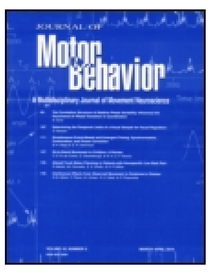

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PURSUIT ROTOR REMINISCENCE IN SCHIZOPHRENICS AND NORMALS[1]

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Normal and schizophrenic Ss (N=24 each) did pursuit rotor tracking and reminiscence was the score of interest; rest pauses of 2, 12, and 30 min., and 1, 6, and 24 hr. were interpolated in counterbalanced order after 5 min. of practice. It was predicted, on the basis of previous work, that schizophrenics would show greater reminiscence after the longer rest pauses, normals after the shorter rest pauses. The expected cross-over effect was found, but at a non-significant level only. There were no order effects. A discussion is given of the relation of these results to the interpretation of schizophrenia in terms of "arousal."

A proper understanding of the nature of the abnormality which characterizes clinical groups such as schizophrenics requires (a) the experimental demonstration of significant differences between such groups and others not sharing the particular abnormality in question, and (b) the elaboration of theories regarding the factors underlying the observed experimental differences. The present study is concerned with an experimental variable which has been suggested as likely to distinguish schizophrenic patients from matched normals, namely pursuit-rotor reminiscence.

Eysenck (1961) attempted to account for the frequently-observed general slowness in psychotic patients by reference to two possible causes, namely (1) lack of motivation, and (2) a slow rate of dissipation of reactive inhibition. He suggested that reminiscence studies could be used to test which of

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these hypotheses was the more likely, and quoted an unpublished study by Ley in which groups of psychotics and normals were given rest pauses in pursuit rotor learning of either 10 min. or 24 hr. For the short rest period the normals had high reminiscence scores, while for the long rest period reminiscence was less. For the psychotics, the short rest period resulted in no reminiscence at all, while the long rest period produced higher reminiscence than was observed in either of the normal groups. This finding was regarded as favoring the second hypothesis listed above. Rachman (1963), in a study modeled after that of Ley, found similar results. Broadhurst and Broadhurst (1964) and Claridge (1960) showed that short rest periods produced very little reminiscence in schizophrenics, and O'Connor (1957) and Huston and Shakow (1948, 1949) showed that strong reminiscence effects could be obtained in schizophrenics when long rest periods were used. Higgins and Mednick (1963) found greater reminiscence after a short rest in earlier-stage schizophrenics than in advanced-stage schizophrenics. The empirical data are thus in good agreement, but it should be noted that there are good reasons for doubting the adequacy of the reactive inhibition theory as an explanation of reminiscence, and a theory in terms of consolidation of the memory trace is now preferred by Eysenck (1965). The manner in which this change in theory influences predictions and explanations of experimental findings will be considered later. Our experiment is essentially designed to test the hypothesis that length of rest pause will affect the reminiscence scores of normals and schizophrenics differentially, with short rest pauses favoring normals, and long rest pauses favoring schizophrenics; this prediction follows equally from the discarded inhibition theory and from the new consolidation theory.

Method

Subjects. Ss were 46 male patients from a larger group of male chronic schizophrenics at All Saints' Hospital, Birmingham. They were unquestionably diagnosed as schizophrenics and had had a minimum of 2 yr. in the hospital, but could be taken off all medication for at least 1 wk. prior to experimentation. They were not suffering from gross physical handicaps such as to preclude cooperation in the motor tasks of the experiment and were in the age range 18-60 yr. Ten Ss were discarded during testing for failing to reach the criterion of learning (at least one 10-sec. period in first trial showing score of first 10-sec. period + 1.5 sec. on target) on the pursuit rotor despite cooperation. Ten further Ss were later discarded when owing to apparatus failure, their records gave incomplete results. Two Ss were discarded when it was found that their diagnoses were complicated, one by head injury and one by alcoholism. Twenty-four Ss remained, aged 18-58 yr., with an average age of 39.6 yr. (SD=12.1). The average length of present hospitalization was 11.7 yr (SD=9.2), which gives some indication of the chronicity of their disorders.

The control Ss were 32 male members of staff of the hospital who volunteered. The criterion adopted for inclusion was absence of a history of mental illness. Six Ss gave results which were incomplete because of apparatus failure and therefore were discarded. Two Ss were discarded as being too young

for comparison with the chronic patient group. The remaining 24 Ss were aged 23 to 56 yr., with an average of 33.5 yr (SD=9.9). The age difference between the groups was not significant, $t(23) = 1.89$, $p > .05$.

