# Confirmation of a relationship between reduced auditory P300 amplitude and thought disorder in schizophrenia

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## Abstract

We have previously reported an association between reduced amplitude of auditory P300 event-related potential and severity of positive thought disorder as assessed by the Comprehensive Index of Positive Thought Disorder in a sample of patients with chronic schizophrenia. Here we replicate those findings using a different measure, Thought Disorder Index (TDI), in a new larger sample of 55 patients. The auditory P300 amplitude showed a significant negative correlation with scores on TDI. This correlation was relatively more pronounced in the left temporal region than in the right temporal region. These results further suggest that electrophysiological abnormalities of information processing may underlie positive thought disorder in schizophrenia.
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## 1. Introduction

Thought disorder is considered one of the core features of the psychopathology of schizophrenia (Bleuler, 1911/1956) and a number of rating scales have been developed to assess its severity (Andreasen, 1986; Marengo et al., 1986). One such scale that has proved useful in objectively and quantitatively assessing the positive thought disorder in patients with schizophrenia is the Thought Disorder Index (TDI) (Johnston and Holzman, 1979). The neurophysiological basis of thought disorder, however, remains unclear.

Reduced amplitude of auditory P300 event-related potentials (ERPs) is one of the most consis-

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tently replicated biological observations of schizo-
phrenia (Blackwood et al., 1987; Ford et al., 1992;
McCarley et al., 1991; Pfefferbaum et al., 1989). In
an attempt to clarify the neurobiological basis of
thought disorder, several research groups (Ford et
al., 1999; Frodl et al., 2002 ; Higashima et al.,
1998; Juckel et al., 1996; Ward et al., 1991)
have previously reported a relationship between
P300 and thought disorder in schizophrenia. How-
ever, the ratings of thought disorder were derived
from symptom rating scales such as the BPRS and
the PANSS. Our previous study (Iwanami et al.,
2000) showed a correlation between auditory P300
amplitude and thought disorder assessed using the
Comprehensive Index of Positive Thought Disorder
(CIPTD) (Marengo et al., 1986), one of the com-
prehensive rating scales for thought disorder. The
aim of the present investigation was to replicate
those findings using TDI in a new larger sample
of patients with schizophrenia.

## 2. Methods

### 2.1. Subjects

Fifty-five patients with schizophrenia (30 males
and 25 females) participated in this study (mean
age, 30.7 years; SD = 9.0). This sample was comple-
tely independent of the previous sample of 29 patients
employed by Iwanami et al. (2000). The current
sample had a mean age at onset of 24.1 years
(SD = 7.9), and a mean duration of illness of 6.6
years (SD = 7.0). All patients met the DSM-IV criteria
for schizophrenia (American Psychiatric Association,
1994). The subjects were receiving antipsychotic
medication, and the mean daily dosage in chlorpro-
mazine equivalents (Inagaki et al., 1999) was 728 mg
(SD = 676). Symptoms present on the day of testing
were rated with the Positive and Negative Syndrome
Scale for Schizophrenia (PANSS) (Kay et al., 1987).
The mean score was 14.3 (SD = 4.8) for the positive
subscale, 19.6 (SD = 6.2) for the negative subscale,
and 34.1 (SD = 8.0) for the general psychopathology
subscale. This study was approved by the ethical
committee of Faculty of Medicine, University of
Tokyo. All subjects gave written informed consent
to the participation.

### 2.2. ERP recording

The subjects performed an auditory oddball task to
elicit P300 in a sound-proofed and electrically shielded
room. They were presented with a series of auditory
stimuli with a fixed interstimulus interval of 1500 ms.
Eighty-five percent of the stimuli were tones of 1000
Hz, and the other 15% were tones of 2000 Hz. Stimuli
were presented in a Bernoulli sequence. The subjects
were instructed to keep their eyes closed throughout the
tasks and to press a button with their right hand as
quickly as possible upon hearing the infrequent high-
pitch tones. The stimuli intensity was 75 dBSPL, and the
tone duration was 50 ms, with a rise/fall time of 10 ms.

The scalp electroencephalogram (EEG) was recorded
with Ag/Ag–Cl disc electrodes at Fp1, Fp2, F3, Fz, F4,
T3, C3, Cz, C4, T4, T5, P3, Pz, P4, T6, and Oz according
to the international 10–20 electrode system, referred to
linked earlobes. The sampling rate was 400 Hz, and the
analog filter bandpass was set at 0.15–120 Hz. The
analysis period was 640 ms, including a 40-ms presti-
mulus baseline. Trials contaminated by peak to peak
potentials over 100 μV or accompanied by an EOG of
over 75 μV were eliminated from the averaging. The
responses to each stimulus with correct reactions were
averaged separately. We recorded EEG until acquiring
stable ERP data of 40 infrequent stimuli and 200 fre-
quent stimuli. Finally, the averaged waveforms were
digitally filtered with a cutoff frequency of 30 Hz. P300
were defined as the most positive peak between 250
and 500 ms poststimulus at Fz, T3, Cz, T4, and Pz.

### 2.3. Assessment of thought disorder

TDI (Johnston and Holzman, 1979; Solovay et al.,
1987) was used to assess the presence and severity of
positive thought disorder in patients with schizophre-
nia. Rorschach tests were administered to the patients
with schizophrenia, using the full 10-card procedure.
The subjects' responses were tape-recorded and tran-
scribed verbatim. The transcribed protocols for all
cases were scored according to the scoring manual
(Solovay et al., 1986; Japanese version, Hata et al.,
2002) by a trained clinical psychologist (K.M.), who
was blind to the ERP data. One of the authors (A.H.),
who was the first author of the Japanese version of TDI
and had extensive experiences with the scoring of TDI,
provided extensive training for the rater (K.M.). Two