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Time estimation and time production in depressive patients

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ABSTRACT – Twenty-three depressive inpatients and matched controls were studied three times at 2-week intervals. Both patients and controls initially overestimated, and subsequently approximated to, the "short" time spans (5–240 sec) whilst both correctly estimated the "long" ones (15 and 30 min) over the three occasions (Time Estimation Test, TET). There were no differences in the TET scores among the patients themselves, or between the patients and controls with the exception of one time span which the patients overestimated more than the controls. Among the depressive symptoms, only retardation was correlated with the TET scores. Similarly in the production of 30 sec (Time Production Test, TPT) there were no differences among the patients or between patients and controls. Again, only retardation was negatively correlated with the TPT score. Since the TET scores of the "short" time spans were negatively correlated with the TPT scores, it was speculated that both results derived from a single faculty, which was clinically manifested as retardation.

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The observation that depressed patients feel time passing slowly has been made by several clinical psychiatrists (1, 2). Experimental studies have also confirmed this (3, 4, 5, 6), and their results are in general agreement with the opinion that the sense of slow time flow is specific to the depressive state but not so to clinical entities of depressive illnesses (7, 8). The "subjective judgement of the passage of time (9) has been termed "time awareness" (5), though different investigators use different terminologies.

Time awareness may, however, be a faculty independent of the ability to judge how long an unknown time interval is (time estimation) or to produce a given time interval without the aid of a watch or other external cues (time production).

The findings of most of the past investigations on time estimation (1, 3, 4, 5, 7, 10, 11, 12, 13) and time production (4, 5, 11, 14) in depressive patients are, as the findings on time awareness, difficult to interpret, partly because of the ambiguity of the selection criteria, lack of

matched controls, and insufficiency in follow-up. We tried to overcome these methodological drawbacks and reported our findings on time awareness (8). Here we report the results of the time estimation and time production tests done in the same experimental setting.

Material and methods

Sample

The same patients and normal controls as those who took part in the time awareness study were examined.

The patients were 23 consecutively admitted new inpatients with depressed mood as their chief complaint, 13 males and 10 females, aged 20 to 66 (mean 42.2). After completing the Present State Examination (PSE) and diagnosis established by Catego Computer System (15), the sample patients were divided into three diagnostic categories:

I. Endogenous depression ($n = 14$, mean age ± SD 40.4 ± 14.2); Catego main classes D+, D?, R+, and R? are included.

II. Depressive or anxiety neurosis ($n = 5$, mean age ± SD 44.4 ± 17.6); Catego main classes A+, A?, N+, and N? are included.

III. Schizophrenia or paranoid state with depressive symptoms ($n = 4$, mean age ± SD 46.8 ± 11.5); Catego main class S+, S?, P+, O+, and O? are included.

The same number of normal volunteers, matched for age, sex and race, were examined in the same way as the patients.

Written informed consent was given by every subject prior to the interview.

Interview

Each subject was interviewed three times at 2-week intervals. For the patients the interviews were immediately, 14 days and 28 days after admission. Each interview was held in the same room between 1 and 4 p.m., and lasted approximately 45 min, during which time Hamilton's Rating Scale for Depression (HRS) (16) and a set of time experience tests, including the Time Awareness Test, Time Estimation Test (TET) and Time Production Test (TPT), were administered.

Time Estimation Test

Six pairs of relatively short "blank" time spans were given and the subject was asked to guess the length of each interval by using a visual analogue scale. The intervals were 5, 10, 20, 80, 160, and 240 sec.

Two relatively long intervals (15 and 30 min) were also tested during the interview by asking the subject how long he felt it was since the interview had started.

Time Production Test

The subject was asked to count 30 sec without external cues, and the actual length of time (in sec) was checked by the interviewer with a stopwatch.

Statistical analysis

Two-tailed non-parametric tests were applied (17).

Table 1
Mean scores (± SD) of TET of the "short" time intervals

Test	Interview	Patients	Controls	P
TET	1st	9.0± 6.0 (23)	7.2± 3.9 (23)	N.S.
5 sec	2nd	7.6± 4.1 (23)	4.7± 2.0 (23)	N.S.
	3rd	7.0± 4.0 (23)	5.5± 3.6 (21)	N.S.
TET	1st	20.3± 8.6 (22)	16.2± 8.5 (23)	N.S.
10 sec	2nd	17.3± 8.4 (23)	12.1± 5.2 (23)	**
	3rd	15.1± 6.3 (23)	12.8± 7.6 (21)	N.S.
TET	1st	33.7± 12.1 (23)	26.2± 12.7 (23)	*
20 sec	2nd	29.7± 12.7 (23)	20.7± 7.2 (23)	N.S.
	3rd	26.7± 10.4 (23)	22.6± 10.2 (21)	N.S.
TET	1st	189.9±133.9 (22)	117.7±131.0 (23)	*
80 sec	2nd	156.5±106.1 (23)	89.7± 43.0 (23)	**
	3rd	165.4±150.7 (23)	93.7± 68.2 (21)	N.S.
TET	1st	371.9±345.9 (22)	219.9±125.7 (23)	N.S.
160 sec	2nd	278.6±145.9 (23)	197.7± 82.7 (23)	N.S.
	3rd	265.3±168.2 (23)	205.4± 90.4 (21)	N.S.
TET	1st	397.0±520.1 (22)	332.2±134.4 (22)	N.S.
240 sec	2nd	405.8±175.2 (23)	332.6±129.1 (23)	N.S.
	3rd	347.2±164.6 (23)	324.0±114.0 (21)	N.S.

