Psychology and pseudolearning

JOHN T. WILLIAMS, Jr., DEPARTMENT OF PSYCHOLOGY,
UNIVERSITY OF SOUTH CAROLINA, Columbia, S. C. 29208

"Learning curves" were generated from a table of random numbers to represent chance behavior in a two-choice situation. It was found that seemingly adequate criteria such as seven correct in eight consecutive trials allowed more rapid chance "learning" than might be expected by superficial statistical considerations.

In 1964 a number of leading psychologists and zoologists from America and Europe met at Cambridge to discuss learning in invertebrates. This conference, reported in the first supplement to *Animal Behaviour*, underscored the tremendous problems which are unique to one attempting to understand the behavior of lower organisms. Since results in learning experiments with planarians appear to be influenced by such variables as directional orientation within an electrical field and even the phase of the moon, it is not surprising that much consideration was given to pseudolearning at this meeting. Also, many, if not all, demonstrations of "learning" in paramecia have been shown to be based upon such things as changing taxes and trophisms resulting from changes in internal and external environments. While the comparative psychologist is trying to cope with these problems, he should not make his job more difficult by confounding the situation with avoidable problems concerning pseudolearning.

One way in which pseudolearning may be produced is by the misuse of statistical procedures. What does constitute a satisfactory criterion for learning in lower forms? One might argue that any criterion which would not be reached by chance more than, say, one time in a hundred or certainly one time in a thousand would be satisfactory. Almost no psychologist would object to a criterion of ten consecutive correct trials in a two-choice situation; after all, the probability of getting ten consecutive correct trials by chance is less than .001. This is all well and good, as long as one remembers that this is the probability of getting ten correct in the first ten trials and that the probability increases with additional trials so that there is a good chance of a S's reaching criterion within two or three hundred trials without learning the problem. This problem in interpretation is fairly rare, but it does occur.

One of the most comprehensive surveys of learning throughout the animal kingdom (Thorpe, 1963) twice cites a study by Seidman (1949) concerning reversal learning by newts and terrapins. In addition to his using a very questionable procedure, Seidman selected a criterion for learning of only three consecutive correct trials on each problem. It does not take too much effort to calculate that the probability of a S's reaching this criterion by chance within five trials is .25. Perhaps Thorpe's citations were based on abstracts or on secondary sources, but it certainly seems that the journal editor who accepted Seidman's article should have been more critical while reading the paper.

Table 1
Random Learning with Various Criteria

Criterion	Median	Mean	Range
3 consecutive	12.0	13.9	3-60
4 consecutive	21.0	28.2	4-104
5 consecutive	39.0	61.1	5-421
6 consecutive	79.5	114.9	6-622
7 in 8 trials	30.0	56.4	8-328
8 in 10 trials	37.0	68.0	10-386

Fig. 1. "Learning curves" generated by random numbers in a two-choice situation with criteria of three, four, five, or six consecutive correct trials. (N = 50 in each group.)

In order to form a base from which to evaluate certain experiments, a study was conducted to determine what might happen in a two-choice learning situation in which the S does not pay attention to the relevant cues and thus can not possibly learn. To generate "learning" data in the absence of any learning, a table of random numbers was used and any even number was chosen as a "correct response." The table had 50 numbers per row, and the arbitrary method of determining the number of "trials to criterion" was to start at the left of a row and count digits as trials until criterion was reached. If criterion was not reached within 50 trials, counting would be continued on the next row, but if criterion was reached, counting would begin at the left of the next row for the next "S." An N of 50 was sampled at each criterion level. The results, using this procedure, for criteria of three, four, five, or six consecutive correct trials are shown in Fig. 1. The means, medians, and ranges for these data, as well as for data generated with criteria of seven correct in eight trials and eight correct in ten consecutive trials, are shown in Table 1. Curves generated by these last two criteria rise between curves for four and for five correct until over 60% of the Ss have reached criterion, after which they correspond closely with the curve for five consecutive correct.

Probably few psychologists would be surprised by results in a learning experiment using lower vertebrates or invertebrates if the median was 30 trials to learn a T maze with a criterion of seven correct responses in eight trials, but these data indicate that this is what would be expected by chance. It is quite possible that such factors as responding to irrelevant stimuli or tendencies to alternate spontaneously would make a living organism less apt to reach criterion by chance than would a set of random numbers, but we should still recognize that there is a greater danger of creating statistical pseudolearning than many seem to realize. Unfortunately, there are many areas within psychology in which a significant interaction between statistical usage and pseudolearning may sometimes occur.

REFERENCES

- SEIDMAN, E. Relative ability of the newt and the terrapin to reverse a direction habit. *J. comp. physiol. Psychol.*, 1949, 42, 320-327.
THORPE, W. H. *Learning and instinct in animals*. Cambridge, Mass., Harvard Univ. Press, 1963.