

Time Estimation of Depressive Patients: The Influence of Interval Content

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Summary. Duration judgements for intervals of different lengths and content were studied in depressive in-patients ($n = 47$) and a control sample of surgical in-patients ($n = 16$). As suggested by research on non-clinical subjects, tasks during the intervals influenced the depressed patients' duration judgements. Severely depressed endogenous depressives ($n = 17$) over-estimated time when left completely unoccupied or when attending to tasks requiring concentration. Endogenous depressives ($n = 17$) remitted with regard to subjective depression but, exhibiting signs of psychomotor retardation, selectively over-estimated time when required to concentrate under time pressure. Neurotic/reactive depressives ($n = 13$) with an intermediate level of subjective depression and almost normal psychomotor functioning did not over-estimate any of these intervals. Time estimations of patients and controls did not differ for intervals in the range of seconds and minutes requiring attention to time only, and for a longer part of the experimental session. Alteration of time estimation and results of a time experience inventory corresponded for endogenous depressives but not for neurotic/reactive depressives. Results are discussed in terms of the influence of affective state and subjective concentration effort on the over-estimations observed.

Key words: Depression – Time experience – Time estimation – Time perception

The old clinical observation that depressed patients often feel that time passes slowly (Straus 1928) has been confirmed in several studies. The subjective

speed of time, usually called time experience or time awareness, has been assessed by either simply asking the subject whether for her/him time passes rapidly, slowly or at a medium speed (Bech 1975; Lehmann 1967; Mezey and Cohen 1961; Münzel et al. 1987) or by obtaining ratings regarding time experience in general and in a number of specified situations (Kitamura and Kumar 1982; Wyrick and Wyrick 1977). The results show that the feeling of time passing slowly (a) returns to normal with improvement or remission of depressive symptoms (Bech 1975; Kitamura and Kumar 1982; Mezey and Cohen 1961; Münzel et al. 1987), (b) is present in depressive states regardless of diagnostic category (Bech 1975, Kitamura and Kumar 1982; Mezey and Cohen 1961; Münzel et al. 1987), (c) is not present in normal controls (Bech 1975; Kitamura and Kumar 1982; Wyrick and Wyrick 1977), non-depressed schizophrenics and patients with organic brain syndromes (Lehmann 1967) and (d) is present in its opposite form in hypomanic patients (Mezey and Knight 1965).

Attempts to substantiate these findings by assessing duration judgements of depressives, i.e. judgement of the length of a given interval, on the other hand have yielded inconsistent results. No differences compared to control groups or in the course of the depressive phase (Bech 1975; Kitamura and Kumar 1983; Lehmann 1967; Mezey and Cohen 1961), inaccurate estimations (Dilling and Rabin 1967), over-estimations (Melges and Fougereousse 1966; Payk 1976; Wyrick and Wyrick 1977) and under-estimations of time (Tysk 1984) have been reported. In a preceding study (Münzel et al. 1987) we observed over-estimations for a subgroup of agitated depressives, which remained together with a faster personal tempo even after the depressive symptoms had disappeared.

The results of psychological research on duration judgements of non-clinical subjects suggest the importance of at least three general aspects, which have so far been insufficiently considered in clinical studies: the distinction between time perception and time estimation, between prospective and retrospective time judgements and the influence of the content of the interval.

The distinction between time perception and time estimation is based on the duration of the interval. Only in the case of short intervals, which do not exceed the so-called psychological present – up to about 5s –, can one speak of time perception in the sense of an immediate reaction to a present stimulation. Time judgements of longer intervals represent estimations from memory, while in the first case one is dealing with the study of a perceptual process, memory processes play an additional role in the second case (Fraisse 1984).

The distinction between prospective and retrospective time judgements is based on the direction of attention. In a prospective procedure the subject knows before the interval that she/he will be asked to give a duration judgement, in a retrospective procedure the subject is not informed about the time judgement task until the end of the interval. The obvious difference in these procedures lies in explicitly drawing the subject's attention to time in the case of prospective judgements. The prospective procedure typically results in larger time judgements and the two procedures can have differential effects when raising the information processing demands of a task (Hicks et al. 1976, 1977).

