Response sequences following "wrongs" in a concept task*

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METHOD

The Ss were 240 Emory University undergraduates enrolled in an introductory psychology course.

The stimuli were four plastic wall plates of the variety found in most buildings. They consisted of a brown switch plate with one hole (B1), a similar ivory-colored switch plate (I1), a brown receptacle plate with two holes (B2), and a similar ivory-colored receptacle plate (I2).

The Ss arrived at the testing room by appointment and were seated at a desk opposite E. The E then placed the four stimuli on the desk, scrambled them and said to S, "I am going to present you with these four items. They are not placed down in any particular order so don't worry about their positions." After S had handled the stimuli for approximately 10 sec, E said, "Now I am going to take them all back and will present you with one of these at a time. As I present each item to you, I want you to respond with either 'pie' or 'cake,' and I will tell you when you make your response whether it is right or wrong for the particular item I am showing you."

From an experimental point of view, the procedure consisted of only three trials. The Ss actually were presented with six trials, the first two of which always received a response of "wrong" from E, regardless of S's response. The third trial always received a response of "right," while the fourth, fifth, and sixth were randomized in order that a pattern would not emerge which could be communicated from one S to another. The stimuli were presented in one of 12 predetermined sequences to each S. The sequences were arranged to provide orders in which identical stimuli, opposite stimuli, and stimuli with one value in common occurred in succession. There were 20 Ss in each of the 12 groups.

RESULTS

The 12 stimulus sequences were categorized into six groups of two counterbalanced sequences. The first response made by each S, whether it was "pie" or "cake," was labeled A, and the other response, B. Table 1 shows the frequency with which each of the four response sequences occurred for the six pairs of stimulus sequences. Only the responses from the first three trials, prior to "right," were recorded.

In Stimulus Sequence I, the first two stimuli were opposites and the third had one value in common with each of the previous stimuli. If all response sequences were equally likely, the expected response frequency would have been 10 for each sequence. Twenty-three Ss, however, perseverated on their first responses. The result is significantly different from chance ($\chi^2 = 24.4$, $df = 3$, $p < .001$), with essentially all the deviation occurring in Response Sequence 1 ($\chi^2 = 22.5$, $df = 1$, $p < .001$). The statistical technique for such partitions of chi-square contingency tables has been reported previously (Bresnahan & Shapiro, 1966).

Although the null hypothesis of equal frequencies for the four response sequences in the chi-square test would be generated only by a model of random hypothesis sampling without memory, the specific partitions of the chi-square test are directly applicable to the various alternative models. For instance, it might have been predicted that, for Stimulus Sequence I, the 32 who

Two hundred and forty Ss were run on one of 12 fixed sequences of stimuli which varied along two dimensions. Each S was required to make one of two responses on each trial; regardless of which response was made, it was called "wrong." The frequencies with which response sequences occurred were tabulated. It was suggested that a simple stimulus-response model might fit the data at least as well as hypothesis-sampling models employing memory parameters.

Concept acquisition studies present Ss with multidimensional, multivalued stimuli. Theoretical accounts of concept formation have turned from response strengthening to hypothesis testing (Krechevsky, 1932; Lashley, 1929, p. 135). The S has been viewed as formulating a hypothesis and retaining the hypothesis if his response is called "right," and rejecting his hypothesis and formulating a new one if his response is called "wrong." This strategy has been referred to as "win-stay, lose-shift" (Goodnow & Pettigrew, 1955). Various models have been constructed to account for the method of shifting; all have involved the random selection of a new hypothesis from some subset of the population of all possible hypotheses (see Levine, Yoder, Kleinberg, & Rosenberg, 1968, or Gregg & Simon, 1967, for a description of the specific models). Elaborate mathematical models have been constructed to formalize and quantify predictions generated by win-stay, lose-shift. Variables such as the number of errors prior to the first correct response have been investigated (e.g., Suppes & Ginsburg, 1963). In spite of occasional failures (e.g., Erickson, 1968), the basic notion of hypothesis sampling has been retained.

Most investigations have had relatively little statistical power, since the most stringent test of the model occurs only on those trials on which the S makes an error. The majority of studies, particularly those from which models have been derived, have used randomized sequences of stimuli.

The intent of the present investigation was to determine the relationship between stimulus and response sequences. Twelve sequences were selected for study. Each sequence consisted of three trials. Each S gave three responses. The first two responses were called "wrong."

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Table 1
Observed Frequencies of Each Response Sequence for Each Set of Stimulus Sequences

	Stimulus Sequence	Response Sequence				Comparison	df	Chi Square
		1 AAA	2 ABB	3 ABA	4 AAB			
I.	B1. I2. B2 I1. B2. I2	23	5	3	9	1 vs 2 vs 3 vs 4 1 vs 2, 3, 4 4 vs 2, 3	3 1 1	24.4÷ 22.5÷ 1.7
II.	B2. I2. B1 I2. B2. I1	20	13	4	3	1 vs 2 vs 3 vs 4 1 vs 2, 3, 4 2 vs 3, 4	3 1 1	19.4÷ 13.3÷ 4.35*
III.	B2. B2. I2 I2. I2. B2	6	23	6	5	1 vs 2 vs 3 vs 4 2 vs 1, 3, 4	3 1	22.6÷ 22.5÷
IV.	B1. B2. I2 I1. I2. B2	23	6	5	6	1 vs 2 vs 3 vs 4 1 vs 2, 3, 4	3 1	22.6÷ 22.5÷
V.	I2. B2. B2 B2. I2. I2	0	4	18	18	1 vs 2 vs 3 vs 4 1, 2 vs 3, 4 2 vs 3	3 1 1	26.4÷ 25.6÷ 9.8÷
VI.	B2. B2. I1 I2. I2. B1	6	17	15	2	1 vs 2 vs 3 vs 4 1, 4 vs 2, 3 3 vs 1	3 1 1	15.4** 14.4÷ 4.05*
<i>B = brown, I = ivory, 1 = one hole, 2 = two holes</i>						*.05 **.01 ÷.001		

had AA or the first two responses would have chosen A and B equally on the third trial, yet 23 of the 32 Ss perseverated on the A response. This tendency to perseverate on the previous response creates consistent discrepancies between theory and data for all six stimulus sequences.

