Accuracy and variability in the production of short durations¹

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One hundred and twenty subjects each attempted to flash a telephone switchhook 40 times for a specified duration (0.3, 0.5, or 0.7 sec.). The effectiveness of feedback, of a mnemonic aid, and of providing an example of the proper duration were all investigated in terms of their effect on accuracy and variability in performance. Feedback was found to be the only important variable and served to produce more accurate and less variable performance.

Ss were instructed to flash a telephone switchhook for .3, .5, or .7 sec. The method that was used is labeled in the psychological literature as time estimation by the method of reproduction or production, depending on whether or not S is first given an example of the duration that he is supposed to produce. Doebling (1953), Hawkes, Bailey, & Warm (1960), Kowalski (1943), and Adkins (1957) all found that durations of approximately 500 msec. tend to be overestimated, i.e., the durations Ss provided tended to be longer than the desired duration, but they did not specifically address themselves to the efficacy of using feedback to train Ss for greater accuracy.

We hypothesized that mnemonic instructions and the absence or presence of feedback would affect the accuracy of the produced duration. Also, since it was hoped that the results would be relevant to performance which would be called for on a continuing basis, the data were collected over an extended period of time.

Subjects

Sixty four male and 56 female nontechnical employees of Bell Telephone Laboratories were used as Ss.

Apparatus

The telephone switchhook flashes were measured in msec. using a specially designed circuit (Fillingham, 1964).

Procedure

Each S was called on the telephone and was asked to flash the telephone switchhook 10 times on each of three sessions separated by one week and a fourth session which followed approximately three weeks later. The Ss were divided into three groups of 40 Ss each. One of these groups was instructed to flash the switchhook for a duration of .3 sec.; another group for .5 sec.; and the third group for .7 sec.

Each group was further subdivided into two subgroups of 20 Ss each, according to whether or not feedback was provided. If feedback was provided, it was only provided on the first three sessions and consisted of "too long" for flashes .9 sec. or longer,

"too short" for flashes .1 sec. or shorter, and "good" for all flashes inside this interval.

Each of these groups was further divided into two subgroups of 10 Ss each. One subgroup was given a "demonstration" flash of the appropriate duration at the beginning of the first session. The other subgroup was given a mnemonic at the beginning of the first and second sessions for achieving consistency in switchhook flash duration. The mnemonic used was to say the word "three," "five," or "seven" while depressing the switchhook and before releasing it.

Results and Discussion

The duration of each switchhook flash was recorded and for each session of 10 flashes the median and the standard deviation were computed for each S as representing the central tendency and the variability of the performance. The major variables for an analysis of variance were Training session (1, 2, 3, and 4); Duration (.3, .5, and .7 sec.); Technique (mnemonic, demonstration); and Feedback (yes, no). The analysis used was for repeated measures on the same S (Collier, 1958). The standard deviation scores were first transformed to log variance scores in order to stabilize the variance in the sense of making the variance of the analyzed scores less dependent on their mean values (see, for example, Rao, 1952).

The analysis used also assumes that successive measures on the same Ss are correlated to a constant degree. However, a check on the residual correlations indicated a violation of this assumption in that the log s^2 scores on Session 4 have significantly lower correlation with earlier sessions than is true

Fig. 1. Average of medians and standard deviations of 10 responses provided by each S in each session.

for Sessions 3 and 2. Consequently, the analysis of variance of $\log s^2$ scores omits the data for Session 4.

As indicated in Fig. 1, the variability of performance as measured by the within-S standard deviation of the 10 flashes within a session decreases on successive sessions ($F=21.21$, $df=2/216$ using $\log s^2$ scores). The variability is not, however, significantly affected by the other experimental variables.

The accuracy of performance as measured by the median flash duration is affected by the Duration, Training, Session, Feedback, and Duration by Feedback interaction effects. Figure 1 also shows that the median response time decreases on sequential sessions (with increased training) ($F=2.61$, $df=3/324$). It is also lower with than without feedback ($F=16.58$, $df=1/108$). Without feedback all intended durations are overestimated, which is in agreement with the results in the literature (e.g., Adkins, 1957; Kowalski, 1953; Doehring, 1953; and Hawkes, Bailey, & Warm, 1960). However, feedback serves (as would be expected) to bring the response time into agreement with the intended duration (for Duration by Feedback interaction, $F=3.13$, $df=2/108$). Nevertheless, in this case the 300 msec. condition is overestimated and the 700 msec. condition is underestimated. To interpret this finding, it should be recalled that the same feedback was provided for all duration conditions, i.e., if 100 msec. < response time < 900 msec. the S was told "good" for all three duration conditions.

Fig. 2. Average of 10 response medians showing interaction of feedback with duration of standard.

Fig. 3. Distribution of switchhook flashes. The flash times for 0.3, 0.5, and 0.7 are based on 190, 190, 200 flashes respectively in last session. Also shown in the combined cumulative distribution.

This procedural feature probably contributed to encourage response clustering near 500 msec. for all three duration conditions. These effects are indicated in Fig. 2.

The cumulative duration distribution is shown in Fig. 3 for the combined subgroups in each desired duration condition.

In brief, the results indicate that if feedback is provided, and sufficient training is given, Ss in such an experiment will depress the switchhook for a short duration accurately and with fairly small variability.

References

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Note

1. Now at American Telephone and Telegraph Co., New York, New York.