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Visual Form Perception: A Comparison of Individuals at High Risk for Psychosis, Recent Onset Schizophrenia and Chronic Schizophrenia

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Abstract

Schizophrenia has been associated with deficits in visual perception and processing, but there is little information about their temporal development and stability. We assessed visual form perception using the Rorschach Comprehensive System (RCS) in 23 individuals at clinical high risk for psychosis, 15 individuals with recent onset schizophrenia (≤ 2 years since onset), and 34 with chronic schizophrenia (≥ 3 years since onset). All three groups demonstrated reduced conventional form perception (X+%), as compared with published norms, but did not differ significantly from one another. In contrast, the high-risk group had significantly better performance on an index of clarity of conceptual thinking (WSUM6) compared to the chronic schizophrenia patients, with the recent-onset group scoring intermediate to the high risk and chronic schizophrenia groups. The results suggest that individuals at clinical high risk for psychosis display substantial deficits in visual form perception prior to the onset of psychosis and that these deficits are comparable in severity to those

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Contributors

David Kimhy designed the study, performed data collection, scoring, statistical analyses, and data interpretation, and wrote the 1st draft of the manuscript.

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Jill Harkavy-Friedman contributed to designing the study, data collection and scoring, statistical analyses, data interpretation, and writing of the manuscript.

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Dan Javitt contributed to statistical analyses, interpretation of the data and writing of the manuscript.

Dolores Malaspina contributed to designing the study, interpretation of the data, and writing of the manuscript.

All authors contributed and have approved the final manuscript.

Conflict of Interest

All authors declare that they have no conflicts of interest.

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observed in individuals with schizophrenia. Therefore, visual form perception deficits may constitute a trait-like risk factor for psychosis in high risk individuals and may potentially serve as an endophenotype of risk for development of psychosis. Clarity of conceptual thinking was relatively preserved among high risk patients, consistent with a relationship to disease expression, not risk. These deficits are discussed in the context of the putative neurobiological underpinnings of visual deficits and the developmental pathophysiology of psychosis in schizophrenia.

Keywords

Schizophrenia; Psychosis Prodrome; High Risk; Rorschach; Visual Deficits; Visual Perception; Form Perception; Endophenotype; Thought Disorder

1. Introduction

Schizophrenia has been associated with deficits in visual perception (Amador et al., 1995; Doniger et al., 2001, 2002; Gabrovska et al., 2003; Heckers et al., 2000; Silverstein et al., 2006). In particular, individuals with schizophrenia have been reported to display deficits in visual form recognition and perceptual closure (Amador et al., 1995; Doniger et al., 2001, Gabrovska et al., 2003), as well as deficits in figure-ground perception (Malaspina et al., 2003, 2004). Perceptual closure refers to the ability of the visual system to “fill in” missing information when viewing a stimulus under partial, obstructed, or fragmented conditions (Snodgrass & Feenan, 1990). Figure-ground perception refers to the ability to discriminate visual objects from the background in which they are embedded (Malaspina et al., 2003). The ability to achieve perceptual closure, recognize an object, and discriminate it from other visual stimuli is associated with effective functioning, as suggested by the association between visual-processing deficits in schizophrenia and poor outcome on social functioning measures (Doniger et al., 2001; Silverstein et al., 2006; Kee et al., 1998). While such deficits are well documented in individuals with schizophrenia (Doniger et al., 2001, 2002; Malaspina et al., 2003, 2004), there is relatively little information about their temporal development and stability. Although visual perception abnormalities have been documented in individuals at increased risk for psychosis (Klosterkotter et al., 2001; Cohen et al., 2006; Van der Stelt et al., 2006), other studies reported no difference or mixed results (Silverstein et al., 2006; Hawkins et al., 2004), or even enhanced visual processing abilities (Parnas et al., 2001). Thus, it is unclear whether such deficits are present among individuals at clinical high risk for psychosis or whether they develop in parallel to the onset of psychosis. It is also unclear whether the severity of such visual deficits increases over the course of illness.