( ) = number of samples.
P = P value of two-tailed Wilcoxon matched-pairs signed-rank test.
N.S. = not significant. * $P < 0.05$. ** $P < 0.01$.

Table 2
Mean scores (± SD) of TET of the "long" time intervals

Test	Interview	Patients	Controls	P
TET	1st	13.6± 6.1 (22)	13.2±4.6 (23)	N.S.
15 min	2nd	15.2± 6.0 (22)	14.3±5.8 (23)	N.S.
	3rd	14.7± 8.4 (23)	13.5±3.5 (20)	N.S.
TET	1st	27.9±10.9 (22)	24.1±6.4 (22)	N.S.
30 min	2nd	28.7±10.6 (23)	27.5±7.4 (23)	N.S.
	3rd	28.5±13.6 (23)	26.1±6.8 (21)	N.S.

Results

Time Estimation Test

The controls tended to overestimate the "short" time spans in the initial interview, but gradually approximated to the actual time intervals in subsequent interviews (Table 1). This reached statistical significance for the 5-sec (Friedman two-way analysis of variance, $P < 0.01$) and 10-sec ($P < 0.01$) intervals. The patients showed the same tendency (Table 1) which reached statistical significance for the 10-sec ($P < 0.05$), 20-sec ($P < 0.05$), 160-sec ($P < 0.05$) and 240-sec ($P < 0.05$) intervals. There were hardly any significant differences in the TET scores of the depressives and controls from the same in-

Table 3
Mean scores (± SD) of TPT

Test	Interview	Patients	Controls	*P*
TPT	1st	17.0± 7.7 (23)	24.1±8.7 (23)	N.S.
	2nd	19.6± 9.4 (23)	22.8±8.3 (23)	N.S.
	3rd	20.8±10.0 (23)	25.1±7.1 (21)	N.S.

( ) = number of samples.
P = *P* value of two-tailed Wilcoxon matched-pairs signed-rank test.
N.S. = not significant.

terview except for the 80-sec interval results (Table 1).

As regards the estimation of the "long" time intervals, the scores of the patients were much the same as those of the controls during each interview (Table 2). Both groups also showed consistency in their scores over the three interviews.

In short, both patients and controls manifested an initial overestimation tendency, and subsequent approximation, only for the "short" time spans but not for the "long" ones. The TET scores of the patients rarely differed from those of the controls.

None of the TET scores were correlated with the severity of depression, expressed by the total score of the HRS. Among the symptoms listed on the HRS, only "retardation" was significantly correlated with the TET of a 20-sec interval (Kruskal-Wallis one-way analysis of variance, $P < 0.05$). Thus the patients were found to overestimate the time span when they were retarded (Fig. 1).

There were no differences in the TET scores of the three diagnostic groups. There was no significant correlation between either sex, or age, and the TET scores.

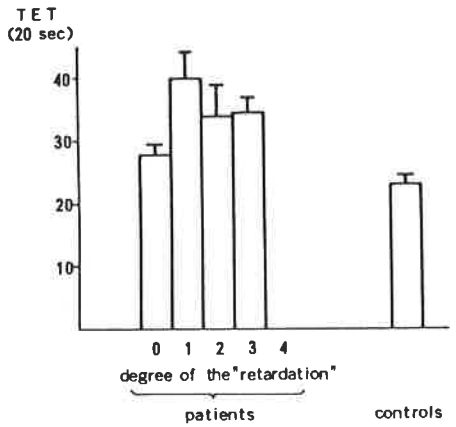

Fig. 1. The 20-sec interval TET scores of controls and patients divided according to severity of "retardation". A straight line represents SEM.

Time Production Test

The TPT scores of the patients were lower than those of the controls over the three interviews though this did not reach statistical significance (Table 3).

The total score of the HRS was not correlated with the TPT score. Among the symptoms of the HRS, however, "retardation" was found to be significantly correlated with the TPT score (Kruskal-Wallis one-way analysis of variance, $P < 0.05$), which was lower when "retardation" was present than when absent (Fig. 2).

