ELSEVIER

Psychiatry Research 111 (2002) 125–136

PSYCHIATRY RESEARCH

www.elsevier.com/locate/psychres

Visual processing and neuropsychological function in schizophrenia and schizoaffective disorder

Colleen A. Brenner[a,*], Paul H. Lysaker[b], Marcia A. Wilt[a], Brian F. O'Donnell[a]

[a]*Indiana University Department of Psychology, 1101 East Tenth Street, Bloomington, IN 47405, USA*
[b]*Roudebush Veterans Administration Medical Center, 1481 West Tenth Street, Indianapolis, IN 46202, USA*

Received 22 June 2001; received in revised form 20 May 2002; accepted 28 May 2002

Abstract

Persons with schizophrenia and schizoaffective disorder exhibit deficits in both visual processing and neuropsychological tasks. Little is known, however, about whether these deficits are related to one another. We administered psychophysical tests of visual discrimination and recognition, and neuropsychological tests of abstract flexibility, verbal learning, visual memory, working memory and attention to 42 outpatients with stable but chronic schizophrenia or schizoaffective disorder. Multiple regression analyses were performed to determine the relationship between these measures of neuropsychological function and visual psychophysical performance. Results indicated that motion perception was associated with working memory, and that the addition of a memory component to motion perception (motion recognition) was associated with both working memory and visual memory. Visual performance was not associated with symptom severity as measured by the PANSS. These results suggest that psychophysical tests of visual processing may contribute to deficits on neuropsychological tests of visual cognition, and may also reflect cross-modal disturbances of working memory function.

Keywords: Cognition; Continuous Performance Test; California Verbal Learning Test; Wisconsin Card Sorting Test

1. Introduction

Schizophrenia patients exhibit deficits in early stage visual processing (Harris, 1994; O'Donnell et al., 1996; Schwartz et al., 1994). These deficits include difficulties tracking moving objects, motion discrimination, and discerning form from motion (Chen et al., 1999; Hooker and Park, 2000; Schwartz et al., 1999). Similar deficits have been reported in the prodromal phase of the illness, and in the non-affected relatives of schizophrenia patients and may therefore serve as a potential biological marker of vulnerability to the illness (Green et al., 1997, 1999; Phillipson and Harris, 1985; Ross et al., 1996). Less clear at present, however, is how deficits in visual processing are related to the multiple cognitive deficits widely documented in schizophrenia (Chen et al., 1997; Franke et al., 1992; Morice and Delahunty, 1996). Are they, for example, differentially related to

*Corresponding author. Tel.: +1-812-855-2311; fax +1-812-856-4544.
E-mail address: cobrenne@indiana.edu (C.A. Brenner).

0165-1781/02/$ - see front matter
PII: S0165-1781(02)00139-7

impairments in attention, memory and executive function? Is it possible that deficits in early stage vision disrupt subsequent cognitive processes?

To address the issue of whether deficits in visual processing are related to neurocognitive function, this study examined the intercorrelations between psychophysical measures of form and motion discrimination and recognition with neuropsychological tests of attention, memory and executive function. Psychophysical tests usually measure an individual's performance threshold as a function of variations in noise or contrast (Wandell, 1995). In the present study, psychophysical tests of form and motion discrimination and form and motion recognition were used to test visual processing. These tests measure a person's ability to make perceptual judgments at different levels of noise, and have previously been used in a study of schizotypal personality disorder (SPD) (Farmer et al., 2000). Impairments on similar tests of dot motion discrimination have been shown to be sensitive to schizophrenia (O'Driscoll et al., 1998; Richardson et al., 1996; Stuve et al., 1997). Discrimination of moving dot trajectory activates the dorsal visual pathway in primate studies of cellular response in the cortex, especially area MT (Britten et al., 1992; Newsome and Pare, 1988). Discrimination and recognition of form attributes, however, activate the ventral visual pathway, especially the inferotemporal cortex (Desimone, 1991; Desimone et al., 1984). The delayed match-to-sample recognition task used in this study is likely to require involvement of frontal lobe regions responsible for visual working memory (Goldman-Rakic, 1994, 1999; Ungerleider et al., 1998). Neuropsychological tests, however, typically use psychometric measures of mean performance on a set of items as the dependent variable, usually with static stimuli presented well above the perceptual threshold. These values are then used to compare an individual to normative distributions, or groups to each other. The neuropsychological tests used in this investigation were chosen either because of their sensitivity to schizophrenia, or their dependence on visual-perceptual and cognitive processes. To measure vigilance, a Continuous Performance Test (CPT) was administered to index verbal and visual sustained attention (Addington and Addington, 1997, 1998; Cornblatt and Keilp, 1994). To assess memory, three forms of memory indices were administered: the California Verbal Learning task (CVLT) to assess verbal memory (Delis et al., 1987), the Family Pictures subtest of the Wechsler Memory Scale (WMS) III to assess visual memory (Wechsler, 1997b) and the Letter Number Sequencing subtest of the Wechsler Adult Intelligence Scale (WAIS) III to assess working memory (Gold et al., 1997; Wechsler, 1997a). Lastly, the Wisconsin Card Sort Test (WCST) was employed as a measure of executive function (Grant and Berg, 1948). Using these measures, we evaluated the relationship between psychophysical tests of form and motion perception and static neuropsychological tests taxing various cognitive domains.

In addition to investigating the relationship between visual processing and neuropsychological function in schizophrenia, we also investigated the relationship between visual performance and symptom profiles. Research has shown differential EEG, backward masking, attention, executive function, and verbal memory performance between positive and negative symptom schizophrenia patients (Berman et al., 1997; Collins et al., 1997; Gruzelier et al., 1993; Liu et al., 1997; Merrin and Floyd, 1996; Schuepbach et al., 2002; Slaughuis and Curran, 1999; Zakzanis, 1998). Not all investigations, however, report such unambiguous relationships between symptoms and neurocognitive function (Barbarotto et al., 2000; Nieuwenstein et al., 2001). These results indicate that symptoms of schizophrenia and neuropsychological performance may reflect a multi-dimensional disorder (Zakzanis, 1998). Factor analysis of the PANSS supports a multidimensional characterization of symptoms in schizophrenia. For example, Bell et al. (1994) have found that the Positive and Negative Syndrome Scale (PANSS) captures five independent domains of psychopathology. Bell et al. (1994) reported that symptoms in schizophrenia could be reliably differentiated as positive, negative, cognitive, excitement and emotional discomfort factors (Bell et al., 1994; Bryson et al., 1999). Since an increased number of factors may provide a more reliable way to explore the possibly heterogeneous symptom dimensions in schizophrenia, we used this five-factor symptom model to investigate the