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Comparison of visual perceptual organization in schizophrenia and body dysmorphic disorder

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ABSTRACT

People with schizophrenia are impaired at organizing potentially ambiguous visual information into well-formed shape and object representations. This perceptual organization (PO) impairment has not been found in other psychiatric disorders. However, recent data on body dysmorphic disorder (BDD), suggest that BDD may also be characterized by reduced PO. Similarities between these groups could have implications for understanding the RDoC dimension of visual perception in psychopathology, and for modeling symptom formation across these two conditions. We compared patients with SCZ ($n=24$) to those with BDD ($n=20$), as well as control groups of obsessive–compulsive disorder (OCD) patients ($n=20$) and healthy controls ($n=20$), on two measures of PO that have been reliably associated with schizophrenia-related performance impairment. On both the contour integration and Ebbinghaus illusion tests, only the SCZ group demonstrated abnormal performance relative to controls; the BDD group performed similarly to the OCD and CON groups. In addition, on both tasks, the SCZ group performed more abnormally than the BDD group. Overall, these data suggest that PO reductions observed in SCZ are not present in BDD. Visual processing impairments in BDD may arise instead from other perceptual disturbances or attentional biases related to emotional factors.

1. Introduction

It is increasingly recognized that there is overlap between certain psychiatric syndromes in terms of their genetic, neurobiological, cognitive, behavioral, and phenomenological characteristics (Guilmatre et al., 2009; Bellivier et al., 2013; Doherty and Owen, 2014; Monzani et al., 2014). The mounting evidence for this conclusion has led the National Institute of Mental Health (NIMH) to introduce the Research Domain Criteria (RDoC) initiative (Cuthbert and Insel, 2010; Insel et al., 2010). The rationale behind RDoC is that diagnosis and treatment of mental disorders should not be driven primarily by a focus on signs and symptoms (given their problems with reliability and various forms of validity), but rather, by a focus on dimensions of functioning with known pathophysiological mechanisms. A related implication of RDoC is that the yield of psychopathology research may be more fruitful if studies examine these dimensions across current diagnostic categories. One RDoC dimension that has been studied repeatedly within diagnostic categories is cognition, a subcategory of which is perception.

A well-documented visual impairment in schizophrenia (SCZ) is in perceptual organization (PO) – the processes by which individual elements of sensory information are collectively structured into larger units of perceived objects and their interrelations (Palmer, 1999). Over 50 studies have demonstrated reduced PO in SCZ (for reviews, see Uhlhaas and Silverstein (2005), Silverstein and Keane (2011)). Some of these studies suggest that, among psychiatric conditions, PO impairment is specific to SCZ, in that it has not been observed in mixed groups of psychotic patients without SCZ, in non-psychotic patients, or in patients who abuse drugs that are not psychotomimetic (Silverstein and Keane, 2011) [there is debate, however, over whether autism, another neurodevelopmental disorder, is characterized by reduced PO (Dakin and Frith, 2005; Sun et al., 2012)].

Recently, however, perceptual impairments that may be aspects of, or secondary to, reduced PO have been observed in body dysmorphic disorder (BDD), a condition characterized by preoccupation with perceived defects in visual appearance. For example, Feusner et al. demonstrated that BDD patients are impaired at processing low spatial frequency information in faces, and

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demonstrate hypoactivity in occipital regions during processing of low spatial frequency information from own face, other face, and object stimuli (Feusner et al., 2007, 2010a, 2010b, 2010c, 2011). Patients with BDD and individuals with a high degree of body image concern also show a reduced face inversion effect (i.e., a worsening of performance when making judgments about faces that are upended compared to upright faces) (Feusner et al., 2010b; Jefferies et al., 2012; Mundy and Sadusky, 2014). Because the face inversion effect has traditionally been thought to reflect the contrast between rapid configural processing of upright faces versus slower serial processing of inverted faces (Tanaka and Farah, 1993; Tanaka and Sengco, 1997; Freire et al., 2000; Taubert et al., 2011; Peters et al., 2013) (but see Rakover (2013), Civile et al. (2014), Xu and Biederman (2014) for other accounts of the effect), and because low spatial frequency information carries the majority of information about global form (Tanaka and Farah, 1993; Costen et al., 1996; Deruelle and Fagot, 2005), these data suggest a reduction in PO in BDD. Of note, patients with SCZ have shown performance impairments on tasks that are similar to the ones used to study face processing in BDD, including reduced face inversion effects (Schwartz et al., 2002; Chen et al., 2008; Soria Bauser et al., 2012; Tsunoda et al., 2012) (but see Chambon et al. (2006), Butler et al. (2008)), reduced processing of low spatial frequency information in faces (Silverstein et al., 2010), and reduced encoding of the structural features of faces (Turetsky et al., 2007; Tsunoda et al., 2012). To date, however, no studies directly comparing BDD and SCZ on visual perception have been conducted.

The purpose of this pilot study was, therefore, to directly compare BDD and SCZ patients on two measures of PO that have repeatedly shown sensitivity to impairments in SCZ: an Ebbinguaus illusion task and a contour integration (CI) task. In addition, a group of obsessive–compulsive disorder (OCD) patients was included to control for obsessive–compulsive features, and to determine whether problems in organizational strategies that have been observed in OCD (e.g., on verbal and visual memory tasks (Deckersbach et al., 2000a, 2000b, 2000c; Savage et al., 2000) could account for task performance in BDD. Psychiatrically healthy controls were also included.