The content of the interval, e.g. number, complexity and modality of sensory stimuli in the case of time perception and number and difficulty of events or tasks during longer intervals, greatly influences duration judgements. What is actually perceived or estimated is not time per se, but rather internal or external events happening in time. Besides the objective content of the interval its subjective effects have to be considered, i.e. the interaction of the objective content with the motivational and physiological state of the subject (Fraisse 1984).

In the above-mentioned clinical studies duration judgements of depressed patients were studied mainly in a prospective manner, as far as can be inferred from the description of methodology. Lengths of intervals varied from 1 s to several minutes and usually there was no task other than duration judgement of the interval. When intervals of longer duration were estimated they consisted of inter-individually varying segments of the experimental situation. Assessment of subjective depressive state, clinical rating of depression and diagnostic category have not always

been reported and in some studies only information about the amount and type of psychoactive medication is given. Other variables known to influence duration judgements such as activation, attentional demands of the task, or the subjective experience of the interval have usually not been taken into account.

The results of the majority of studies suggest that time perception of depressives is unimpaired (Kitamura and Kumar 1982; Lehmann 1967; Mezey and Cohen 1961; Münzel et al. 1987; Wyrick and Wyrick 1977). However, no data have been reported for durations below 1 s and time perception has not been studied under the influence of information processing demands of more than minimal degree. Divergent results pertain almost exclusively to time estimation. The fact that the clinical studies do not report or differ in a number of variables makes it impossible to draw any conclusions as to which of them might be responsible for the inconsistent findings.

The inconsistency between time experience results and duration judgement results (Bech 1975; Kitamura and Kumar 1982, 1983; Lehmann 1967; Mezey and Cohen 1961; Münzel et al. 1987) can be interpreted in different ways. It has been argued (Bech 1975) that when depressives report time as passing slowly it is a way of communicating depressive affect rather than denoting an experienced change in the flow of time. One could also argue that the apparent contradiction results from studying inappropriate types of intervals. The experience of time passing slowly is often induced by spontaneous attention to time, for instance in situations of waiting or when bored or tired by an activity. Generally speaking, spontaneous attention to time is due to a mismatch between a person's motivational and/or physical state and her/his present activity (Fraisse 1985). Considering symptoms like loss of energy, psychomotor retardation and lack of motivation it seems reasonable to assume that depressives have a heightened tendency to spontaneously attend to time and as a result experience time as passing more slowly. However, when duration judgements are assessed in a prospective way differences in spontaneous attention to time between depressives and control subjects are cancelled out. Furthermore intervals of short duration, i.e. in the range of time perception, and/or undemanding content seem less suitable for allowing depressive symptoms of affect or cognition to come to bear. Thus the experimental procedure could be the reason for the inconsistent findings between reported time experience and experimentally obtained duration judgements of depressives.

It has been shown in non-clinical studies that affective state and difficulty of the task influence duration judgements. The general explanation for this is

that the experience of duration is based on the number of internal or external events memorized and all that renders a task more unpleasant or more difficult multiplies the number of events (Fraisie 1981, 1984). Thus based on the findings of general psychology one would expect an over-estimation of time if an interval is rendered unpleasant and/or difficult due to the interplay of depressive symptomatology and task demands. In this study we wanted to investigate time estimations of depressives under the influence of different occupations, i.e. when left completely to themselves (no diversion, no concentration demands), when asked to attend to time (diversion, low concentration demands), when working on a task without speed requirement (diversion, medium concentration demands) and when working on a task with speed demands (diversion, high concentration demands). The assessment of duration judgements for intervals in the range of time perception and for a longer segment of the experimental session were included in order to allow a comparison with results of other studies.

Method

Design

The demonstration of a reversible influence of depressive symptoms on time estimation requires a repeated measurement design assessing patients in an acute and in a remitted state. However, it is impossible to obtain truly retrospective time estimations when the measurement is repeated. We therefore decided on a single measurement design including patients at different stages of their hospitalization and forming subgroups according to severity of depression and diagnostic category.

