

# Simple Reaction Time Crossover Occurs in Schizophrenic Outpatients

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## Abstract

A crossover pattern similar to that reported for inpatient schizophrenics (e.g., Bellissimo and Steffy 1972) has now been found for outpatients, and its frequency of occurrence in these outpatients is comparable to that reported for hospitalized patients by DeAmicas and Cromwell (1978). The process-reactive construct was unrelated to crossover in the current study, although crossover is found only in process patients in hospitalized samples. The difference in findings may be due to the insensitivity of the particular measure of this concept used here, or to the lack of validity for the construct in samples of chronic patients in the community and in treatment. The present results, together with DeAmicas and Cromwell's (1978) data suggestive of the presence of crossover in nondisturbed first degree relatives of schizophrenics, are consistent with an interpretation of this reaction time phenomenon as a behavioral marker of vulnerability. This hypothesis warrants study in a more extensive series of patients, and from a longitudinal perspective in which behavioral measures and clinical-social functioning variables are tracked across time.

Studies by Shakow and others (cf. Bellissimo and Steffy 1972) have found that schizophrenics' simple reaction times (RTs) in contrast to those of normal subjects, are no faster when lengthy preparatory intervals (PIs) are presented in isomodal blocks than when PIs are randomly ordered; indeed, they are slower. Bellissimo and Steffy (1972) observed this crossover interaction in schizophrenic inpatients but not in psychoneurotic or personality-disordered inpatients. These results

suggest that the crossover effect may be a behavioral indicator of a clinical episode of schizophrenia or of the trait of vulnerability to schizophrenia (cf. Zubin and Spring 1977). One approach to determining whether this behavioral phenomenon is a vulnerability or an episode marker is to study simple RT performance of patients in varying degrees of remission. To the extent that a vulnerability interpretation of the crossover interaction is appropriate, the phenomenon would be expected to be found in outpatients and to be independent of current clinical state. The following is a report of a pilot study investigating this possibility.

## Method

**Subjects.** Thirty-six former State hospital patients (21 male and 15 female), from 19 to 56 years of age ( $M = 38$ ) were studied. All had been diagnosed schizophrenic and hospitalized at one State hospital for more than 2 years before participation in this study. The patients were being followed in either of two outpatient clinics, where treatment with antipsychotic medication was continued. The patients at one clinic ( $n = 19$ ) had been reevaluated, and diagnosed as schizophrenic using a more narrow concept of schizophrenia quite similar to that of the Research Diagnostic Criteria (Spitzer, Endicott, and Robins 1977). The reevaluation was done independently of this study. Patients at the other clinic ( $n = 17$ ) were selected on the basis of their inpatient diagnosis, which continued to govern their treatment. That diagnosis had been made using broader *DSM-II*

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criteria (American Psychiatric Association 1968).

Background characteristics, self-report premorbid adjustment scores (Ullmann and Giovannoni 1964), current adjustment, and history of symptom ratings for this sample may be found in table 1. Current global adjustment and history of symptom ratings were provided by each patient's attending psychiatrist using the scales and definitions of the Research Diagnostic Criteria and Schedule for Affective Disorder and Schizophrenia. No patients who had any indication of organic brain dysfunction or mental retardation, or who had received electroconvulsive therapy within the past year were included in the study.

**Procedure.** Simple RT to an auditory imperative stimulus was obtained using Steffy and Galbraith's (1974) procedure. In this procedure, the criterion RTs are those to blocks of four isotemporal test trials with 1-, 3-, or 7-second PIs that are imbedded within a randomly ordered series of trials with PIs ranging from 1 to 8 seconds. The response to the first of the four trials is taken as the RT to an irregular PI, while the response to the fourth is taken as the RT to a regular PI. Each block appears three times so that three responses enter into each subject's regular and irregular RT scores at each of the 1-, 3-, and 7-second PIs. There are eight practice trials followed by a series of 85 trials in this procedure.