The goal of the present study was to compare visual form perception in individuals at clinical high risk for psychosis, individuals with recent onset schizophrenia, and individuals with chronic schizophrenia. We used performance on the Rorschach Comprehensive System (RCS) as a proxy for visual form perception. Specifically, we examined whether individuals at high risk for psychosis would demonstrate deficits on RCS's Form Quality (FQ) variable comparable to deficits observed in individuals with schizophrenia. The FQ variable assesses the degree of conventional form perception. To evaluate the specificity of this deficit in the high risk group, we also compared the three groups' clarity of conceptual thinking using the WSUM6 index - an RCS composite index assessing idiosyncratic language, lack of conceptual discrimination, irrational synthesizing, and strained reasoning. Individuals with schizophrenia have been reported to score significantly higher (worse) on the WSUM6 compared to healthy controls (Exner, 2003; Perry et al., 2003). Therefore, we hypothesized that the participants with schizophrenia would have significantly higher WSUM6 scores compared to the high-risk group, reflecting reduced clarity of conceptual thinking.

2. Experimental/materials and method

2.1 Participants

Fifty-one individuals with schizophrenia were recruited from current and former patients of an inpatient research unit at the New York State Psychiatric Institute (NYSPI). The schizophrenia patients were divided into two groups based on time since onset of schizophrenia: recent onset (up to 2 years) vs. chronic (3 or more years). Data on twenty-four help-seeking individuals identified as being at high risk for psychosis based on clinical status were obtained from the Center of Prevention and Evaluation (COPE) - a psychosis prodrom research program located at the NYSPI. All participants provided written informed consent and the studies were approved by the NYSPI's Institutional Review Board.

2.2 Assessments

High-risk status was established using the Structured Interview for Prodromal Symptoms and the Scale of Prodromal Symptoms (SIPS/SOPS; Miller et al., 1999), a semi-structured diagnostic interview that identifies clinical high-risk (prodromal) status based on 1) presence of attenuated psychotic symptoms; 2) brief intermittent psychotic symptoms; and/or 3) genetic risk (1st degree family member) with recent decline in functioning (30% decline in GAF scores during past 12 months). The SIPS/SOPS was administered and scored by an expert research psychiatrist who was involved in the development of the measure (CC). She has established excellent interrater reliability ($\kappa=1.00$ for prodromal category and $\sim .7$ to $.9$ ICC's for dimensional ratings of positive and other symptoms) with other leading prodromal research sites (PRIME program, Yale and RAP program, Zucker-Hillside Hospital, NY). Previous studies using SIPS/SOPS with individuals at clinical high risk for psychosis reported a 40% likelihood of developing psychosis by 12 months and a 50% likelihood of developing psychosis within the next 24 months (Miller et al., 2002; Yung et al., 1996).

Diagnosis of schizophrenia or schizoaffective disorder was determined using the Diagnostic Interview for Genetic Studies (DIGS; Nurnberger et al., 1994), a semi-structured diagnostic interview and medical records review that is used to gather diagnostic and course of illness information for the mood, psychotic, and substance use DSM-IV Axis I disorders, as well as functioning (GAF). The DIGS was administered by clinical research interviewers at the Master's level or above. A team of clinical research psychologists and psychiatrists made consensus diagnoses based on information collected via the DIGS.

Visual form perception was assessed using the Form Quality (FQ) variable of the Rorschach Comprehensive System (RCS; Exner, 2003). The RCS is a cognitive-perceptual task consisting of ten standard, ambiguous inkblots presented on preordered cardboards. Administration was completed using the RCS standard procedure ("free association" and inquiry). The RCS presents subjects with a high-load cognitive-perceptual task requiring her/him to organize and assign meaning to ambiguous visual stimuli under conditions of minimal structure (Perry & Braff, 1994). It includes elements of form recognition, perceptual closure, and figure-ground perception.