Sample

A total of 47 depressive patients with the following discharge diagnoses were examined once during their hospitalization: Unipolar depression (ICD-9 No. 296.1, $n = 31$), bipolar depression (ICD-9 No. 296.3, $n = 3$), neurotic or reactive depression (ICD-9 Nos. 300.4, 301.8, 309.0, 309.1, $n = 13$). Without consideration of type of depression 31 patients were examined during the first 3 weeks after admission to hospital, the remaining 16 patients were examined during the week before discharge.

A control group of 16 surgical in-patients, comparable with regard to age and level of education and occupation, were examined 1 to 2 weeks after surgery.

Measures and Procedure

Duration Judgements. Three intervals of 4 min each were estimated by the method of verbal estimation, i.e. the patient indicates the estimated duration of an interval delimited by the experimenter. The tasks during these intervals were no task (rest period: no diversion, no concentration demands), comparing two pictures and marking differences between them

(task without speed requirement: diversion, medium concentration demands) and completing an abbreviated version of a letter cancellation concentration test (Brickenkamp 1972; task with speed requirement: diversion, high concentration demands). One interval of 4 min was estimated by the production method, i.e. the patient has to indicate when he assumes 4 min have passed. There was no other task during this interval than to estimate time (diversion, low concentration demands). Intervals of 1, 5 and 10 s were produced 5 times. They were filled with a red light turned on by the experimenter and turned off by the patient pressing a button when he assumed the indicated number of seconds had passed. About 30 min after the beginning of the experimental session a verbal estimation of the interval was requested.

All of the verbal estimations were obtained in a retrospective manner, all of the time productions were prospective duration judgements. Actual durations of the short productions were registered electronically, longer durations were monitored and registered by the experimenter with a stop-watch. No feedback was given about the actual lengths of the intervals.

Time Experience. Time experience was assessed by an inventory consisting of 5 statements regarding subjective flow of time rated on 5-point scales (1 = very quick, 5 = very slow). The statements referred to the experience of time in general, when with other people, when alone, when occupied and when idle. Following the duration judgement each of the 4 min intervals was rated on 5-point scales with regard to subjective speed of time and agreeableness of the task.

Depression. Subjective depressiveness was assessed by a depressive mood inventory (Befindlichkeitsskala: BfS), results are reported as T scores based on the norms of the test manual (Zerssen 1976); due to organizational reasons clinical rating of depression (HAMD; Hamilton 1960) could be obtained for only half of the depressed patients.

Psychomotor Speed. Simple visual reaction time was obtained for reactions with little and with an enhanced motor component. The patient had to press a button as soon as a light in front of him went on; his finger was either placed on the button or his hand was placed 20 cm away; three blocks of 10 reactions each of either arrangement were measured alternately. Tapping at the fastest rate possible during an interval of 5 s was a further measure of motor speed. The duration of counting from 1 to 20 at an agreeable rate was obtained as measure of personal tempo.

Performance measures. The number of letters checked and percentage of mistakes in the concentration test and the number of differences detected during the picture comparison task were measures of performance while working with and without speed requirements.

All patients were assessed individually between 9 and 11 a.m., the complete procedure lasting 40 to 60 min excluding the HAMD rating. This was conducted by an independent rater before the patient came to the experimental room. The other measures were obtained in the following order, brackets indicating measures not reported here: (pulse rate) – reaction time – BfS – rest period, verbal estimation – tapping – (pulse rate) – personal tempo – picture comparison, verbal estimation – concentration test, verbal estimation – (anxiety inventory) – production of 4 min – production of 1, 5, 10 s – time experience inventory. On the day of assessment dosage of all psychoactive medication had been constant for at least 2 days.

