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Thirty years ago William M. Marston pointed out that ". . . little systematic psychological experimentation is being carried on in the field of normal adult testimony."[1] The statement is as applicable today as it was then. The dearth of such investigations should not be particularly surprising, however, in view of the many factors which influence the reliability of witness report. Although much progress has been made in developing and standardizing methods for the detection of *intentional* deception, the perceptional, cognitive, motivational, and emotional processes which influence the ability of the willing and honest witness to testify accurately are too complex in their interactions to permit of many useful generalizations at the present time. A few kinds of error, nevertheless, occur so unexceptionally that they are worth noting. The present report summarizes an experiment involving one of these—the error of estimation of short time intervals.

Although many laboratory experiments have been undertaken to study estimation of time intervals, most of them are of no value as a basis for predicting error in testimony. Nearly all the early investigations were concerned with establishing the "indifference interval" which required working with fractions of a second or, at most, a few seconds. Of greater practical value is knowledge concerning errors of estimate of intervals a minute or two in length such as in the case mentioned by Münsterberg in which ". . . everything depended upon the time which had passed between a whistle signal from the street and the noise of an explosion. It was of the greatest importance for the court to know whether the time was long enough to walk a distance for which at least half a minute was needed. Of two unbiased witnesses one swore that the time was less than ten seconds; the other, that it was more than one minute."[2] Studies made of this general interval range are few. Elon H. Moore, in the 1930's, made a survey of over sixty years of scientific literature bearing upon testimonial accuracy and "could discover but nine studies dealing with accuracy in the recollection of time

1. Marston, W. M., Studies in Testimony. Journal of Criminal Law and Criminology, *15*:5, 1924.
2. Münsterberg, H., On the Witness Stand. New York, Doubleday Page, 1909.

intervals."[3] Most of these, and several more recent studies, relate to special situations which do not concern the present topic. A careful consideration of the remainder, however, indicates that certain commonly occurring factors are associated with systematic errors of estimation in length of time intervals.

One of the most frequently noted observations is that lack of overt activity on the part of the subject leads to over-estimation. William James was calling attention to this fact when he wrote "Close your eyes and simply wait to hear somebody tell you that a minute has elapsed. The full length of your leisure with it seems incredible."[4] It has sometimes been contended that, just as this "unfilled time" seems long, so "filled time" seems short, while others have insisted that their studies show "filled time" to seem long also. A comparison of the conditions under which the experiments were conducted shows that, in general, if the "filled time" has included many events *not involving overt activity of the witness,* it will probably be over-estimated. An attitude of tense expectancy, often accompanying a series of exciting events witnessed by the observer, also tends to increase the estimate of elapsed time, an experimentally established conclusion which agrees with common observation. But it must not be assumed that general impression is a safe basis for predicting the direction of estimation error of time intervals.

Most persons, for example, guess that the length of a painful interval would be over-estimated. What few experiments have been done indicate that this is not the case for intervals of the range in question, though not many experimenters have had the fortitude to duplicate Sturt's conditions in which ". . . she brought the lighted end of the cigarette against her hand, keeping it there . . ." until the end of the time interval was indicated.[5] Henrikson[6] reports an experiment to determine whether there is a significant difference between the judgment of elapsed time when a person is making a formal speech to a group and when he is not, and whether the judgment of length of speaking time is influenced by the degree of stage fright. He found that inactive subjects more often over-estimated the time, while speaking subjects more often under-estimated the same intervals. He also concluded that there was no significant tendency for degree of stage fright to correlate positively with an estimation of speaking time, contrary to what the students

3. Moore, E. H., Studies on the Testimony of Time Intervals. Oregon Law Review, *29*:161, 1950.
4. James, W., Principles of Psychology, Vol. 1, p. 626. New York, Henry Holt, 1890.
5. Sturt, M., The Psychology of Time. New York, Harcourt Brace, 1925.
6. Henrikson, E. H., A Study of Stage Fright and the Judgment of Speaking Time. Journal of Applied Psychology, *32*:532, 1948.

themselves expected and what "common sense" would predict. The tendencies which emerged were actually in the opposite direction. In summary, then, it can be said that pain and fright *per se* probably do not cause over-estimation of the length of a short time interval, but that lack of overt activity on the part of the witness, the occurrence of many events observed by the witness, and an attitude of tense expectancy all serve to increase the estimate.