Apparatus. A conventional pursuit rotor constructed by Lloyd's Instruments Ltd., London, was employed. This consisted of a gramophone-type turntable, 10 in. in diameter, revolving clockwise at 60 rpm with a metal spot 0.7 in. in diameter embedded with its center 3.25 in. from the center of the turntable. Contact between the rotating metal spot and an articulated pointer held by S was recorded (in sec. on target within 10-sec. periods) by automatically-alternating chronotrons. The pursuit rotor timer had a 3-sec. warning-to-read light. With this signal Ss moved onto the turntable before the first 10-sec. work period.

Procedure. Testing was carried out in a room 6.5 x 9.5 ft. off a quiet hospital ward. Lighting was standardized throughout the day by blacking out the one window and using a constant electric illumination which provided illumination of 16 fc recorded by a light meter on the pursuit-rotor turntable.

Ss were given standard instructions and demonstration of pursuit rotor tracking. Seven periods of massed practice (5 min. each) were then arranged with six different rest intervals of 2, 12, and 30 min., and 1, 6, and 24 hr. in duration. Ss performed after all rest intervals arranged in balanced order with the limitation that the short intervals (2, 12, and 30 min.) were always together in this order as "Short rest periods." Four rest intervals remained as far as balancing of order was concerned, and hence 24 (4!) was the minimum number of Ss possible; every S in the two groups practiced under a different combination of orders. Ss were randomly assigned to orders in so far as the next S to be tested was chosen at random from the pool of available Ss. The rest interval order used was then determined by the experimental time schedules designed to fit various rest interval combinations into the days available for the experiment.

Ss also practiced tapping for 5-min. periods after the same rest intervals in the same balanced order. Half the Ss in each group performed pursuit rotor practice first and half practiced tapping first. Results are reported elsewhere (Broadhurst & Eysenck, 1973, in press).

Measures of intelligence (the Progressive Matrices Test – Raven, 1960) and of the personality factors extraversion and introversion (Eysenck Personality Inventory, Form A – Eysenck & Eysenck, 1964) were also attempted although in the schizophrenic group many Ss were found to be untestable. Ss were asked to estimate the time spent on first practice of the motor tasks and they performed a task involving number naming at random. These results have been reported elsewhere (Ramsay & Broadhurst, 1968; Broadhurst, 1969).

Scoring. Reminiscence on the pursuit rotor task was measured for each S and after each rest interval by averaging the time-on-target during the last three 10-sec. periods of the preceding massed practice and subtracting this from the time on target during the first 10-sec. period after rest. While many other measures of interest can be explored in pursuit rotor performance, it is the reminiscence measure which is examined in the light of our predictions.

Results

Order Effect. It was considered necessary first to exclude any possibility of an order effect of the programmed rest intervals. Since no two Ss within a group had worked with rest intervals in the same order, the effect of order could be assessed in a limited fashion only.

In normal and schizophrenic groups separately there were six Ss who performed after the block of short rest intervals (2, 12, and 30 min.) first in the balanced order, six who met it second, six third, and six who met it fourth. (The short rest intervals always followed one another in the order 2, 12, 30 within the short block.) Analysis of variance of reminiscence scores in these order positions gave non-significant results for normal and schizophrenic Ss analyzed separately.

Analysis of variance was also carried out on the reminiscence scores after short intervals for all 24 Ss of each group separately. Results were again non-significant. The absence of significance here, combined with the absence of significance when the short interval scores were separated according to the order, enabled us to conclude that order of inserting the time intervals had not affected the results.

Effect of length of rest interval. The results of pursuit rotor reminiscence in sec. on target are plotted as a function of length of preceding rest interval (log times) in Fig. 1. Reminiscence was highest for the 12-min. interval, and decreased with increasing length of interval; it was also less for the 2-min. rest interval. There was an unexpected dip for the 30-min. interval, both for schizophrenics and normals. For all intervals except 24 hr., normals as expected had larger reminiscence scores; at the 24-hour interval schizophrenics as expected had larger reminiscence scores. The differences, although in the predicted directions, fell far short of statistical significance, with $t(23) = 0.43$, $p > .05$ for the 2-min. period. Analysis of variance of scores as a function of rest interval did not reach significance for the groups separately, but did reach significance, $F(5,235) = 2.31$, $p < .05$, when schizophrenics and normals were combined; the absence of interaction effects in this analysis justified the combination of the groups, but also argued against our hypothesis. Various other analyses were carried out, e.g., restricting ourselves to scores obtained on first reminiscence (thus avoiding the confounding of length of rest interval and order of performance), or averaging the short rest intervals, and thus restricting the analysis to four intervals rather than six.