The FQ variable assesses the degree of conventional form perception by categorizing subjects' responses into Ordinary (Xo), Unusual (Xu), and Minus (X-) types based on frequency norms and their fit to the contours of the inkblots (Exner, 2003). Ordinary responses (Xo) are ones that were reported in *at least* 2% of the 9,500 RCS protocols used in the RCS validation pool and in which the individual's response "fits" the area of blot being chosen and described. Unusual responses (Xu) are those that were reported in *fewer than* 2% of the validation pool protocols, but were unanimously judged by three independent judges to be recognized quickly and easily, and to fit the blot contours. A designation of Minus response (X-) is given to

responses reported in *fewer than 2%* of the validation pool protocols and which have been judged to be distorted, arbitrary, or unrealistic in their use of form in creating a response. These categories have been validated using a pool of 9,500 RCS protocols with 205,701 responses (Exner, 2003, p. 122), including records from non-patient adults (51,183 responses), non-schizophrenia outpatients (92,951 responses), and non-schizophrenia inpatients (61,567 responses). To maximize reliability, each RCS protocol must include at least 14 responses in order to be considered valid (Exner, 2001). A fourth response type used by Exner (2003), Ordinary-Elaborated responses, includes an unusually detailed articulation of form in a response that otherwise would be scored as Ordinary (Xo). Given their scarcity in the present sample (as well as in normative samples), Ordinary-Elaborated responses were tallied under the Xo type.

The individual's responses to the RCS can be viewed as a sample of cognitive-perceptual functioning. The percentage of Ordinary responses (out of the total number of responses; X+ %) is used as an index of the degree by which an individual perceives visual form in a way that is conventional and similar to most other individuals without schizophrenia (Exner, 2003). In a study of 600 non-patient adults, healthy individuals perceived form in a conventional way ("Ordinary" responses; X+%) about three quarters of the time ($M=.77$, $SD=.09$; Exner, 2001). Scores of .70 or higher are typically associated with non-psychotic populations and are considered characteristic of generally healthy functioning. Such scores indicate that the respondent has "a substantial proclivity to formulate behaviors that are in accord with social demands and expectations" (Exner, 2003, p. 383). In contrast, two large samples of individuals with schizophrenia had substantially lower X+% scores, providing conventional responses less than one half of the time ($M=.40$, $SD=.15$, $n=200$ and $M=.43$, $SD=.11$, $n=128$; Exner, 2001). A core assumption underlying the RCS is that all individuals will experience some perceptual form distortions, with individuals suffering from schizophrenia differing from healthy ones in the frequency of such distortions.

Clarity of conceptual thinking was measured using the RCS's WSUM6 - an index assessing idiosyncratic language, lack of conceptual discrimination, irrational synthesizing, and strained reasoning. The mean WSUM6 score in non-patient adults is 4.48 ($SD=4.08$); scores between 7 and 11 are considered to indicate some cognitive slippage and faulty judgment, and scores higher than 12 suggest occasional ideational discontinuity or faulty conceptualizations (Exner, 2003). WSUM6 scores of 18 or higher are often observed in individuals with schizophrenia and related disorders and are associated with poor reality testing, disorganized and inconsistent thinking, and substantial impairment in conceptualization (Exner, 2003).

All Rorschach protocols were administered by the first author (DK) according to the standard procedure of RCS (Exner, 2001) and scored by him using the Rorschach Interpretative Assistance Program (RIAP 4+ for Windows, ver. 4.52.127; Psychological Assessment Resources, Inc.). Studies assessing the interrater reliability of X+% have reported excellent results. Viglione and Taylor (2003) reported interclass correlation coefficients (ICC) of .87 for X+% for a study of 84 RCS protocols with 1732 responses. Similarly, Meyer et al. (2002) reported excellent ICC for X+% ($ICC=.96$) using 219 RCS protocols from eight distinct data sets rated by graduate students in training, clinicians in research settings, and experienced raters in private clinical practice. Weiner (1995) suggested that a minimum of 80% agreement among raters should be used as a standard of reliability for scoring RCS variables for research purpose. Twenty random RCS protocols from the schizophrenia participants were scored independently by the first author (DK) and a clinical psychologist (BR) who is an expert in scoring RCS protocols. The interrater reliability for the RCS Form Quality (FQ) and WSUM6 variables was satisfactory (86% and 85%, respectively).

