ELSEVIER

Schizophrenia Research 43 (2000) 11–20

SCHIZOPHRENIA RESEARCH

www.elsevier.com/locate/schres

Perceptual organization, the disorganization syndrome, and context processing in chronic schizophrenia

Steven M. Silverstein [a,*], Ilona Kovács [b], Rodney Corry [a], Carolyn Valone [a]

[a] *University of Rochester Medical Center, Rochester, NY 14620, USA*
[b] *Laboratory of Vision Research, Rutgers University, Piscataway, NJ, USA*

Received 18 August 1999; accepted 23 August 1999

Abstract

Schizophrenia patients' perceptual organization abilities were assessed with a psychophysically well-controlled measure of contour integration. Compared with psychiatric and staff controls, schizophrenia patients were less able to detect contours comprising Gabor elements as the detection of these contours relied increasingly on long-range spatial interactions. Impaired task performance was also found to correlate significantly with higher levels of disorganized symptomatology. These data provide further evidence for impaired perceptual grouping in schizophrenia. In addition, the findings support the hypothesis that a common cortical processing algorithm involving contextual coordination is impaired in schizophrenia, leading to reduced binding of object features in vision, and reduced contextual disambiguation of linguistic information during thought and speech.

Keywords: Context processing; Contour integration; Disorganization syndrome; Perceptual organization; Visual information processing

1. Introduction

One model of visual-information processing impairment in schizophrenia postulates a dysfunction in perceptual organization processes, or a reduced ability to combine stimulus components into object representations during the first 200 ms of processing (Place and Gilmore, 1980; Silverstein et al., 1996a, 1998a). Since perceptual organization is necessary for the delineation of objects in the visual field, and stimulus representations with object properties are stronger competitors for attention than stimulus components (Kahneman and Triesman, 1984) or weakly organized stimuli (Ward and Goodrich, 1996), an impairment at this early stage of processing is thought to result in less focused attention and reduced processing of the meaning and/or significance of visual stimuli.

In general, the literature on visual perceptual organization in schizophrenia can be summarized in three statements: (1) stimuli with continuous contour that have symmetrical properties are processed normally (Knight, 1992; Chey and Holzman, 1997); (2) stimuli comprising noncontiguous elements that are nonconfigural are not processed as perceptual wholes to the same degree as they are among other individuals (Silverstein et al., 1996a, 1998a); and (3) there are mixed findings

* Corresponding author. Present address: NY Presbyterian Hospital, Weill Medical College of Cornell University, 21 Bloomingdale Rd, White Plains, NY 10605, USA.
E-mail address: steven.silverstein@worldnet.att.net (S.M. Silverstein)

0920-9964/00/$ - see front matter
PII: S0920-9964(99)00180-2

regarding the ability of schizophrenia patients to process configural stimuli made up of noncontiguous elements (Cox and Leventhal, 1978; Rabinowicz et al., 1996; Silverstein et al., 1998b). While some studies of the latter issue suggest that patients are impaired in this function, there has been no strong test of this hypothesis, as all past studies have had a number of methodological and conceptual weaknesses. For example, in Cox and Leventhal's (1978) visual suffix study, ease of grouping was manipulated across several conditions, but only overall, between-group accuracy rates (collapsed across condition), and not diagnostic group by condition interactions, were reported. Thus, no conclusions could be drawn about differential responsivity of the diagnostic groups to the perceptual organization manipulations. Moreover, Silverstein et al. (1998b) found a normal between-condition performance pattern among schizophrenia patients using the visual suffix task. In Cox and Leventhal's (1978) two other studies, perceptual grouping was required within the context of texture discrimination and numerosity tasks. These visual search tasks made heavy demands on processes other than perceptual organization, so although schizophrenia patients performed more poorly than controls, these data are not straightforward evidence of perceptual organization impairment. Similarly, Rabinowicz et al. (1996) reported that when the task was to determine the shape implied by sparse dot patterns, schizophrenia patients performed more poorly than other groups. This finding, however, may simply reflect a generalized performance deficit. Moreover, because schizophrenia patients improved at the same rate as controls as more elements were added to displays, the authors noted that they were able to process stimulus form. In short, while studies of schizophrenia patients' ability to perceptually organize configural arrangements of noncontiguous elements suggest that they are impaired in this function, strong evidence for this is minimal. Therefore, one goal of this study was to test this issue using a straightforward but psychophysically well-controlled procedure wherein degree of perceptual grouping could be formally specified, and where task performance was not confounded by other cognitive factors.

A second goal of the study was to examine the relationship between perceptual organization ability and the disorganization syndrome. In two previous studies, abnormalities in perceptual organization in schizophrenia were associated with greater disorganized (but not positive, negative, or general) symptoms (Knight and Silverstein, 1998; Silverstein et al., 1998a). In a third study (Knight and Silverstein, 1998), abnormal perceptual organization was related to increased disorganized and associative thought disturbance, but not combinatory or idiosyncratic thought disturbance in schizophrenia. These data support the hypothesis that abnormal perceptual organization in schizophrenia is one manifestation of a larger disturbance in the combining of context-related stimuli (Carr and Wale, 1986; Silverstein and Schenkel, 1997). In this view, perceptual organization in vision is seen as a form of 'object thinking' (Glezer, 1995) involving the binding of image elements into a context-appropriate coherent whole, where the context can be seen as the other elements that combine to make up the line, curve, or object (Lamme, 1995; Kovács, 1996; Phillips and Singer, 1997). This is seen as analogous to the binding of words or concepts into coherent thought and linguistic structures, except that in these cases, the binding is based on context-appropriate meaning (Logan and Zbrodoff, 1999). Indeed, several investigators have hypothesized that the formation of propositional visual representations (i.e., those that represent the spatial relationships between object components) is necessary to process visual images, and that these are structurally similar to the propositional representations underlying thought and language (Chechile et al., 1996; Glezer, 1995; Logan and Zbrodoff, 1999). Further evidence for a common mechanism underlying linguistic and visual representations comes from studies of individuals with parietal lobe damage, where deficits in both the 'comprehension' of spatial relations (i.e., perceptual organization) and the comprehension of logical relations are commonly observed (Glezer, 1995). There is now growing support for the existence of common cortical processing algorithms (Grossberg, 1999; Phillips and Singer, 1997), as well as evidence that contextual coordination operates across domains to implement processes such as perceptual grouping in vision, lexical