Table 1. Gender distribution and group means (\pm SD) for age and depressiveness

	Endogenous depressives		Neurotic depressives	Controls
	High (<i>n</i> = 17)	Low (<i>n</i> = 17)	(<i>n</i> = 13)	(<i>n</i> = 16)
Age	49 (\pm 13)	44 (\pm 10)	40 (\pm 16)	44 (\pm 13)
Sex	13 F, 4 M	13 F, 4 M	10 F, 3 M	12 F, 4 M
Befindlich- keitsskala (T scores)	74.2*** (\pm 4.09)	55.4 (\pm 11.41)	64.1** (\pm 12.85)	52.5 (\pm 4.56)
HAMD (0-63)	20 (\pm 7) <i>n</i> = 8	14 (\pm 6) <i>n</i> = 7	14 (\pm 7) <i>n</i> = 8	

*** $P < 0.001$, ** $P < 0.01$; Mann-Whitney U test vs controls

Table 2. Group means (\pm SD) for psychoactive medication of the depressed patients (E Chl = equivalent to chlorpromazine)

	Endogenous depressives		Neurotic depressives
	High (<i>n</i> = 17)	Low (<i>n</i> = 17)	(<i>n</i> = 13)
Anti-depressants (mg)	115 (\pm 76) <i>n</i> = 16	109 (\pm 55) <i>n</i> = 16	67 (\pm 46) <i>n</i> = 9
Neuroleptics (E Chl)	147 (\pm 131) <i>n</i> = 4	45 (\pm 44) <i>n</i> = 5	21 (\pm 10) <i>n</i> = 2
Tranquilizers (mg)	3 (\pm 6) <i>n</i> = 5	2 (\pm 4) <i>n</i> = 4	0

Non-parametric Mann-Whitney U tests were used for analysing differences between depressives and controls including an explicit α -protection for repeated testing against the control group ($\alpha^* = \alpha/\text{number of experimental groups}$; Lienert 1973). One-tailed tests were applied except for personal tempo, 1 s productions and time experience ratings of the 4 min intervals. Results of previous studies (Münzel et al. 1987; Steinberg et al. 1985) as well as theoretical considerations suggested two-tailed tests for these variables.

Results

For analysis of data the sample of depressed patients was divided into three subgroups: endogenous depressives with high and low subjective depression (EDH and EDL) and neurotic/reactive depressives (ND), the small number of patients in this group did not enable further subdivision. The control group and the resulting three groups of depressives (Table 1) were comparable with regard to age and sex. The EDH patients had the highest level of subjective de-

Table 3. Group means (\pm SD) for the duration judgements (VE = verbal estimation, P = production, DS = deviation score)

	Endogenous depressives		Neurotic depressives	Controls
	High (<i>n</i> = 17)	Low (<i>n</i> = 17)	(<i>n</i> = 13)	(<i>n</i> = 16)
Rest period (240 s, VE)	334* (\pm 134)	251 (\pm 51)	288 (\pm 140)	255 (\pm 59)
Picture comparison (240 s, VE)	337* (\pm 131)	301 (\pm 123)	283 (\pm 58)	285 (\pm 76)
Concentration test (240 s, VE)	353(*) (\pm 136)	362* (\pm 132)	272 (\pm 72)	273 (\pm 109)
Time estimation (240 s, P)	166 (\pm 85)	182 (\pm 64)	210 (\pm 73)	209 (\pm 45)
1 s (P)	1.88(*) (\pm 1.22)	1.24 (\pm 0.50)	1.10 (\pm 0.38)	1.09 (\pm 0.31)
5 s (P)	4.67 (\pm 2.07)	3.44 (\pm 1.50)	3.84 (\pm 1.58)	4.14 (\pm 1.50)
10 s (P)	8.80 (\pm 3.15)	7.14 (\pm 2.87)	8.76 (\pm 3.78)	8.84 (\pm 3.65)
Test session DS (min, VE)	-11 (\pm 13)	-3 (\pm 6)	-7 (\pm 10)	-7 (\pm 6)

* $P < 0.05$, (**) $P < 0.10$; Mann-Whitney U test vs controls

pression followed by ND patients, both groups differing significantly from the control group ($U = 0$, $p < 0.001$ and $U = 37.5$, $p < 0.01$), while EDL patients did not differ from the controls. The HAMD scores, available for only about half of each subgroup, suggest that EDL and ND patients exhibited the same elevated level of clinical symptoms. This is also supported by psychomotor speed results.