In Stimulus Sequence II, the first stimuli had one value in common and the third was the opposite of the second. Twenty Ss perseverated; 13 switched responses from the first to the second trial, whereupon they retained the second response on the third trial. The result is significantly different from chance ($\chi^2 = 19.4$, $df = 3$, $p < .001$); Response Sequence 1 differs significantly from the others ($\chi^2 = 13.3$, $df = 1$, $p < .001$); Response Sequence 2 differs significantly from Response Sequences 3 and 4 ($\chi^2 = 4.35$, $df = 1$, $p < .05$).

The results from the remaining four stimulus sequences are easily discernible in Table I. All of the stimulus sequences result in significant chi-square values for the response sequences. It can be noted that the greatest tendency to retain a response occurred when opposites were presented in succession; the next greatest tendency to retain a response occurred when stimuli with one value in common were presented in succession; the last tendency occurred when identical stimuli were presented in succession.

DISCUSSION

The win-stay, lose-shift formulation was based upon data generated by random or pooled stimulus presentations. Results generally supported the model of Ss randomly sampling hypotheses from some set whenever a "wrong" occurred. When more refined experimental techniques were developed to test the implications of the simple model, the data required that additional parameters be employed. Some Es (e.g., Levine et al.

1968; Erickson, 1968) chose to add memory parameters of various complexities to the model. To consider just one example, Trabasso & Bower (1966) postulated that the S remembers the just previous stimulus and response and "temporarily sets aside any attribute which has inconsistent response assignments on trials n and $n - 1$." However, no single memory postulate has succeeded in handling all the divergent results (e.g., see Gregg & Simon, 1967).

The present data analysis considered results from each specific stimulus sequence. Not surprisingly, the data do not support a simple model of random hypothesis sampling. Future responses are clearly a function of prior responses and stimuli whenever a "wrong" occurs.

Although there are too many possible models to allow the testing of them all, several models of hypothesis sampling employing various memory, or consistency, parameters were considered. None readily fits the data from all the sequences. A simple stimulus-response model appears to yield the best predictions. When a response to a given stimulus is followed by "wrong," the response is preserved if a completely different stimulus is presented on the next trial, the response is changed if the same stimulus is presented on the next trial, and the response is intermediate if a stimulus with one commonality and one difference is presented on the next trial. It is possible that Ss form hypotheses only when instructed to do so or only after the first correct response.

REFERENCES

- Bresnahan, J. L., & Shapiro, M. M. A general equation and technique for the exact partitioning of chi-square contingency tables. *Psychological Bulletin*, 1966, 66, 252-262.
- Erickson, J. R. Hypothesis sampling in concept identification. *Journal of Experimental Psychology*, 1968, 76, 12-18.
- Goodnow, J. J., & Pettigrew, T. F. Effect of prior patterns of experience upon strategies and learning sets. *Journal of Experimental Psychology*, 1955, 49, 381-389.
- Gregg, L. W., & Simon, H. A. Process models and stochastic theories of simple concept formation. *Journal of Mathematical Psychology*, 1967, 4, 246-276.
- Krechevsky, I. "Hypothesis" in rats. *Psychological Review*, 1932, 39, 516-532.
- Lashley, K. S. *Brain mechanisms and intelligence: A quantitative study of injuries to the brain*. Chicago: University of Chicago Press, 1929.

Levine, M., Yoder, R. M., Kleinberg, J., & Rosenberg, J. The presolution paradox in discrimination learning. *Journal of Experimental Psychology*, 1968, 77, 602-608.

Suppes, P., & Ginsberg, R. A fundamental property of all-or-none models, binomial distributions of responses prior to conditioning, with application to concept formation in children. *Psychological Review*, 1963, 70, 139-161.

Trabasso, T., & Bower, G. Presolution dimensional shifts in concept identification: A test of the sampling with replacement axiom in all-or-none models. *Journal of Mathematical Psychology*, 1966, 3, 163-173.

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Reinforcement in children: Received and expected*

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Trial-to-trial effects of reinforcement and nonreinforcement were studied in 48 children during a simple motor task. In the absence of information regarding the availability of reinforcement during each trial, Ss responded more rapidly after a reinforced trial than after a nonreinforced trial. In the presence of a signal providing information regarding the availability of reinforcement during each trial, Ss responded more

rapidly before an expected reinforcement than before an expected nonreinforcement.

This experiment was designed to compare the trial-to-trial effects of reinforcement and nonreinforcement upon rate of responding. The presentation of a reinforcement on Trial n can affect behavior in one of two ways. It may reinforce the previous response, the response that occurred on Trial n , or it may provide information regarding the probability of reinforcement on Trial $n + 1$. Information regarding reinforcement on Trial $n + 1$ may be provided inadvertently through the E's use of counterbalanced or restricted sequences. The investigation of the trial-to-trial effects of reinforcement, therefore, requires (1) the use of several probabilities of reinforcement and (2) the manipulation of information concerning reinforcement on Trial $n + 1$ independent of the presentation of reinforcement on Trial n .

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