1.1. Ebbinghaus illusion

In a typical Ebbinghaus illusion demonstration, the perceived size of a circle is altered when it is surrounded by other circles; it appears larger than its actual size when surrounded by smaller circles and smaller than its actual size when surrounded by larger circles (see Fig. 1). The effect has been known for over 100 years (Titchener, 1902), and has been the subject of numerous experiments, especially since the 1970s (e.g., Massaro and Anderson, 1971; Girgus et al., 1972; Weintraub and Schneck, 1986; Coren and Enns, 1993; Rose and Bressan, 2002; Doherty et al., 2010; Schwarzkopf and Rees, 2013). Patients with schizophrenia have demonstrated reduced illusion effects, expressed as *more accurate size perception* compared to controls when judging target circle size in *misleading* context conditions (Uhlhaas et al., 2006; Silverstein et al., 2013; Tibber et al., 2013). This effect is most pronounced when patients have active psychotic symptoms (Silverstein et al., 2013).

1.2. Contour integration

CI is one of the most widely used measures of PO in the SCZ and basic vision literatures (Field et al., 1993; Kovacs and Julesz, 1993; Polat et al., 1997; Kovacs, 2000; Chandna et al., 2001). CI is typically measured as the ability to detect or make a judgment about a closed contour made up of non-contiguous elements, embedded within a display of randomly oriented elements (see Fig. 2). Previous studies have shown that people with SCZ are less able to detect and make shape judgments about contours when compared to healthy, psychotic, non-psychotic and non-psychotomimetic substance abusing control groups (Uhlhaas and Silverstein, 2005; Silverstein and Keane, 2011). CI impairment has also been observed in aging (Roudaia et al., 2011), dyslexia (Simmers and Bex, 2001), and amblyopia (Polat et al., 1997), and can be affected by psychotomimetic drugs that affect occipital lobe functioning (Uhlhaas et al., 2007; White et al., 2013). To our knowledge, only one prior study has investigated CI in BDD (Rossell et al., 2014). This recent study found normal performance; however, they used an older, card-based version of the task with only 15 stimuli and a lengthy exposure duration (30 s). In the present study, we used a recently developed computerized version of the CI task with a large number of trials and a relatively brief stimulus duration (Silverstein et al., 2012).

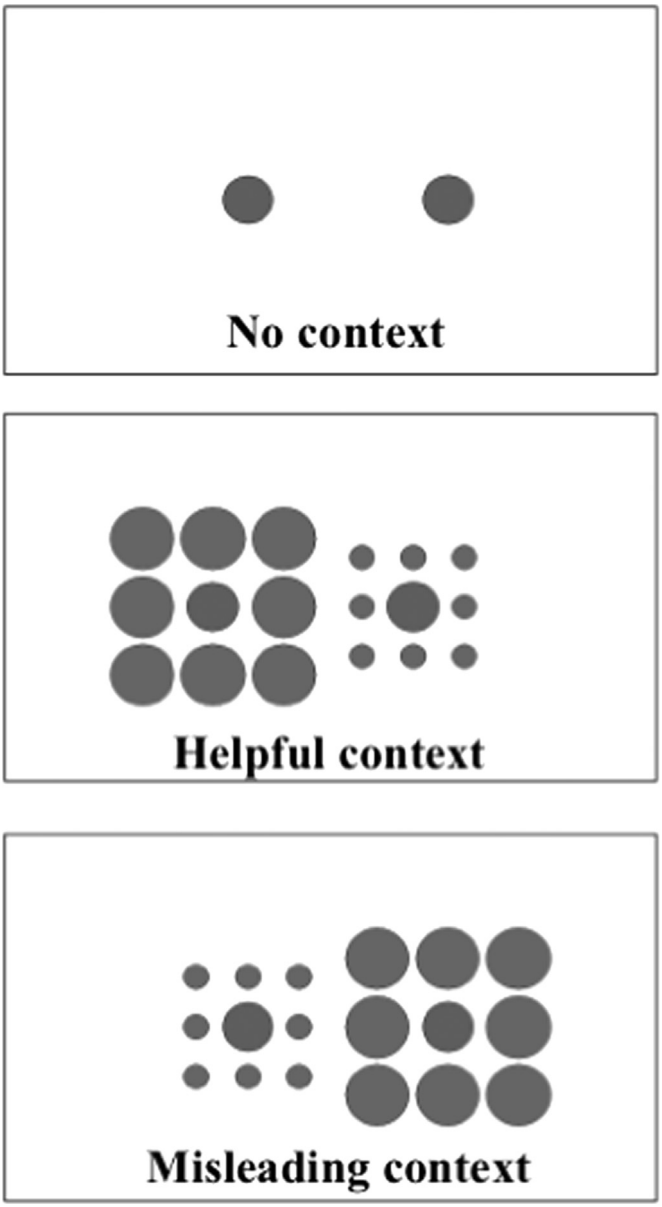

Fig. 1. Sample stimuli from each of the 2 conditions (bottom 2 panels) of the Ebbinghaus illusion task. In each case, the target circle on the right is larger than the one on the left. The top panel shows the actual circle sizes, for comparison.