The level of psychoactive medication is shown in Table 2. Mean values are based on the number of patients receiving the respective type of drug. Dosage of anti-depressants and tranquilizers were averaged for the different substances, which were comparably distributed within groups; neuroleptics were transformed into chlorpromazine units. On the average patients of the two endogenous groups received comparable amounts of anti-depressants and tranquilizers, while ND patients received less anti-depressants and no tranquilizers. EDH patients had the highest level of neuroleptic medication. However, only 2 to 5 patients of each group received either neuroleptics or tranquilizers. All control patients, 4 ND patients and 1 patient in each of the endogenous groups received no psychoactive medication.

An overview of duration judgement results is given in Table 3. When inspecting the Table the

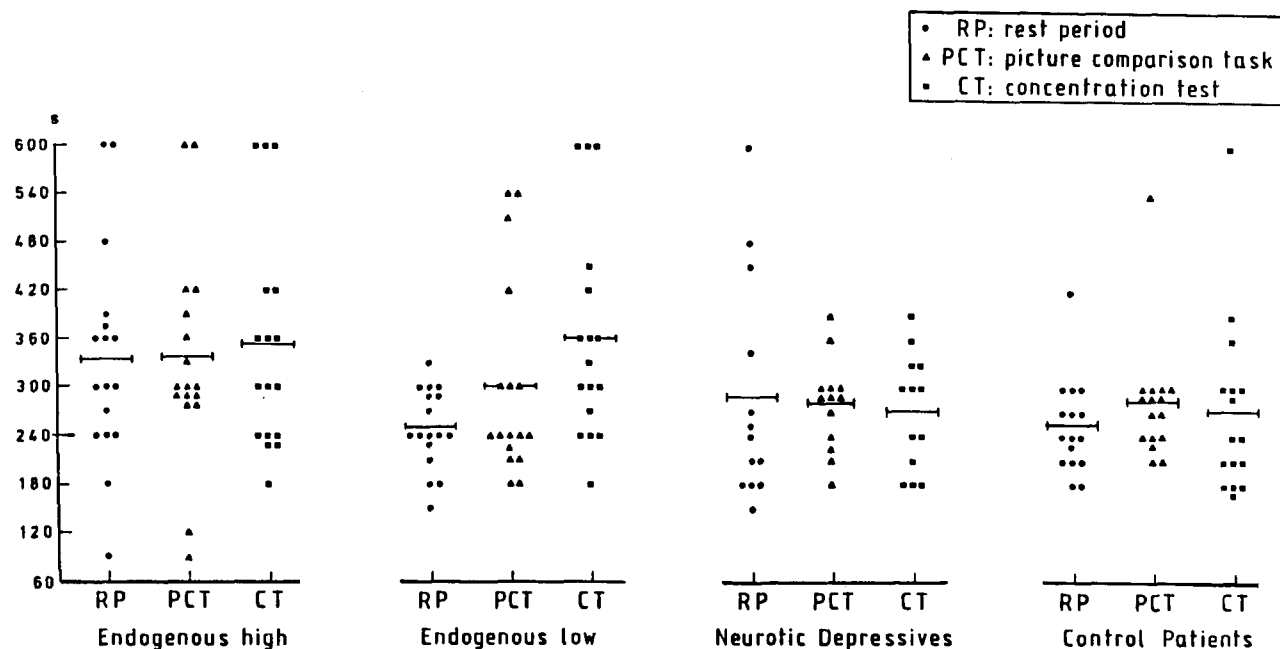


Fig. 1. Raw score distributions for verbal estimations of 4 min intervals with different content

method of judgement has to be considered: over-estimation of time is represented by higher values of verbal estimates and by lower values of production estimates. Compared to the control group EDH patients over-estimated the rest period ($U = 76, p < 0.05$), the interval filled with the picture comparison task ($U = 73, p < 0.05$) and marginally over-estimated the interval filled with the concentration test ($U = 80, p < 0.10$). When given the task to perceive or estimate time EDH patients gave marginally longer 1 s productions ($U = 74.5, p < 0.10$) but did not differ in their productions of 5, 10 and 240 s. They under-estimated the 30 min segment of the experimental session filled with a variety of tasks to the same extent as the controls. The EDL patients selectively over-estimated the concentration test interval ($U = 74, p < 0.05$) and ND patients' duration judgements did not differ from the control group for any of the intervals assessed.

