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THE EFFECT OF ANXIETY ON TIME JUDGMENT AND TIME EXPERIENCE IN NORMAL PERSONS

BY

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This investigation was prompted by the frequent observation that in normal persons awareness of the passage of time varies with the emotional state. Certain physiological changes, occurring spontaneously (François, 1928; Hoagland, 1933; Lecomte du Noüy, 1936) or induced by drugs (Bromberg, 1934; Wolf, 1952; Goldstone, Boardman, and Lhamon, 1958), are associated with abnormal time judgments. The well-known physiological accompaniments of emotion (Altschule, 1953) might be responsible for a disorder of the 'physiological clock' (Gooddy, 1958 and 1959), *i.e.*, of the bodily functions habitually serving as time mechanisms.

The methods used for testing judgment of time have been critically discussed by Clausen (1950) and the relevant literature reviewed by Wallace and Rabin (1960). We have selected tests to measure (*a*) the judgment of time in the absence of external clues (time production), and for this we used a method of counting aloud (Steinberg, 1955); (*b*) the ability to reproduce given time intervals without reference to their duration; (*c*) verbal estimation of the duration of given intervals; (*d*) judgment of the duration of long and actively spent intervals. Observations were made before the subjects were due to speak before a critical audience, an experience which they regarded as emotionally disturbing. Significant changes in adrenocortical function have been reported in comparable situations (Connell, Cooper, and Redfearn, 1958).

Our aims were to investigate (1) whether anxiety is associated with an impairment of time judgment, resulting in a discrepancy between personal (internal or psychological) and actual (external or clock) time; (2) whether there was any relationship between subjective distortions of time-perceptions and the results of objective tests.

The Experiment

The subjects were 24 doctors (21 men and three women), working at the Maudsley Hospital. Their ages ranged from 27 to 36 years, with a mean of 30. They were in normal health.

Testing took place in a quiet and relatively isolated room, the subject and one experimenter being present. Each subject was tested twice, once during a normal working day and once about an hour before he was due to speak in public. In half the subjects the control test preceded the experimental one and in the other half the order was reversed. The two tests were separated by 12 to 42 days. The testing procedure, identical on both occasions, was as follows:

Counting (Production).—The subject was asked to count aloud at one count per second. The time taken to count to 31, *i.e.*, his estimate of 30 seconds, was measured by stop watch. The test was performed twice successively (subtests 1 and 2).

The subjects were asked to complete the Maudsley personality inventory; the results of this were required for a different investigation, and it was inserted at this point to provide an interruption of about 10 minutes between the main parts of the test.

Tapping (Reproduction).—An electrically driven automatic time signal, emitting a brief pip every three seconds, was used for this test. The subject was told that after hearing five consecutive pips he would be asked to reproduce the intervals separating the pips by tapping on the table; the time from the first to the eleventh tap, *i.e.*, his estimate of 30 seconds, was measured with a stop watch. This was immediately repeated (subtests 1 and 2).

The subject was asked to estimate the interval between pips after he had listened to another sequence of five (verbal estimation). The subject was asked how he was feeling. After his answer he was asked whether he was feeling relaxed or tense. The subject was asked how time seemed to be passing (normal, slow, or fast). Finally, the subject was asked to estimate the total time he had been in the room. This time was compared with the actual time spent, as measured with a stop watch, usually about a quarter of an hour.

Results

The results for time production by counting are shown in Table I. The means, standard deviations, and range of results were very similar on both occasions. The mean time taken to count out what

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TABLE I
COUNTING AND TAPPING

	Control		Emotion		Control		Emotion	
	1	2	1	2	1	2	1	2
Mean (seconds)	39·8	40·3	40·2	40·3	29·5	29·7	30·7	29·9
S.D.	11·6	13·5	12·9	12·9	4·7	3·1	4·7	3·9
Range	22·7-75·0	23·1-74·8	12·3-66·0	14·3-67·0	21·0-43·2	24·3-37·0	22·8-35·7	23·0-40·0
$r_{1,2}$	+0·95		+0·97		+0·86		+0·57	

was thought to be 30 seconds was in fact almost exactly 40 seconds; only four subjects took less than 30 seconds. The wide variation between individuals is reflected in the standard deviation and the range of results. This is in contrast to the remarkable consistency of each individual's performance in subtests 1 and 2 on each occasion; the correlation factor between the two subtests was equally high each time. However, the correlation between the results of the two testing occasions was very low.

Table I shows all results for time reproduction by tapping. On both occasions the mean time taken to reproduce the 10 three-second intervals was almost exactly 30 seconds. The smaller variation in time judgment between individuals is shown in the figures for standard deviation and ranges. In a state of anxiety the correlation coefficient between subtests 1 and 2 was + 0·57 as against + 0·86 obtained in the control test. This difference is statistically significant ($t = 2{\cdot}1$; S.E. $= 0{\cdot}308$; $P < 0{\cdot}05$).

Table II shows that the mean, standard deviation, and range of estimations of the three-second interval were very close on both occasions, with a high correlation (+ 0·8) between the two sets of results.

TABLE II
INTERVAL ESTIMATION

	Control	Emotion
Mean (seconds)	3·6	3·7
S.D.	1·0	1·1
Range	2-6	2-6

When tested before they were due to speak in public, 20 of the 24 subjects said they were either anxious or tense; only two rated themselves similarly in the control observations.

Before speaking in public, seven subjects said that time seemed to pass faster than normally, and five said it seemed to pass more slowly. These 12 all rated themselves as anxious or tense. There was no relationship between the way in which the passage of time appeared to be altered and the direction of the deviations in any of the individual test results. In the control tests all 24 subjects said that time was passing normally.

The actual time spent in testing was nine to 19 minutes in the control and eight to 15 minutes in the emotional setting, which illustrates the more hurried performance in the latter situation. Table III shows the results, the estimated time being given as a percentage of the actual time spent. Means and standard deviations are similar, but the range slightly narrower under emotion.

TABLE III
DURATION OF EXPERIMENT

	Control	Emotion
Mean (percentage of actual time)	110	109
S.D.	28	25
Range	62-200	78-174

Discussion

Distortions of time-sense are common in many forms of mental disturbance, including anxiety. They may represent a form of depersonalization-derealization, and this may underlie our finding that half of our subjects, when rating themselves anxious or tense, had a subjectively altered experience of time, without objectively demonstrable differences in time judgment.

The tendency to count slowly compared with clock time is in accord with previously recorded observations (Steinberg, 1955). Two observations emerged from the tapping experiment: (1) The judgments were much more accurate than in the other experiments. A reason for this may be that in this experiment the subject's notion of clock-measured time is not introduced and cannot therefore interfere with his judgments. (2) When the subjects were anxious the test-retest reliability was significantly impaired, so that this test would seem to be more sensitive to anxiety than the others. A possible explanation is that the influence of subtest 1 on the performance in the immediately following subtest 2 ('anchor' effect) is disrupted by anxiety.

Summary

The effect of anxiety on the time experience and time judgment of 24 normal subjects was measured.

The anxiety was caused by the anticipation of speaking before a critical audience. The tests included production, reproduction, and verbal estimation of time intervals ranging from one second to 19 minutes, and were supplemented by introspective statements about time experience.

Our findings were: subjective distortion of time experience occurred in half of our subjects. There were no corresponding objective changes in time judgment. Judgments in the time reproduction experiment were the most accurate but their reliability was impaired during anxiety.

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