2.3 Procedure

The schizophrenia and high-risk participants were administered the instruments during 2000–2002 and 2004–2006, respectively. For the high-risk participants, RCS data were obtained from clinical assessments in the COPE clinic typically completed within a week of admission and baseline SIPS/SOPS ratings. For the outpatient schizophrenia participants, assessments were completed in parallel to participation in scheduled follow-up research evaluations as part of a longitudinal study of schizophrenia. The RCS protocols were typically administered within one or two days of the follow-up research assessments, with a maximum of seven days between assessments. For the inpatient schizophrenia participants, assessments were completed typically during the week prior to their discharge from an inpatient research unit, in parallel to research discharge assessments. Patients were typically hospitalized at NYSPI for 3–6 months and were commonly clinically stable during their week prior to their discharge, often waiting for housing placement or completion of discharge plans. This period was selected to reflect “optimal” and stable functioning that was, as much as possible, similar to the status of the outpatient schizophrenia participants.

2.4 Data Analyses

Many RCS variables violate the statistical assumptions required for inferential statistics (i.e., skewness, kurtosis, normal distributions, and percentage of zero values). However, Viglione (1995, p. 210–211) suggested that degree of conventional form perception ($X+\%$) and WSUM6 index satisfy these assumptions in patient samples, and are therefore suitable for parametric analyses. The data were analyzed using SPSS for Windows (version 15.0). Differences between the groups were analyzed using one-way Analysis of Variance (ANOVA) and Student's t-tests. Alpha was set at .05. For cases of non-homogenous variance, Dunnett's C test was used for post-hoc testing.

3. Results

Three participants (1 high risk, 2 chronic schizophrenia) did not provide the minimum fourteen responses required for a valid RCS protocol and their data were excluded from analyses. The final sample included 23 participants at high risk for psychosis, 15 with recent onset schizophrenia, and 34 with chronic schizophrenia. The sample's demographic and clinical data are presented in Table 1. The participants with schizophrenia were significantly older, had more previous hospitalizations, and had lower global functioning GAF scores. As expected, the chronic schizophrenia group had longer duration of psychosis and more hospitalizations compared to the recent onset schizophrenia group.

Table 2 presents the means, standard deviations, and ranges of number of responses, FQ (Form Quality) and the WSUM6 index (clarity of conceptual thinking) scores. The three groups provided a similar number of responses ($F(2, 69)=.60, p=.55$). All three groups had a mean $X+\%$ score equal or lower than .50, indicating that they reported conventional responses less than half of the time, a rate substantially lower than that reported in non-patient samples (.77; Exner, 2001). Similarly, none of the participants received an $X+\%$ score higher than .70, a score typically considered characteristic of generally healthy functioning (Exner, 2003).

There were no significant differences between the three groups on the degree of Ordinary responses ($X+\%$; $F(2, 69)=1.17, p=.32$) or Minus responses ($X-\%$; $F(2, 69)=2.23, p=.12$), indicating that the high-risk group performed as poorly as the schizophrenia groups. All groups performed similarly on Unusual responses ($Xu\%$; $F(2, 69)=.71, p=.49$), on which they produced scores that were similar to published normative means. These data indicate that the lower rate of ordinary responses by the participants was due to higher production of distorted

responses, rather than an increase in responses that were unusual, though fitting the blots' contours.

Performance on the WSUM6, an index of clarity of conceptual thinking, differed significantly across groups ($F(2, 69)=4.04, p=.02$). The Levene's test of homogeneity of variance was not significant ($p=.103$). However, because of the substantial WSUM6 variances among the groups (ranged from 82.08 to 190.72), we chose not to assume that the variances were homogenous and used Dunnett's C for post-hoc comparisons. There was a significant difference in the means between the high risk and chronic schizophrenia groups, but no significant difference between the recent onset and the other groups. However, all groups showed scores substantially higher than published norms for healthy controls.

In the high-risk group, participants with 1st-degree relatives with a history of psychosis produced significantly more Unusual responses ($X_u\%$; $M=.19, SD=.04; n=6$) compared to those without such family history ($M=.14, SD=.06; n=16$; one subject's family history was unknown due to adoption; $t(20)=2.08, p=.05$). There was also a trend of having fewer Ordinary responses in high-risk participants with 1st-degree relatives ($X_+\%$; $M=.37, SD=.16; n=6$) with a history of psychosis compared to those with no such family history ($M=.49, SD=.12; n=16$; $t(20)=1.84, p=.08$).