The distribution of individual values for the three verbally estimated 4 min intervals is shown in Fig 1. It can be seen that about half of the EDH patients over-estimated each of these intervals by more than 25% (1 min) compared to only 1 or 3 patients of the control group. More than half of the EDL patients over-estimated the concentration test interval to the same extent, while their estimates of the rest period and the picture comparison task showed a distribution similar to the controls.

Depressed patients and controls differed little in their ratings of time experience and agreeableness of tasks for the 4 min intervals (Table 4). Compared to

the controls ND patients felt that time passed more slowly during the concentration test ($U = 49.5, p < 0.05$) and EDH patients felt that time passed more quickly while estimating time ($U = 68, p < 0.05$). The rest period was experienced as marginally less agreeable by EDH patients ($U = 86, p < 0.10$) and EDL and ND patients rated the picture comparison task as less agreeable ($U = 76.5, p < 0.05$ and $U = 60.5, p < 0.10$).

Regarding psychomotor speed and performance (Table 5) EDH patients differed most from the controls. They exhibited longer reaction times ($U = 46$ and $U = 49.5, p < 0.01$) and a slower tapping speed ($U = 39.5, p < 0.001$), they also showed a reduced performance in the concentration test ($U = 49$ and $U = 44, p < 0.01$) and in the picture comparison task ($U = 19, p < 0.001$). The EDL patients were less retarded, but also differed significantly from the controls in reaction time with enhanced motor component ($U = 67, p < 0.05$), tapping speed ($U = 57, p < 0.01$), percentage of mistakes in the concentration test ($U = 67.5, p < 0.05$) and number of differences in the picture comparison task ($U = 38, p < 0.001$). They had a marginally faster personal tempo ($U = 71, p < 0.10$). The ND patients differed significantly from the controls in two of the performance measures only: they worked more slowly during the concentration test ($U = 50, p < 0.05$) and during the picture comparison task ($U = 22.5, p < 0.001$).

The results of the time experience inventory are presented in Table 6. The EDH patients rated time to pass more slowly than controls in general ($U = 58,$

Table 4. Group means (\pm SD) for ratings of time experience (TE) and agreeableness of task (AT) of the 4 min intervals (1 = very quick, very agreeable, 5 = very slow, very unagreeable)

	Endogenous depressives		Neurotic depressives	Controls
	High (<i>n</i> = 17)	Low (<i>n</i> = 17)	(<i>n</i> = 13)	(<i>n</i> = 13)
Rest period				
TE	2.47 (\pm 1.07)	2.29 (\pm 0.68)	2.07 (\pm 0.64)	2.43 (\pm 0.81)
AT	3.12(*) (\pm 1.16)	2.52 (\pm 0.72)	2.53 (\pm 0.66)	2.37 (\pm 0.88)
Picture comparison				
TE	2.17 (\pm 0.81)	1.94 (\pm 0.56)	2.00 (\pm 0.57)	2.18 (\pm 0.83)
AT	2.47 (\pm 0.72)	2.64* (\pm 0.78)	2.54(*) (\pm 0.66)	2.00 (\pm 0.73)
Concentration test				
TE	2.06 (\pm 0.89)	2.06 (\pm 0.89)	2.30* (\pm 0.75)	1.56 (\pm 0.69)
AT	2.88 (\pm 1.05)	3.12 (\pm 0.78)	3.15 (\pm 0.69)	2.81 (\pm 0.91)
Time estimation task				
TE	2.23* (\pm 0.97)	2.76 (\pm 1.03)	2.84 (\pm 0.80)	3.06 (\pm 0.77)
AT	2.70 (\pm 0.92)	2.76 (\pm 0.75)	2.61 (\pm 0.50)	2.50 (\pm 0.52)

