

Span of Apprehension Deficits in Schizophrenia and Mania

by Milton E. Strauss, Carol A. Prescott, Diane F. Gutterman, and Larry E. Tune

Abstract

Reduced perceptual span has been suggested to be a cognitive marker of vulnerability to schizophrenia. However, the specificity of this impairment in visual information processing to schizophrenia is not well established. This preliminary study examined perceptual span in schizophrenic and manic patients divided into subgroups with and without active symptomatology. Symptomatic patients had reduced span in comparison with less symptomatic groups, but there were no differences between schizophrenic and manic patients.

There has been considerable interest in recent years in the identification of characteristics that are linked to vulnerability to schizophrenia. Biological or psychological markers of vulnerability may be more difficult to detect than the clinical symptoms that characterize active episodes of the disorder, but they may also be more stable and reliable features of schizophrenia (Cromwell 1975; Cromwell and Spaulding 1977). The discovery of vulnerability-linked characteristics is of particular importance for studies of asymptomatic children of schizophrenic patients. Only a small subset of these children will develop the illness, and markers would permit identification of subgroups for intervention efforts.

As Asarnow (cf. Asarnow and MacCrimmon 1978) has discussed, a vulnerability-linked marker must meet three criteria: (1) it must be present in schizophrenic patients during symptom-free as well as symptomatic periods; (2) it must be detectable in individuals at elevated risk for schizophrenia; and (3) it must reliably distinguish between schizophrenic patients, and mem-

bers of other diagnostic categories. In a recent review (Nuechterlein and Dawson 1984) of attention and information processing among individuals at risk, among patients with active psychotic symptoms, and among patients in stages of remission, certain attention and memory tasks were identified as possible markers for the disorder. The present study is concerned with one of these: span of apprehension, or perceptual span.

Span of apprehension refers to the amount of information that can be processed from a very briefly presented visual display. Neale (1971; Neale et al. 1969) was the first to demonstrate that schizophrenic patients have a reduced perceptual span relative to nonpsychotic control groups. He used a forced-choice procedure in which the patient was required to indicate which of two letters (T or F) appeared among a larger number of irrelevant letters in a display. This method places little demand on memory, and performance appears to reflect the efficiency of the visual search of sensory stores (Nuechterlein and Dawson 1984). Subsequent studies have shown that some biological children of schizophrenic patients show impairments on this task (Asarnow et al. 1977; MacCrimmon et al. 1980), as do schizophrenic patients in postpsychotic phases of their illness (Asarnow and MacCrimmon 1978, 1981). Recently, young adults without histories of psychiatric illness have been studied with this task. Those with poor performance responded deviantly on questionnaire measures of traits associated with schizophrenia (Asarnow et al. 1983).

Reprint requests should be sent to Dr. M.E. Strauss, Dept. of Psychology, Johns Hopkins University, Baltimore, MD 21218.

Poor performance on this task thus meets the first two criteria for a schizophrenia vulnerability trait: It is seen in patients interepisodically and in persons at elevated risk for schizophrenia. However, it is not clear that this perceptual deficit is specific to this illness. Until recently, comparison groups in studies of schizophrenic patients have been nonpsychotic individuals. Since mania is also characterized by disturbances in attention and information processing (Oltmanns 1978), and may be clinically confused with schizophrenia (Pope and Lipinski 1978), it is important to establish that span of apprehension discriminates between these two disorders.

There have been two studies reported that are pertinent to this issue. Asarnow and MacCrimmon (1981) compared span deficits of schizophrenic and manic-depressive outpatients. The participants were referred by their physicians as being free of major symptoms, and all had maintained a stable community adjustment for at least 1 year. Patients were excluded from study if on examination they had Psychiatric Status Schedule profiles (Spitzer et al. 1970) in the actively disturbed range or if a Global Adjustment Scale (GAS) (Endicott et al. 1976) rating indicated that symptoms interfered with community adjustment. Reduced span was found among these

schizophrenic patients in comparison with both bipolar patients and normal controls.

Asarnow and MacCrimmon's study did not differentiate between patients whose last episode of illness had been mania rather than depression. A recent study of span of apprehension in clinically ill patients (Strauss et al. 1984) suggests that this distinction may be important. It was found there that both schizophrenic and manic patients had comparably reduced perceptual spans, while the performance of depressed bipolar patients did not differ from inpatient controls who had never been psychotic. The present study examines whether perceptual span is greater in manic patients tested in a euthymic period than in those tested while exhibiting symptoms of mania.