It is interesting to note (Fig. 1) that though schizophrenic and normal reminiscence scores did not change according to prediction, they showed an unprecedented and remarkably consistent common fluctuation with preceding time interval. This suggested that a trend analysis might be appropriate and when carried out it indicated that the two groups of scores together changed significantly $F(1,230) = 69.33$, $p < .001$, in the direction of linear descent. Quadratic, cubic, and quartic trends were, however, not significant.

Further analysis of the joint movement of the groups of scores was undertaken, both by Kendall's tau for rank order (Siegel, 1970, p. 213, 285) and by Spearman's rho (r_s). They yielded similar values significant at the 2.8% level ($r_s = 0.83$) thus confirming the impression from Fig. 1 that the schizophrenic and normal scores moved consistently together as a function of length of

preceding rest interval. The psychological significance of this observation, of which a preliminary report was published (Broadhurst, 1966), remains to be found.

Discussion

Eysenck's (1965) adoption of a consolidation theory for reminiscence makes the results of the present study relevant to the argument about the relation between schizophrenia and arousal; consolidation is considered to be a

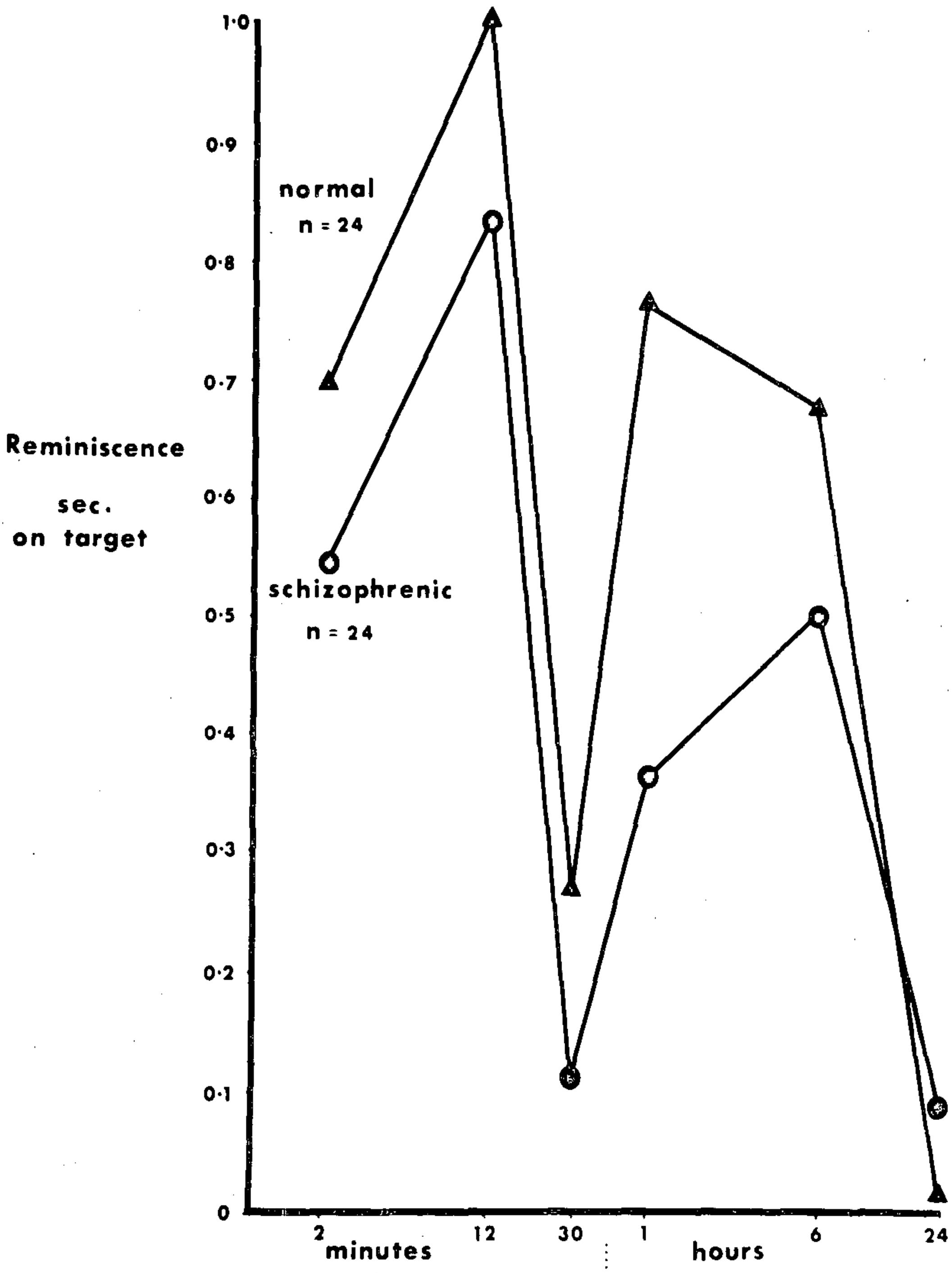

Fig. 1. Pursuit rotor reminiscence of normal and schizophrenic Ss plotted as a function of prior rest interval.

function of degree of arousal, and from this view there follows directly the prediction relating degree of reminiscence to length of rest interval. The argument is based on Walker's (1958) hypothesis that ongoing consolidation interferes with reproduction performance. In a state of high arousal, strong consolidation lays the foundation for good performance later (after consolidation has ceased), but interferes with good performance soon after learning; in a state of low arousal weak consolidation leads to poor performance later, but does not interfere with good performance soon after learning. Howarth and Eysenck (1968) have offered experimental evidence for this hypothesis, using extraverts and introverts respectively as low-arousal and high-arousal Ss (Eysenck, 1967). More direct proof has been given by Clark (1967), using the pursuit rotor with schizophrenic Ss and 10-min. and 24-hr. rest pauses; Ss were rated as high or low on arousal on the basis of two-flash threshold scores (Venables, 1963). Reminiscence scores, in terms of increased time-on-target in sec., were 1.13 and 0.39 for the low-arousal group (N=60), and 0.75 and 1.03 for the high-arousal group (N=67); the results for the 10-min. rest pause are given first. The cross-over effect was highly significant statistically.

