Frequency ratios and oscillatory behavior in the two-choice situation^{1, 2}

JAMES K. BREWER, LOUISIANA POLYTECHNIC INSTITUTE AND FLORIDA STATE UNIVERSITY
F. J. KING, FLORIDA STATE UNIVERSITY

The present study was undertaken to determine if different frequency ratios resulted in different oscillatory predictive behavior in the two-choice situation. Four different frequency ratios were used on four groups of Ss and for each group an autocovariance analysis was conducted on the Ss' responses. The resulting autocovariance plots indicated differential oscillatory patterns for the four frequency ratio groups.

In the process of building a mathematical model to predict behavior in the two-choice situation, attention has been centered on several principles. Among these are frequency (Overall & Brown, 1957, 1962; Voeks, 1948), recency (Brown & Overall, 1959; Jarvik, 1951), and pattern-following (Feldman, 1962). However, few studies have suggested that the Ss' cyclical or oscillatory behavior be identified and incorporated in the model. In particular, the connection between the frequency ratio and the oscillatory behavior has scarcely been investigated. The present investigation was intended to determine if different oscillatory behavior was present for different frequency ratios.

Method

Materials. Four sets of 5 x 8 cards were used in the present study. Each set contained 60 cards and each card in a set was randomly marked with 0 or 1 according to one of the following frequency ratios of 1's to 0's; 50:50, 60:40, 67:33, and 75:25.

Procedure. Each of the four sets of cards was presented to a group of Ss. The Ss were requested to assume that the cards presented were drawn from an infinitely large population of cards each marked with a 0 or 1. They were told nothing about the frequency ratios of the sets of cards. The cards were presented one at a time and at each presentation the Ss predicted whether a 1 or 0 would occur on the next card. They marked these predictions on IBM 301 answer sheets. Sufficient time was allowed for all Ss to make an unhurried prediction at each presentation (trial).

Subjects. The Ss were taken from graduate and undergraduate classes in Educational Research at Florida State University. The 50:50, 60:40, 67:33, and 75:25 ratio groups respectively contained 22, 30, 21, and 21 Ss. Both sexes were present in each group.

Results and Discussion

An autocovariance analysis was carried out for each of the four groups of Ss using the total number of 1 predictions at each trial as the input variable. The autocovariance of series X at lag p prior to detrending is

$$R_X^{(p)} = \frac{1}{n-p} \sum_{q=1}^{n-p} (X_q - m_X)(X_{p+q} - m_X), p=0, 1, 2, \dots, m,$$

where m_X is the average of the input data, n is series length and m = lag. Since the data was detrended so that it could be treated as a stationary time series (Kendall, 1948), the expression

$$A_X^{(p)} = R_X^{(p)} - \frac{m_X^2}{12} \lambda p \alpha_X^2, p=0, 1, \dots, m$$

was used for the autocovariance at lag p. In this equation

$$\lambda p = n^2 \left[1 - 2 \frac{p}{n} - 2 \left(\frac{p}{n} \right)^2 \right] \text{ and}$$

$$\alpha_X = \frac{1}{k(n-k)} \left[\sum_{i=n-k+1}^n X_i - \sum_{i=1}^k X_i \right],$$

where k is the integral part of $\frac{n+2}{3}$ and n = 60 (Dixon, 1954).

A detrending procedure was also conducted using moving averages and no material differences were noted in the two detrending procedures. Figures 1 through 4 show the results of the autocovariance analysis with lags up to 40. The ordinates in the figures are not on the same scale but this is of no consequence in the discussion to follow.

In Fig. 1 it will be noted that the oscillations are not equally spaced nor are they damped, however, the major peaks are roughly 20 trials apart. According to Kendall

Fig. 1. Autocovariance for 50:50 Series.

Fig. 2. Autocovariance for 60:40 Series.

(1948) and Anderson (1954), the series of predictions generating this behavior is probably composed of a sequence of harmonic terms. Figure 2 shows quite evenly spaced oscillations (cycles) for the 60:40 group with no damping present. This might indicate a tendency to regularly repeat series of predictions. For the 67:33 group some damping seems to be present with no regular oscillations. The behavior in this case could, according to Kendall (1948), be the result of the presence of an autoregressive scheme. The autoregressive scheme could be described by stating that the *regularity* of the motion is determined by the psychological structure of the Ss and the *existence* of the motion is determined by external impulses. Figure 4 shows that virtually no oscillations are present for the 75:25 group.

These results imply that prediction made for the higher ratios of 1's to 0's will evidence more damping in

Fig. 3. Autocovariance for 67:33 Series.

Fig. 4. Autocovariance for 75:25 Series.

their autocovariances. This is reasonable since for higher ratios the tendency is to predict the most frequent digit (Brewer, 1965), thus fewer oscillations will be present. For the lower ratios the predictive behavior involves more guesswork and thus oscillations are more likely to be present.

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Notes

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