Methods

Subjects. All patients included in this study met *DSM-III* criteria for schizophrenia or bipolar disorder (American Psychiatric Association 1980). None had evidence of brain disease, mental deficiency, alcohol or drug abuse, or the occurrence of electroconvulsive therapy within the year before testing, based on chart review. The characteristics of the participants are summarized in table

1. The groups did not differ for age, education, or gender distribution (p 's > 0.20). Informed consent was obtained after participants received a thorough explanation of study procedures.

The schizophrenic patients were outpatients referred for study as clinically stable and at their usual level of functioning. All of these patients were interviewed by a psychiatrist (L.E.T.) on the day of testing with an abbreviated Present State Examination (Mini-PSE) (Tune et al. 1982). The low-symptom group comprised eight patients for whom no reports of positive symptoms of schizophrenia were elicited during the interview. The symptoms most often seen among these patients were blunted affect and social withdrawal. Eight patients with positive or productive symptoms were selected from a group of 20 to compose the active symptom group. These patients had hallucinations, delusions, and thinking/concentration disturbances, as well as negative symptoms such as blunted affect and social withdrawal.

Because of this method of selection, the two schizophrenic groups differed substantially on the Mini-PSE ($t = 4.28$, $df = 14$, $p < .001$, table 1). As table 1 shows, they also differed significantly on the GAS ($t = 3.76$, $df = 14$, $p < .002$). The GAS mean ratings for the high- and low-

Table 1. Characteristics of participants

	Schizophrenics		Bipolar-manics	
	Low-symptom ($n = 8$)	High-symptom ($n = 8$)	Low-symptom ($n = 9$)	High-symptom ($n = 5$)
Male/female	5/3	5/3	4/5	3/2
Age	31.0 (6.5)	37.2 (15.2)	37.3 (8.1)	36.0 (14.5)
Education (yr)	12.6 (2.8)	12.1 (3.0)	12.4 (3.7)	11.4 (2.7)
Global Assessment Scale	73.1 (15.2)	47.1 (12.4)	67.6 (8.7)	N/A
Mini-Present State Examination	1.0 (1.1)	16.8 (10.4)	N/A	N/A

Note.—Mean (SD) except for gender ratio. N/A = not available.

symptom groups correspond to "severe symptomatology and impaired functioning" and "minimal symptoms and only slight impairment in functioning," respectively. Six patients were receiving oral neuroleptics, nine were being treated with depot neuroleptics, and one was not receiving neuroleptic drugs. Six were also receiving anticholinergic medications to control neuroleptic side effects.

Five inpatients who were manic on admission made up the symptomatic affective disorder group. No formal symptom ratings could be obtained, but chart review showed tangential, nonsequential thoughts, incoherent speech, or flight of ideas in all cases. Delusions, irritability, and euphoria were also noted in nurses' and physicians' notes. Four patients were tested within 10 days of admission. The fifth was tested after 19 days, at which time the chart still described him as quite irritable. All patients had at least one prior episode of illness, and were being treated with lithium and antipsychotic medications.

The euthymic affective disorder patients were being followed in an outpatient clinic at the same center as all other patients. They were referred to the study on the basis of appearing clinically remitted from their last episode of mania. Their mean GAS score of 67.6 represents "mild symptoms . . . generally functioning pretty well." This score is comparable to that of the low-symptom schizophrenic patients ($t < 1$) and is higher than that of high-symptom schizophrenic patients ($t = 3.98$, $df = 15$, $p < .001$). These patients also completed the Profile of Mood States (McNair et al. 1971). Their mean scores were consistent with their therapists' impressions of no clinically significant symptoms; all scales were at the levels reported

in the original standardization of this instrument for patients judged not to need treatment. All nine patients were taking lithium; three were also receiving neuroleptics.

Procedures. Patients were tested with a span of apprehension procedure like that used by Asarnow and MacCrimmon (1978). The stimulus displays were arrays of black, upper-case letters assigned to an imaginary 4×4 matrix. Each display contained either a T or an F (the target letters) and 2, 5, 8, or 11 other consonants, randomly selected without replacement. Letters were 2.54 cm high (1") \times 1.9 cm wide (0.75") when rear projected onto a screen. The entire matrix was 20.3 cm \times 20.3 cm (8" \times 8"). There were 20 practice trials and 160 test trials, with an equal number of stimuli at each display size in randomized order. Each target letter appeared in half the trials, and the placement of targets was balanced across the quadrants of the display. The subject sat 1 meter from the screen.