Percentage of Ordinary responses did not differ by sex ($t_{70}=1.32, p=.19$), inpatient vs. outpatient status ($t_{47}=.70, p=.49$), schizophrenia vs. schizoaffective diagnosis ($t_{47}=1.32, p=.19$), or global functioning (GAF) ($t_{70}=.65, p=.52$). Correlations of GAF scores with $X_+\%$, $X_u\%$, $X_-\%$, WSUM6, and number of responses were not significant for any of the groups, nor for all groups combined. Similarly, among the schizophrenia subjects, age was not significantly correlated with $X_+\%$, $X_u\%$, $X_-\%$, WSUM6, and number of responses (controlling for duration of psychosis). However, among the high risk participants age was significantly correlated with $X_+\%$ ($r=.45, p=.03$) and $X_u\%$ ($r=.43, p=.04$).

Among the high risk group, eight subjects were taking antipsychotic medication at the time of the RCS assessment. Estimates of chlorpromazine-equivalent doses ($M=46.04, SD=98.82$; range 0–400; $n=23$; Woods, 2003) did not correlate significantly with $X_+\%$, $X_u\%$, $X_-\%$ or WSUM6. Information about the schizophrenia groups' medication intake at the time of the RCS assessment was not available.

4. Discussion

The present study is the first to assess visual form perception using the RCS among rigorously diagnosed individuals identified as being at clinical high risk for psychosis and in patients with schizophrenia. The results indicate that the individuals at high risk for psychosis displayed poor visual form perception prior to the onset of psychosis - deficits which are comparable in severity to the ones observed in individuals with both recent onset and chronic schizophrenia. The three groups did not differ significantly amongst themselves in the degree of conventional form perception ($X_+\%$), with all three groups performed substantially below published norms. Specifically, all three groups demonstrated conventional ("Ordinary") form perception ($X_+\%$) less than one half of the time, a rate substantially lower than the mean scores reported in non-patient samples (.77; Exner, 2003). As all three groups produced Unusual responses ($X_u\%$) at rates similar to published normative means, the low rates of Ordinary responses ($X_+\%$) were due to increases in distorted, arbitrary or unrealistic use of form in creating responses ($X_-\%$). Notably, none of the participants in the study received an $X_+\%$ score above the .70 marker that is typically regarded as the lower end of the range associated with healthy functioning (Exner, 2003).

Our data are consistent with previous reports of RCS assessments of individuals with schizophrenia that reported X+% means within the .40–.50 range (Exner, 2003). Similarly, the lack of significant X+% sex differences is consistent with a previous report of no gender differences on form perception in schizophrenia patients (Danielsson et al., 2001). Our data also suggest that in individuals with schizophrenia, poor visual form perception as assessed by the RCS appears to remain relatively stable following the onset of psychosis. This view is consistent with a previous report indicating stability of visual form perception in adolescents with schizophrenia who were tested using the RCS at admission to psychiatric hospitalization and 11–14 months later (Exner, 1985).

Our data suggest that individuals at high risk for psychosis, as well as recent onset and chronic schizophrenia patients, perceive form in a manner distinct from healthy individuals. While having a predisposition to perceive visual stimuli in a unique manner may suggest an increased risk for functional difficulties, we did not find an association between X+% and GAF scores. However, this lack of association may be potentially due to the RCS identifying visual deficits that are not reflected in functioning as assessed by a crude and global measure such as the GAF. A number of authors have expressed concern about the limitations of the GAF to index functioning including the use of one item to measure many different functional areas and the GAF's higher association with psychiatric symptoms than functional abilities (Roy-Byrne et al., 1996; Goldman et al., 1992).

Our results raise questions about the developmental timing of visual deficits in schizophrenia and whether they are present prior to the prodromal period. There are no published longitudinal studies of visual form perception using the RCS in individuals at high risk for psychosis. Published cross-sectional norms for healthy children indicate slight X+% increase over childhood (mean scores at age 5=.67, age 12=.75, adults=.77; Exner, 2003). Similarly, in our high-risk group sample age was associated with X+%. However, among healthy adults, the ability to perceive form on the RCS is considered to be a relatively stable, “trait-like” feature. Exner et al. (1985) assessed visual form perception on the RCS in 57 healthy children (27 males, 30 females; IQ M=107.3, SD=14.6) at age eight, and then again at ages ten, twelve, fourteen and sixteen. Conventional form perception (X+%) at age sixteen was highly correlated with form perception at ages eight ($r=.78$), ten ($r=.83$), twelve ($r=.81$), and fourteen ($r=.85$), suggesting that in healthy individuals the ability to perceive visual form on the RCS appears to be relatively stable from middle childhood at least to the mid teens. Similarly, Gronnerod (2003, 2004) conducted meta-analyses of studies assessing stability of RCS variables over time and reported impressive stability of Form Quality variables (.93 prediction over a 5-year period).