* $P < 0.05$, (*) $P < 0.10$; Mann-Whitney U test vs controls

Table 5. Group means (\pm SD) of psychomotor speed and performance measurements (CTT = concentration test task, PCT = picture comparison task)

	Endogenous depressives		Neurotic depressives	Controls
	High (<i>n</i> = 17)	Low (<i>n</i> = 17)	(<i>n</i> = 13)	(<i>n</i> = 16)
Reaction time – near (ms)	420** (\pm 180)	334(*) (\pm 168)	279 (\pm 84)	257 (\pm 63)
Reaction time – far (ms)	728** (\pm 207)	603* (\pm 157)	571 (\pm 151)	499 (\pm 123)
Tapping (no. of taps)	28*** (\pm 6)	29** (\pm 7)	31 (\pm 9)	35 (\pm 5)
Counting tempo (s)	12.8 (\pm 8.5)	10.3(*) (\pm 4.9)	12.2 (\pm 6.9)	13.3 (\pm 4.6)
CTT amount	267** (\pm 67)	302 (\pm 83)	280* (\pm 76)	343 (\pm 66)
CTT mistakes (%)	12** (\pm 8)	7* (\pm 5)	8 (\pm 8)	4 (\pm 3)
PCT hits	11*** (\pm 4)	14*** (\pm 4)	14*** (\pm 3)	19 (\pm 2)

*** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$, (*) $P < 0.10$; Mann-Whitney U test vs controls

Table 6. Group means (\pm SD) for the items of the time experience inventory (TE = time experience, 1 = very quick, 5 = very slow)

	Endogenous depressives		Neurotic depressives	Controls
	High (<i>n</i> = 17)	Low (<i>n</i> = 17)	(<i>n</i> = 13)	(<i>n</i> = 16)
TE in general	3.53** (\pm 1.12)	2.94(*) (\pm 0.96)	3.07(*) (\pm 1.03)	2.25 (\pm 0.93)
TE when with people	3.00** (\pm 1.27)	2.29(*) (\pm 0.68)	2.69*** (\pm 0.63)	1.75 (\pm 0.44)
TE when alone	4.29*** (\pm 0.59)	3.41 (\pm 1.00)	3.92* (\pm 0.95)	3.06 (\pm 0.77)
TE when occupied	2.82** (\pm 1.01)	2.00 (\pm 0.35)	2.30* (\pm 0.63)	1.75 (\pm 0.44)
TE when idle	4.29* (\pm 0.92)	3.76 (\pm 0.83)	4.38* (\pm 0.65)	3.62 (\pm 0.62)

*** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$, (*) $P < 0.10$; Mann-Whitney U test vs controls

$p < 0.01$) and in the four situations listed ($U = 33.5$ to $U = 69$, $p < 0.001$ to $p < 0.05$), while for EDL patients time seemed to pass marginally slower in general and when with other people ($U = 84.5$ and $U = 80$, $p < 0.10$). Time in general was reported as passing marginally slower ($U = 59.5$, $p < 0.10$) by ND patients who at the same reported a situational slowing down of time to almost the same extent as EDH patients ($U = 30$ to $U = 56$, $p < 0.001$ to $p < 0.05$).

In order to exclude the slightly higher age level of EDH patients as an influencing variable, a further analysis was carried out comparing 10 EDH and 10 control patients matched for age. Results obtained were essentially the same as reported before.

Discussion

Severely depressed endogenous patients over-estimated time when left completely to themselves and when attending to a task without speed requirements; they also showed a tendency to over-estimate time when working on a task with speed requirements. Endogenous depressives, who were remitted with regard to subjective depression, over-estimated time selectively when working under speed requirements. Neurotic depressives with an intermediate level of subjective depression did not over-estimate any of these three intervals. In addition intervals in the range of seconds and minutes requiring attention to time only and a longer segment of the experimental session were not over-estimated by any of the depressed groups. The interpretation of this pattern of results requires consideration of interval as well as patient characteristics.