In comparing schizophrenics and normals on tests which reflect differences in arousal, one would expect to find differences only if differences in arousal existed between the groups in question. Lynn (1963) concluded from his review of the Russian literature that there exists a majority group of schizophrenics characterized by low sympathetic tone and reactivity, and a minority group with unusually high sympathetic tone and reactivity. Gellhorn (1957), Venables (1960), Mednick (1958), and many others have come to similar conclusions, and Fenz and Velner (1970) summed up this agreement by saying that "reviewing the literature on arousal in schizophrenia, one comes to the conclusion that depending on the physiological measures used, the selection of Ss, and the experimental situation, schizophrenics fall anywhere along the continuum of arousal, although in most cases toward the high or low ends of this continuum. In addition, some schizophrenics show marked and sudden shifts in autonomic activity, now being 'overaroused' and now 'underaroused' (p. 27)." If Eysenck (1967) is correct in relating differences in arousal to the personality dimension of introversion-extraversion, then one would expect to find heterogeneity of arousal states in schizophrenia and possibly a correlation between extraversion-introversion and different types of schizophrenia. Armstrong, Johnson, Ries, and Holmes (1967) have demonstrated a high correlation between extraversion-introversion and process vs. reactive schizophrenia, and a similar conclusion seems to follow from the work of Venables and Wing (1962) and of Thayer and Silber (1971). Such a conclusion may account for the variable findings of much of the experimental work; results would depend very much on the selection of Ss in each case. Relationships between extraversion and motor performance in schizophrenia could not be assessed in our experiment because of the unreliability of personality questionnaire measures in this group. Also, in our experiment, rejection of Ss on the basis of their failure to learn pursuit rotor performance beyond a certain level might have eliminated those with exceptionally low arousal, thus reducing our results to insignificance in comparison with those of Rachman (1963) and Ley who did not reject Ss on this basis. The outcome of our experiment suggests that future workers with schizophrenics

should use direct measures of arousal, such as the two-flash threshold, to make different samples more closely comparable, or at least to make it possible to identify the composition of the sample used. The use of rating scales, such as those designed by Venables and Wing (1962), might serve the same purpose. Simple psychiatric diagnostic terms are clearly insufficient to denote homogeneous samples.

It is possible that the attenuation of the cross-over effect in our study, as compared with those of Rachman (1963) and Ley, is due to the fact that in their experiments each S was only exposed to one rest pause, while in our study each S experienced six rest pauses. The possibility cannot be ruled out that this factor may have affected results, although the failure of order effects to show any statistical significance suggests that this confounding influence, if it had any influence at all, can hardly have been very important.

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