The RCS is not designed to establish the diagnosis of schizophrenia or to formally assess psychosis (Exner, 2003). However, assuming that poor form perception is similarly stable during development in individuals at high risk for psychosis, visual processing deficits assessed by the RCS may be present prior to the onset of psychotic symptoms and may potentially serve as an endophenotype of risk for development of psychosis. Such deficits may reflect the presence of an early diathesis that in combination with later potential stressors may increase the probability of developing psychosis (Gottesman & Gould, 2003). This view is consistent with our findings in the high risk group that indicated poorer form perception in individuals with 1st-degree relatives with a history of psychosis. These individuals provided significantly more Unusual responses (Xu%), as well as a trend for fewer Ordinary responses (X+%), compared to individuals with no such family history. Similarly, McGorry and colleagues (2002) reported that family history of psychosis increases the risk of developing psychosis in individuals at clinical high risk. There are no published reports about differences in visual processing between individuals at clinical high risk for psychosis with and without family history. However, a number of studies of individuals with schizophrenia reported poorer visual

functioning in individuals with family history of psychosis compared to sporadic cases (Schwarzkopf et al., 1988; Schwartz et al., 1995; Ross et al., 1998).

Our data also indicate that individuals at clinical high risk for psychosis demonstrate poor clarity of conceptual thinking, though it is not as severe as that observed in individuals with schizophrenia. The high risk group WSUM6 mean score of 9.65 (SD=9.06) is in step with their clinical status as being at clinical high risk for psychosis. Such scores indicate more cognitive slippage and faulty judgment than is typically observed in non-clinical populations (M=4.48, SD=4.08; Exner, 2003). Likewise, the mean scores of the recent-onset and chronic schizophrenia groups (M=17.67, SD=13.17 and M=18.24, SD=13.61, respectively) are in line with their diagnoses and clinical status. WSUM6 scores of 18 or higher are typically associated with poor reality testing, disorganized and inconsistent thinking, as well as substantial impairment in conceptualization (Exner, 2003). Our data are consistent with Perry et al. (2003) who reported similar WSUM6 scores in hospitalized schizophrenia patients (M=17.18, SD=21.81) and outpatient schizophrenia patients (M=15.31, SD=16.64). They found significantly different WSUM6 scores in patients with schizotypal personality disorder (M=10.17, SD=9.00), college students with elevations on perceptual aberration, magical thinking, and physical anhedonia (M=5.83, SD=5.47), first-degree relatives of schizophrenia patients (M=6.50, SD=6.95), and healthy controls (M=3.08, SD=4.22; Perry et al., 2003). The relatively low WSUM6 scores of the schizophrenia groups in our sample, in comparison to published schizophrenia norms (Exner, 2003), may reflect their clinical status as relatively stable schizophrenia patients (see symptom ratings in Table 1).

Altogether, these data suggest that poor visual form perception (X+%) may constitute a trait-like risk factor for psychosis in high-risk individuals. In contrast, clarity of conceptual thinking as assessed by WSUM6 was relatively preserved in high risk patients, consistent with a relationship with disease expression, not risk. Additionally, the findings of significant differences between the high risk and schizophrenia participants on the WSUM6 index support the specificity of our X+% findings, suggesting that the lack of difference between the groups on the X+% is not likely due to a response bias in our sample.