The group of patients most depressed and retarded in psychomotor functioning over-estimated the duration of the intervals requiring concentration effort. This can be explained as an expression of the greater subjective difficulty of these task for these patients, i.e. requiring more concentration effort. The same groups' tendency to over-estimate the undemanding but at the same time undiverting rest period can be interpreted as expression of negative affect. This is supported by their tendency to also rate this interval as less agreeable than the controls. It should be added that the longer 1 s productions of these patients do not represent an under-estimation of time. As the phenomenon disappeared in the production of 5 and 10 s it is better understood as an expression of reduced reaction speed.

Concentration effort also explains the selective over-estimation of the concentration test interval by EDL patients. Despite their reduced level of psychomotor functioning, the patients worked almost as quickly as the controls during this interval. However, when working on a task without time pressure they showed a reduced performance level and no over-estimation. In contrast the only slightly retarded ND patients worked slowly during both of these intervals without over-estimating either of them. Cognition of time while occupied has been found to depend on amount of work done and on the difficulty of the task (Fraisse 1981). The influence of these two factors seems to be reflected in this set of results.

Even severely depressed patients did not over-estimate the other intervals. Task and durations of the short intervals and the 4 min time estimation task did not require prolonged concentration effort and at the same time offered distraction from preoccupation with negative mood. The content of the 30 min segment on the other hand varied depending on the state of the patient. Although measures were always obtained in the same order, assessment took longer when patients were retarded or less motivated thus presumably introducing systematically differing demands for the whole procedure. These results agree with the majority of other studies reporting negative findings for these types of intervals (Kitamura and Kumar 1983; Lehmann 1967; Mezey and Cohen 1961; Münzel et al. 1987). At the same time they reduce the likelihood that the over-estimations we observed were based on sample rather than interval characteristics.

As psychoactive substances are known to influence duration judgements, the question arises to what extent the results were influenced by the medication. Stimulants have been reported to lead to over-estimations of time and sedating substances can have the reverse effect. However, findings are

contradictory and no results pertain to anti-depressant medication (Block 1979). The pattern of our results makes it unlikely that an activating effect of the anti-depressants caused the over-estimations observed. Activational differences should have been reflected in the rate of the personal tempo (Doob 1971), which was slightly faster for EDL patients only. They would also be expected to influence time estimates for intervals with little concentration demands as much if not more than others, which was not the case.

For the two groups of endogenous depressives there was a correspondance between alteration of time estimation and time experience as assessed by the time experience inventory. The EDH patients reported a subjective slowing down of time for all items listed, EDL patients' ratings were less elevated differing significantly for one item only. The ND on the other hand reported a slowing down of time without over-estimating any of the intervals assessed. The more inhomogeneous composition of this group with regard to subjective depressiveness does not explain this discrepancy, as intra-group variability of time estimations and time experience ratings was the same or even smaller than in the other groups. This finding needs further investigation as it might reflect a difference of diagnostic categories of depression.

Besides the usual mode of assessing time experience we included time experience ratings of the 4 min intervals. These two modes of assessment not only differ with regard to situational specificity but actually tap different phenomena. The experience of an accelerated or slowed flow of time typically arises out of a discrepancy between actual and estimated duration of an interval, i.e. is based on the knowledge of the actual duration. This was assessed by the questionnaire ratings asking for the present everyday experience of the flow of time. The ratings of the 4 min intervals on the other hand were obtained following the duration estimates but without feedback of the actual duration of the interval. Thus these ratings can be looked at as a control for a possible answering bias of the depressives. The results show that on the whole they did not differ from the controls. This finding and the over-estimations of time we observed contradict Bech's (1975) assumption that depressed individuals in general simply use time terminology to communicate their negative affective state without essentially experiencing time differently.

In summary, the results of this study support our assumption that the content of the interval is a critical factor for duration judgements of depressives. In order to maximize variation of attentional task demands we obtained retrospective time estimates for the main intervals, which precluded a repeated mea-

surement design. In a study now under way we are assessing prospective estimates for essentially the same type of intervals which will allow an intra-individual comparison in the course of the depressive phase.

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