No differences in TPT scores emerged between the three diagnostic groups. Age

Table 4
Correlation of TPT with TET among patients and controls

TPT vs.		Patients			Controls		
		r	*n*	*P*	*r*	*n*	*P*
TET	5 sec	–0.47	69	***	–0.55	68	***
	10 sec	–0.58	68	***	–0.52	68	***
	20 sec	–0.58	68	***	–0.63	68	***
	80 sec	–0.50	68	***	–0.38	68	***
	160 sec	–0.54	68	***	–0.51	68	***
	240 sec	–0.54	68	***	–0.59	68	***
	15 min	–0.12	68	N.S.	–0.16	68	N.S.
	30 min	0.09	68	N.S.	–0.11	68	N.S.

r = Spearman's rank ordered correlation coefficient. N.S. = not significant.
* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

and sex were also found to have no correlation with TPT scores.

Relationship between TET and TPT

Results of TPT were significantly correlated with those of TET for the "short" time interval test, but not for the "long" interval tests for both patients and controls (Table 4). This was a negative correlation: underproduction was correlated with overestimation whilst overproduction with underestimation.

Discussion

Time Estimation Test

The present study indicates that both controls and patients are inclined to overestimate "short" time spans in the initial interview and gradually approximate to the actual time spans in the subsequent interviews. The overestimation is not correlated with the severity of depression. Therefore this tendency can be thought of as a learning effect rather than the effect of the mental state, or of hospitalization.

As regards the literature of TET, some writers have claimed overestimation (3, 10, 11), others correct estimation (1, 4, 7, 13) and others again, underestimation

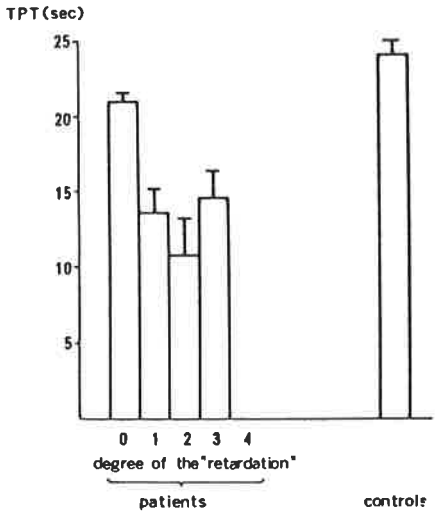

Fig. 2. TPT scores of controls and the patients divided according to severity of "retardation". A straight line represents SEM.

(5, 12). As the present study demonstrates that only psychomotor retardation is correlated with overestimation, the contradictions between past investigations might be explained by lack of information about the number of retarded cases involved in the sample.

Time Production Test

The literature of TPT also offers contradictory results, i.e. overproduction (4) and underproduction (5, 14). The present study shows that the time production of the depressives is no different from that of the normal controls, though again, one symptom, psychomotor retardation, was correlated with underproduction. Heterogeneity of the samples might be an explanation for the earlier contradictions.

One should, however, exercise great caution in being too conclusive, because of the small numbers involved in this study.

Relationship between TET and TPT

It has been demonstrated that scores of TPT are correlated with the "short" time span TET scores but not with the "long" time span TET scores.

This may mean that there exist two discrete categories of time estimation, short and long. This idea can be supported, though indirectly, by two findings. The first is that the initial overestimation and the subsequent approximation in the scores of TET were observed only for the "short" time spans. The second finding is that when a set of time perception tests (including Time Awareness Test (8), TET and TPT) was examined by principal component analysis, time estimation of the "short" time intervals and that of the "long" time intervals appeared in different factors (18). It is of interest that the "short" time interval TET was further divided into "short" (5, 10 and 20 sec intervals) and "medium" (80, 160 and 240 sec intervals) categories. Although most of the researchers cited above adopted the conventionally short and long time intervals, it is, at least to our knowledge, the present study that suggested classifying the TET time intervals in an experimental manner.

It has also been shown that only psychomotor retardation, out of the HRS symptoms, is correlated with underproduction in the TPT as well as overestimation in the TET. If, as indicated above, estimation of "short" time intervals and time production are derived from a single faculty, then retardation may be a clinical manifestation of this faculty.

It might be hypothesized that this faculty is related to the internal clock. If the internal clock runs at the same rate as an external (objective) clock, the subject shows correct time production and correct time estimation; if more quickly, underproduction and overestimation; if less quickly, overproduction and underestimation. This idea could, therefore, explain the negative correlation of TPT with TET. Secondly, only "retardation" was significantly correlated with underproduction and overestimation. Thus the internal clock presumably runs more quickly when the subject is retarded than when not. It is also an interesting coincidence that the circadian rhythm of the body temperature of depressives, while in the phase of retardation, is shorter than in remission (19, 20).

Although the present study needs a replication because of the small numbers investigated, future research on the correlations of time perception tests with bio-

logical measures known to manifest the circadian rhythm seems promising.

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