errors for the observed proportions, computed as $\sqrt{pq/N}$.

Turning to the results of the final tests, it is obvious that the novelty effect did not disappear when the frequency differentials were eliminated. The strength of the effect did drop moderately between the initial and final tests of ef in all four groups. On the other hand, the bc tests yielded much smaller decreases in two of the groups and very sharp increases in the other two for a sizable overall increase. It is not clear why such different results were obtained for the bc and ef tests, but it may be noted that the overall means for the two types of tests have quite similar values for the final test (.755 for bc and .722 for ef); if the means for the bc and ef tests are combined, there is only a nominal decrease in the strength of the novelty effect between the first (.757) and final (.738) tests. These observations suggest that the overall effects of differential frequency were undiminished by the blocks of equal frequency trials and that the differences between the first and final tests reflect a loss of specific effect for the two different frequency ratios employed.

On the whole, it would appear that the novelty effect, once established, does not require differential frequencies for its maintenance. This finding is particularly striking in the case of Group I, since Ss in this group received only 28 trials at differential frequencies, followed by 112 trials at equal frequencies. Clearly, the novelty effect does not result from an averaging of stimulus frequencies over some range of

trials preceding the test; if the range were less than 112, then the resulting frequency ratios would have been 1:1 for Group I Ss, and even if the entire sequence of trials were included, these ratios would be only 1.13:1 for bc and 1.25:1 for ef.

Taken together, the results of this experiment suggest that the novelty effect is a mode of responding to unknown stimulus compounds that is produced (or triggered) by differential frequencies during the time that the stimulus-response associations are being learned, and they suggest further that, once this response mode is adopted, it is retained by Ss regardless of whether the frequency differential is maintained.

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