The patient sat facing a screen on which the word "Ready" was rear projected when a telegraph key was depressed. The depression of the key with the index finger of the preferred hand initiated the PI, the duration of which was regulated by a Hunter decade-interval timer. At the conclusion of the PI, a 2,900 cps

**Table 1. Sample characteristics**

Variable	Total sample (n = 36)	Broader concept subsample (n = 17)	Narrower concept subsample (n = 19)
Age (in years)			
<i>M</i>	37.7	39.4	36.2
<i>SD</i>	11.1	9.7	12.2
Ullmann-Giovannoni score			
<i>M</i>	13.0	13.2	12.9
<i>SD</i>	3.9	3.9	3.9
Global adjustment score			
<i>M</i>	43.7	47.3	40.4
<i>SD</i>	15.8	17.7	13.7
No. core symptoms clearly Present <sup>1</sup>			
<i>M</i>	2.5	2.5	2.5
<i>SD</i>	1.1	1.1	1.1
Specific symptoms:			
Thought broadcasting	30%	20%	40%
Formal thought disorder	50%	70%	30%
Delusions	90%	90%	90%
Hallucinations	70%	60%	80%

<sup>1</sup>Currently or in clinical history

Sonalert tone, the imperative stimulus, was presented and the visual ready-signal was simultaneously terminated. Patients were instructed to release the key as soon as the sound was heard. The response terminated the auditory stimulus, and the interval between the imperative stimulus onset and response was recorded in milliseconds on a Lafayette Clock/Counter.

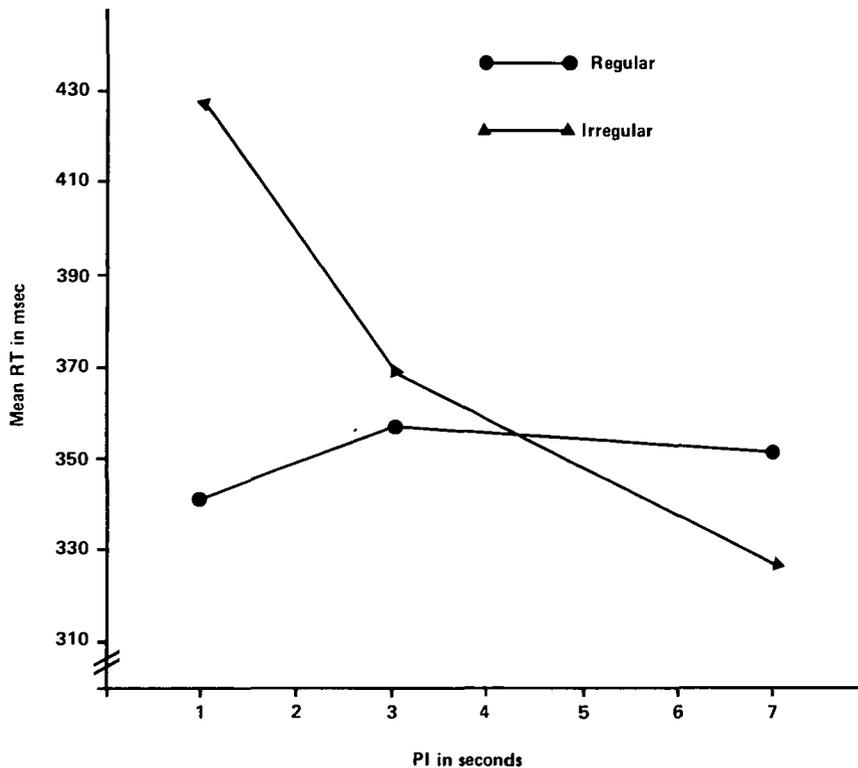
## Results

Patients' average RTs on the test trials were studied in an unweighted means repeated measures analysis of variance, in which the factors were Outpatient Clinic, PI Duration, and Regularity of PI. Outpatient Clinic

was used as a factor to determine whether RT patterns differed as a function of diagnostic criteria with this long-term group. It did not ( $p > .10$ ). There was a trend for subjects to be faster on the regular trials ( $M = 349.0$  msec) than on the irregular trials ( $M = 372.5$  msec;  $F(1,34) = 3.78, p < .10$ ), and subjects were significantly faster as PI increased ( $M_{1\text{ sec}} = 382.1$  msec,  $M_{3\text{ sec}} = 360.6$  msec,  $M_{7\text{ sec}} = 338.1$  msec;  $F(2,68) = 4.289, p < .025$ ).

