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Psychiatry Research 110 (2002) 137–149

PSYCHIATRY  
RESEARCH

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## Attentional control and word inhibition in schizophrenia

Avishai Henik<sup>a,\*</sup>, Cameron S. Carter<sup>b</sup>, Ruth Salo<sup>c</sup>, Marc Chaderjian<sup>c</sup>, Louis Kraft<sup>c</sup>,  
Thomas E. Nordahl<sup>c</sup>, Lynn C. Robertson<sup>d,e</sup>

<sup>a</sup>*Department of Behavioral Sciences and Zlotowski Center for Neuroscience, Ben-Gurion University of the Negev, Beer-Sheva, Israel*

<sup>b</sup>*Department of Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA*

<sup>c</sup>*Department of Psychiatry, University of California, Davis, CA 95616, USA*

<sup>d</sup>*Veterans Administration, Martinez, CA, USA*

<sup>e</sup>*University of California, Berkeley, CA, USA*

Received 19 July 2000; received in revised form 11 March 2002; accepted 20 March 2002

### Abstract

Previous studies have suggested that schizophrenia patients do not utilize contextual information efficiently to modulate attentional performance. The goal of the current study was to compare the utilization of context in modulating responses to irrelevant information on the Stroop task between a group of schizophrenia outpatients and matched controls. A single-trial version of the Stroop task was used to investigate performance on the Stroop task under three expectancy conditions. Eleven schizophrenia outpatients (on and off antipsychotic medication) and sixteen matched controls were tested. The schizophrenia patients showed: (1) augmented facilitation; (2) interference comparable to normals; and (3) normal ability to reduce interference under certain experimental circumstances. Schizophrenia patients were able to utilize contextual information under certain conditions and could modulate the magnitude of irrelevant word interference, although they were not able to overcome the prepotent tendency to read the word during the Stroop task as effectively as normals, which was reflected in greater Stroop facilitation. This suggests that the integrity or impairment of cognitive control functions in schizophrenia is related to the complexity of the context representation required to support that function. © 2002 Elsevier Science Ireland Ltd. All rights reserved.

*Keywords:* Schizophrenia; Stroop task; Expectancy

### 1. Introduction

Cognitive deficiencies have long been reported in schizophrenia with deficits appearing in multiple domains including memory, attention and language (Bleuler, 1911/1950; Kraepelin, 1919/1971).

Inadequate performance, such as associative intrusions in schizophrenia speech, has been attributed mainly to attentional deficits (Cornblatt and Erlenmeyer-Kimling, 1985; Gjerde, 1983; Nuechterlein and Dawson, 1984) and in particular to the patients' inability to inhibit irrelevant words or phrases (Maher, 1983; Manschreck et al., 1988). The study of language processes in schizophrenia has yielded valuable insight into the processes that

\*Corresponding author. Tel.: +972-8-472080; fax: +972-8-472932.

E-mail address: henik@bgumail.bgu.ac.il (A. Henik).

underlie cognitive abnormalities in this psychiatric disorder (Andreasen et al., 1982; Salzinger et al., 1970). In addition, many studies have examined the breakdown of attentional processes in schizophrenia patients using lexical stimuli (Nuechterlein and Dawson, 1984, for review). Although many studies of memory and attention in schizophrenia employ lexical stimuli, only a few have measured the impact of context and expectancy in guiding these processes (Cohen et al., 1999; Cohen and Servan-Schreiber, 1992; Salzinger et al., 1970).

The Stroop task is one test that has employed lexical stimuli to examine attentional inhibition. In the Stroop task, reaction time deficits on color naming are often interpreted as an inability to inhibit the irrelevant lexical stimulus (i.e. color-word). The Stroop task is especially relevant for investigating the ability of schizophrenia patients to utilize context to guide attentional inhibition because healthy subjects show attentional modulation of words in the Stroop task under different expectancy conditions (Tzelgov et al., 1992). The present study investigated the ability of schizophrenia patients to suppress irrelevant word processing under various expectancy conditions of the Stroop task.

### *1.1. The Stroop effect*

The Stroop task (Stroop, 1935) has been employed extensively in studies of word processing (MacLeod, 1991, for a recent review). In this task, subjects are asked to name the ink color of a word and ignore the meaning of the word (e.g. when presented with the word GREEN in red ink, they are supposed to say 'red'). Ink-color-naming is slower on incongruent trials (e.g. GREEN in red ink) than on congruent trials (e.g. RED in red ink) or on neutral trials (e.g. XXX or a non-color word in red ink). That is, the to-be-ignored word interferes with reporting the ink color. With young normals (e.g. college undergraduates) it is usually the case that the interference effect (the reaction time, RT, difference between the neutral and the incongruent conditions) is relatively large and stable, whereas the facilitatory effect (RT difference between the congruent and the neutral conditions) is small and may not reach significance.

Although other conventions are sometimes used to measure Stroop effects, they can be problematic to interpret as no baseline or neutral stimulus is employed (Henik, 1996). Some researchers have suggested that the Stroop effect measures the automaticity of word processing (Logan, 1980, 1985; Posner, 1978; Stroop, 1935). Namely, word reading is initiated without intention and occurs in spite of the subject's effort to suppress it.

### *1.2. Stroop and expectancy effects*

Recent work has shown that subjects may reduce the influence of the irrelevant word. Such reductions are dependent upon language proficiency (Tzelgov et al., 1990) and expectations (Tzelgov et al., 1992). In order to study the effect of expectancy, Tzelgov and his colleagues (Tzelgov et al., 1992) manipulated the proportion of neutral trials in order to induce different expectations as to the forthcoming stimulus. They reasoned that if subjects could suppress reading the irrelevant words, they should be in a better position to do so when a large proportion of words required application of such suppression. Tzelgov and his colleagues found that the greater the proportion of color words (relative to neutral words) in a block of trials, the smaller the interference effect. Interestingly, this manipulation affected interference but did not affect facilitation. It is important to note that the neutral proportion effect does not influence performance in the Stroop task through supplying different opportunities to practice the suppression of the irrelevant word. Instead, modulation of the Stroop effect is achieved by creating expectations, which in turn induce subjects to modulate their attentional resources (Tzelgov et al., 1992). In addition, these findings demonstrated that performance on the Stroop task could be dissociated into two distinct components with only one component (i.e. interference) being affected by strategies. The other component producing facilitation was not affected by expectancy and appears to be automatic or reflexive.

### *1.3. Stroop effect and schizophrenia*

Attentional deficits in schizophrenia patients are thought to be reflected in a decreased ability to

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