Each trial consisted of verbally alerting the subject, exposing the stimulus for 50 ms, and the subject's response. Responses were indicated with a two-position joystick, with the direction of movement for T and for F counterbalanced across subjects within groups. The inter-stimulus interval was approximately 4 sec, and rest periods of 45–60 sec were offered after each 40 trials.

Results

The proportion of correct responses for each display size was transformed into an estimate of the number of letters processed (\hat{d}). This estimate, $\hat{d} = [(2 \times \% \text{ correct} - 1) \times \text{display size}]$, is more psychologically meaningful than the raw score of percent correct. It underscores that while overall accuracy drops as

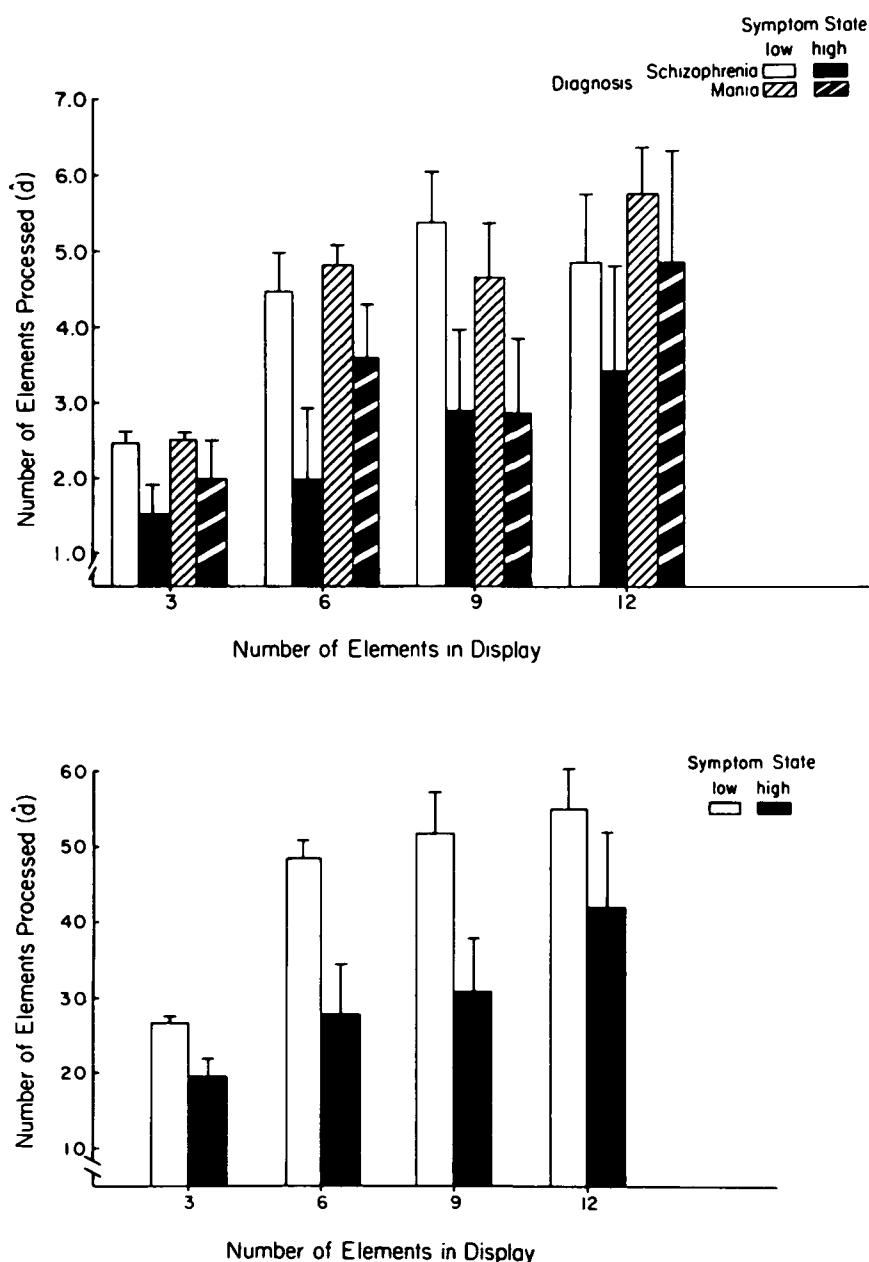
the number of stimuli in a display increases, more letters are in fact perceptually processed from larger than smaller displays, until the maximum span of the observer is reached (Estes and Taylor 1964; Estes 1965).