As inspection of figure 1 shows, there is a crossover pattern in these data. This PI Duration  $\times$  PI Regularity interaction is statistically reliable ( $F(2,68) = 17.273, p < .001$ ). At 1 second, RT to the regular PI is faster than the RT to the irregular PI

**Figure 1. Mean reaction time (RT) as a function of preparatory interval (PI) duration and PI regularity**



(- 86.3 msec;  $t = 4.18$ ,  $df = 35$ ,  $p < .001$ ), at 3 seconds, they are nearly the same (-11.1 msec), and, at 7 seconds, responses are slower to the regular trial (+24.4 msec,  $t = 1.87$ ,  $df = 35$ ,  $p < .05$ ).<sup>1</sup> This pattern is quite similar to that found in Steffy's work with inpatient schizophrenics (e.g., Bellissimo and Steffy 1972; Steffy and Galbraith 1974).

DeAmicas and Cromwell (1978) have recently reported that 57 percent of the process schizophrenic

inpatients they screened had a crossover RT pattern. In that study, a mean difference of 10 msec for regular minus irregular trials at the 7-second PI was used as the index of crossover. By this criterion 64 percent (23/66) of our sample shows a crossover, but this index does not take into account cases where the regular RT is always slower than the irregular PI, in which case no true crossover occurs. A more stringent criterion for crossover, requiring that the individual's mean RT pattern must also be analogous to that in figure 1, was also applied to the present data. Twenty of the 36 (55 percent) patients also showed a crossover by this measure. Rela-

tionships were sought between whether a patient showed crossover and the personal characteristics summarized in table 1. None was significant ( $p > .10$ ), nor was the incidence of crossover different in the two clinic groups.

## References

- American Psychiatric Association. *DSM-II: Diagnostic and Statistical Manual of Mental Disorders*. 2d ed. Washington, D.C.: The Association, 1968.
- Bellissimo, A., and Steffy, R.A. Redundancy-associated deficit in schizophrenic reaction time performance. *Journal of Abnormal Psychology*, 80:299-307, 1972.
- DeAmicas, L., and Cromwell, R.L. "Reaction Time Crossover in Process Schizophrenics, Their Relatives, and Control Subjects." Unpublished manuscript, 1978.
- Spitzer, R.; Endicott, J.; and Robins, E. *Research Diagnostic Criteria for a Selected Group of Functional Disorders*. New York: New York State Psychiatric Institute, 1977.
- Steffy, R.A., and Galbraith, K. A comparison of segmental set and inhibitory deficit explanations of the crossover pattern in process schizophrenic reaction time. *Journal of Abnormal Psychology*, 83:227-233, 1974.
- Ullmann, L.P., and Giovannoni, J.M. The development of a self-report measure of the process-reactive continuum. *Journal of Nervous and Mental Disease*, 138:38-42, 1964.
- Zubin, J., and Spring, B. Vulnerability—A new view of schizophrenia. *Journal of Abnormal Psychology*, 86:103-126, 1977.

<sup>1</sup> Since direction of differences was predicted, one-tailed probability values are reported.

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## Special Report: Schizophrenia

Single copies of *Special Report: Schizophrenia 1976* by Samuel J. Keith et al. are available free of charge from the Center for Studies of Schizophrenia. Multiple copies will also be supplied to requesters who wish to use the report for teaching purposes. The 58-page booklet summarizes recent research in schizophrenia, with special emphasis on work carried out by investigators who have received grant support from the National Institute of Mental Health. The major research areas covered in the report are Diagnosis, Genetics, Biology, Psychophysiology, Psychological Functioning, Family Studies, Studies of Populations at High Risk, Childhood Psychoses, Borderline Conditions, and Treatment. Requests for the report should be addressed to the Center for Studies of Schizophrenia, National Institute of Mental Health, 5600 Fishers Lane, Rm. 10-95, Rockville, MD 20857.