The neurobiology underlying the visual processing deficits in individuals with schizophrenia on the RCS is not fully understood. Minassian and colleagues (2004, 2005) used an infrared corneal-reflection-pupil-center pupillometer to assess pupillary activity and eye movement in individuals with schizophrenia during responses to the RCS task. They found that individuals with schizophrenia had deficits in attention allocation and visual scanning, including less pupil dilation, longer visual fixation, and shorter total visual scanpath relative to healthy participants (Minassian et al, 2005). Additionally, in schizophrenia patients smaller pupillary response and higher levels of perceptual inaccuracy were associated with clarity of conceptual thinking as assessed by WSUM6 (Minassian et al, 2004). Previous work indicates that visual deficits in schizophrenia may be associated with magnocellular dysfunction, resulting in a limited ability to achieve visual form recognition and perceptual closure (Amador et al., 1995; Doniger et al., 2001; Gabrovskia et al., 2003). In particular, deficits in magnocellular functioning may impact the ability to identify and distinguish salient visual stimuli on RCS cards and organize them within the context in which they are embedded. Recent work by Keri & Benedek (2007) indicating an association between magnocellular dysfunction and visual perceptual abnormalities in individuals at high risk for psychosis provide further support for this link. Future work is needed to examine directly the link between magnocellular and RCS dysfunction in individuals with schizophrenia, as well as in individuals at high risk for psychosis.

Limitations of the present study include the cross-sectional design and the potential for ascertainment bias. Therefore, the findings should be viewed as preliminary and interpreted

with caution. Additionally, as this was a naturalistic design we did not control for the potential impact of antipsychotic or other medications on performance on the RCS. There is scant information about this potential relationship -Minassian and colleagues (2005) reported that antipsychotic and anticholinergic medications were not significantly associated with pupillary response to the RCS. Similarly, Danielsson et al. (2001) reported no association between WSUM6 scores and either duration or dosage of neuroleptic medication in a small study of individuals with schizophrenia. The authors did not present data on X+%; however they reported significant negative correlations between percentage of Minus responses (X-%) and both duration and dosage of neuroleptics, but only in male participants. Alternatively, Perry et al. (1995) reported that administration of dextro-amphetamine to healthy males did not result in significant changes in WSUM6 scores or sum of X- scores. In our study, estimates of chlorpromazine equivalents in the high risk group were not associated with WSUM or FQ variables. Although our findings are probably not explained by medication effects, future work is needed to clarify the potential impact of medication on performance on the RCS. Finally, the present study does not include a control group. However, the Rorschach is well-normed in non-patient populations and we included these data in the present report.

The findings have several implications for future research. RCS norms are available for healthy children as young as age five (Exner, 2003) and the X+% scores are generally similar to healthy adults (mean X+% scores at age 5=.67, age 8=.71, age 12=.75, and adults=.77). Such mean scores are substantially higher than the ones reported for adults with schizophrenia (range .40-.50; Exner, 2003). Thus, investigators may be able to assess whether poor visual form perception on the RCS is present as early as age five, and whether such deficits relate to later risk for psychosis. Such a study may contribute to our understanding of the temporal development of visual deficits in schizophrenia. While sensitive to perceptual and cognitive aberrations, the RCS is a measure imprecise to basic visual processes. Researchers should aim to confirm the presence of specific visual deficits in individuals at high risk to psychosis using other, more specific, assessment methodologies. In particular, the precise domains of the visual deficits (i.e., perceptual closure, figure-ground perception) and their associated neurobiological mechanisms should be illuminated.

In summary, the present study is the first to compare visual form perception using the RCS in rigorously diagnosed individuals at high risk to psychosis and patients suffering from schizophrenia. Our results suggest that individuals at high risk for psychosis display poor visual form perception prior to the onset of psychosis, and that these deficits are comparable in severity to those observed in individuals with schizophrenia. This study contributes to the literature about the development and course of visual deficits in individuals with schizophrenia.