As it happens, all these last three factors frequently occur together in many situations concerning which witnesses are asked to give testimony. The frightened but motionless bystander watching a bank hold-up; the highway-accident witness waiting, tense and helpless, for the sound of the ambulance siren; the trembling, silent householder, listening to the burglar rummage the downstairs drawers while his telephone call for police aid seems to have been forgotten—these circumstances provide the optimal conditions for over-estimation of a short time interval.

The following simple class experiment was set up to measure the joint effects of the three factors mentioned in a somewhat less stressful situation than those exemplified above. Starting a stop-watch hidden in his pocket, the instructor walked into the room and announced to the class that an important experiment was about to be undertaken involving the participation of several members of the class whose names were to be drawn at random from the class roll. The class was "assured" that the experiment would involve "no real danger" though the subjects might be made uncomfortable or embarrassed unless everybody remained silent and attentive. The instructor then quickly went through a long series of carefully rehearsed actions—posting colored paper of various sizes and shapes on the blackboard, setting up equipment, and doing other "busy work". He then sat down, surreptitiously observed his stop-watch for the few seconds yet needed to make a total elapsed time of 100 seconds, and slapped his hand loudly on the desk at the end of the interval. Copies of a questionnaire composed of twelve questions were then passed out to the class. Eleven of the questions were padding, included to deemphasize the true purpose of the experiment. The experimental question was: What was the total time between the moment the instructor walked in and the moment he slapped the desk?

This experiment has been conducted a number of times with classes of university students, police officers, and nurses. In every experiment the *entire* distribution of estimates was higher than the true length of the interval, 100 seconds. That is, *no* witness reported the interval as being 100 seconds or less. In a representative experiment (the one

most recently tried) the lowest estimate, out of a total of 36, was 2 minutes, 46 seconds, the median estimate was 8 minutes, and the highest estimate, with several others nearly as great, was 20½ minutes, an error of 1130 per cent!

In an experiment of this type a control is not essential, but does clarify the degree of relevancy of the experimental factors. Two comparative situations were therefore arranged to determine how accurately the same interval would be estimated under more "normal" conditions. Several weeks after the experiment reported above the instructor walked into the class room and lectured for 100 seconds. He then turned and wrote a large X on the blackboard. The members of the class were asked to write on slips of paper passed to them their estimates of the duration of the interval between the moment the instructor had walked in and the moment he wrote the X on the blackboard. In this situation a significant tendency to over-estimate the interval was found as before, but the error was far less than under previous conditions. The average (mean) estimate was 2 minutes, 20 seconds, lower than the lowest estimate of the original experiment. About 22 per cent under-estimated the interval, as compared to no under-estimations previously. Since the class had not been told the results of the first experiment, and since the significant question had been asked along with eleven others, it seems unlikely that any significant carry-over effects occurred.

Another opportunity was given the class to estimate the length of the same time interval a few days later. A straight-forward announcement was made that the instructor was going to signal the beginning and end of a certain interval of time, and the members of the group would be asked to estimate the length of the interval, without the use of a watch, and to write the estimate on a slip of paper. The lecturer talked informally during the 100-second period. Under these conditions the average (mean) estimate was 98.2 seconds, with exactly two-thirds under-estimating the interval, one naming it exactly, and the remainder over-estimating. Most of the subjects reported that they counted seconds or used some similar aid. It might be thought that some practice effects of the two previous attempts at estimation may have influenced the estimates in this situation. Other control groups, however, which had not been tested under the original conditions, made estimates not essentially different from those made by the group acting as its own control.

Admittedly, caution must be used in generalizing from findings in a lecture-room experiment to other situations. But the fact that similar results were obtained with groups of very different composition, that

all subjects made an error of the same kind though differing in amount, and that the error was always in the same direction and on the average very great, seems to justify the expectation that, under reasonably similar conditions, considerable over-estimation of time intervals in the neighborhood of one or two minutes is to be expected.