The upper panel of figure 1 presents the average number of elements processed for each group at each display size. As can be seen, differences in performance between high- and low-symptom groups appear to be more pronounced than those between diagnostic groups. This was confirmed by a Diagnosis \times Symptom State \times Display Size analysis of variance (BMDP2V), which showed that low-symptom patients had larger perceptual spans than high-symptom patients ($F = 6.64$; $df = 1,26$; $p < .02$) while diagnostic groups did not differ ($F < 1$). The performance of the high- and low-symptom groups is shown in the lower panel of figure 1.

A significant effect was also found for display size ($F = 14.83$; $df = 3,78$; $p < .0001$). Post hoc tests (Newman-Keuls) showed that all means differed, save that between the 9- and 12-element displays. This suggests that the asymptotic performance of the low-symptom patients is about five letters, and that of the more symptomatic patients is between three and four. None of the interactions were significant (F 's < 1.55 , $p > .20$).

As noted earlier, both manic and schizophrenic patients in symptomatic states have deficits relative to nonpsychotic controls. To determine if there were differences between high- and low-symptom groups and never-psychotic patients, the performance of these patients was compared with a group of 18 psychiatric inpatients from the same hospital who had never been psychotic. These patients were of

Figure 1. Mean number of letters processed as function of number of elements displayed and both diagnosis and symptom state (top) and symptom state regardless of diagnosis (bottom)



similar age (mean = 32.9, SD = 12.8, range = 17–47) and education (mean = 11.3, SD = 2.4, range = 5–16). This was a heterogeneous group of patients whose diagnoses included unipolar depression (3), personality disorder (2), paraphilia (11), bulimia (1), and somatization disorder (1). Eight were receiving medications. The group had been tested with a 12-element display in an unrelated study (C. Prescott, unpublished data). A one-way analysis of variance comparing this new group (mean = 7.0, SD = 1.47) with the other four was significant ($F = 3.003$; $df = 4, 43$; $p < .03$). Planned contrasts for the high-symptom vs. never-psychotic group and the low-symptom vs. never-psychotic group were both significant (p 's $< .05$).

Discussion

In this study, both schizophrenic and manic patients with positive or productive symptoms had span of apprehension deficits that were greater than those of less symptomatic individuals with the same illnesses. Taken together with the observation that both high- and low-symptom groups processed fewer letters in the 12-element display than did persons who were never psychotic, this suggests that span deficit may be an indicator of vulnerability to the kinds of symptoms that are common to both schizophrenia and mania, such as particular disruptions in attention and concentration. A unitary psychosis hypothesis has recently been re-emphasized on the basis of biological, treatment-response, and outcome measures (cf. Meltzer 1984).

These results are also consistent with Cromwell's (1975) suggestion

that performance measures may be more sensitive indicators of disorder than clinical signs. This idea would seem to merit further examination. It could be useful to study cognitive characteristics among bipolar affective disorder patients across episodes of both mania and depression, to determine whether they wax and wane in conjunction with the emergence and diminution of symptoms of mania. Additional comparisons of minimally symptomatic schizophrenic and manic patients with patients who have never shown psychotic symptoms may reveal whether reduced span could be useful in identifying individuals likely to develop psychotic disorders.

The absence of differences between diagnostic groups in this study, as in the previous study of manic and schizophrenic inpatients (Strauss et al. 1984), would appear to be inconsistent with the concept of span deficit as a marker of schizophrenia. However, the numbers of patients in each of the four groups here were small, limiting the power of this test. Further, since different assessment methods had to be used to characterize the symptom states of two diagnostic groups, symptom levels may not have been sufficiently comparable, particularly in the high-symptom groups. Since symptom state affects performance on this task, comparability between the two high-symptom groups would be particularly important. Symptom levels were not assessed in the inpatient study. Further investigation is needed of the validity of limited perceptual span as a marker of schizophrenia.

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The Authors

Milton E. Strauss, Ph.D., is Pro-

fessor of Psychology and of Psychiatry and Behavioral Sciences; Carol A. Prescott, M.A., is Research Assistant, Department of Psychiatry and Behavioral Sciences; Diane F. Gutterman, M.D., Ph.D., is Assistant Professor, Department of Psychiatry and Behavioral Sciences; and Larry E. Tune, M.D., is Assistant Professor, Department of Psychiatry and Behavioral Sciences at The Johns Hopkins University and School of Medicine, Baltimore, MD.

Announcement

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For further information, please contact:

Lehr-und Forschungsinstitut der
Deutschen Akademie für
Psychoanalyse
Klenzestr. 55
8000 München 5, FRG
Telephone: 089/201 15 86