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Table 1

Demographic and Clinical Information

		Mean	SD	F / t	P
Age	High Risk Recent Onset Schizophrenia Chronic Schizophrenia	19.35 24.13 34.47	3.26 6.30 9.64	F(2, 69)=29.55	<.001
Education (years)	High Risk Recent Onset Schizophrenia Chronic Schizophrenia	12.00 12.40 13.50	2.71 2.32 2.94	F(2,69)=2.23	NS
Age at Onset of Psychosis	High Risk Recent Onset Schizophrenia Chronic Schizophrenia	-- 23.47 22.65	-- 6.35 4.23	t(47) = .48	NS
Duration of Psychosis (years)	High Risk Recent Onset Schizophrenia Chronic Schizophrenia	-- .67 12.29	-- .72 8.67	t(47) = 7.76	<.001
Number of Psychiatric Hospitalizations*	High Risk Recent Onset Schizophrenia Chronic Schizophrenia	.17 1.53 6.62	.49 .83 3.81	F(2,69)=44.80	<.001
GAF Score	High Risk Recent Onset Schizophrenia Chronic Schizophrenia	45.13 40.47 37.85	7.09 9.04 9.42	F(2,69)=4.48	.01
Total PANSS Positive Symptoms	High Risk Recent Onset Schizophrenia Chronic Schizophrenia	-- 11.80 16.12	-- 6.46 6.46	t(47) = 2.16	.04
Total PANSS Negative Symptoms	High Risk Recent Onset Schizophrenia Chronic Schizophrenia	-- 15.53 17.74	-- 4.88 5.90	t(47) = 1.08	NS
Total PANSS General Psychopathology	High Risk Recent Onset Schizophrenia Chronic Schizophrenia	-- 27.87 29.82	-- 4.79 7.09	t(47) = .97	NS
Sex:	High Risk	Recent Onset Schizophrenia	Chronic Schizophrenia		
Male	19	10	20		
Female	4	5	14		
Ethnicity:	High Risk	Recent Onset Schizophrenia	Chronic Schizophrenia		
Asian	2	1	2		
Black/African-American	4	8	7		
Hispanic	6	1	6		
Caucasian	10	5	19		
Multi-Ethnic	1	0	0		
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Total	23	15	34		

DSM-IV Diagnoses of the schizophrenia participants - recent onset schizophrenia (n=15); 12 schizophrenia, 3 schizo-affective disorder, chronic schizophrenia (n=34); 26 schizophrenia, 8 schizo-affective disorder; GAF - Global Assessment of Functioning; PANSS - Positive and Negative Syndrome Scale;

* including for non-psychosis symptoms.

Mean, Standard Deviation, Ranges and One-Way Analyses of Variance (ANOVA) for Effects of Group on Five Rorschach Comprehensive System (RCS) Variables

Table 2

Variable	Group	Mean	SD	Range	F (2, 69)	p
Total Number of Responses	High Risk	18.00	3.44	14 – 26	.60	NS
	Recent Onset Schizophrenia	19.40	4.15	14 – 27		
	Chronic Schizophrenia	18.06	4.86	14 – 37		
Form Quality (FQ)	High Risk	.45	.14	.18 – .64	1.17	NS
	Recent Onset Schizophrenia	.50	.12	.25 – .69		
	Chronic Schizophrenia	.45	.11	.22 – .65		
	High Risk	.16	.06	.05 – .25	.71	NS
	Recent Onset Schizophrenia	.18	.09	.00 – .32		
	Chronic Schizophrenia	.15	.08	.00 – .31		
Percentage of Unusual Responses (Xu%)	High Risk	.36	.12	.14 – .61	2.23	NS
	Recent Onset Schizophrenia	.31	.13	.06 – .56		
	Chronic Schizophrenia	.39	.12	.07 – .63		
Percentage of Minus Responses (X–%)	High Risk	9.65	9.06	0 – 39	4.04	.02
	Recent Onset Schizophrenia	17.67	13.17	0 – 56		
	Chronic Schizophrenia	18.91	13.95	2 – 54		

n = 72 (23 High Risk, 15 Recent Onset, 34 Chronic); Published norms of 600 healthy controls (Exner, 2001) are presented in *italics*: Number of responses ($M=22.32$, $SD=4.40$); $X+%$ - Percentage of Ordinary responses ($M=.77$, $SD=.09$); $Xu%$ - Percentage of Unusual responses ($M=.15$, $SD=.07$); $X-%$ - Percentage of Minus responses ($M=.07$, $SD=.05$); WSUM6 - a composite index of clarity of conceptual thinking based on 6 RCS variables assessing idiosyncratic language, lack of conceptual discrimination, irrational synthesizing, and strained reasoning ($M=4.48$, $SD=4.08$).