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Verbal and Visual-Spatial Memory Impairment in Youth at Familial Risk for Schizophrenia or Affective Psychosis: A Pilot Study

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Abstract

Background—Schizophrenia and affective psychoses share several common biological origins, particularly genetic susceptibility. Kraepelin posited that differing clinical expressions in these disorders reflect different etiopathologies. We tested a neuropsychological component of this hypothesis by evaluating verbal and visual memory performance in nonpsychotic youth at familial risk for psychosis, taking into account contributions to memory dysfunction including executive processing and psychopathology.

Methods—Teenage and young adults (ages 13-25) at familial high-risk (FHR) for schizophrenia (HR-SCZ, n=41) or affective psychosis (HR-AFF, n=24) were compared to community controls (CC, n=54) on verbal (Miller-Selfridge Context Memory) and visual (Rey-Osterreith Complex

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Contributors Drs Seidman, Faraone and Tsuang conceived the study, received grant support, carried out the study, and wrote the manuscript.

Dr Scala carried out data analyses and wrote the paper with Dr Seidman; Dr Pousada-Casal contributed to this process and in carrying out data analyses.

Drs Thermenos and Manschreck contributed conceptually to the verbal memory measures and to the writing of the paper.

Dr Stone supervised the neuropsychological testing data collection in the study and contributed to writing the paper

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Figure) memory tests in which the roles of strategy and contextual processing on distinct recall domains could be assessed. Effects of psychopathology, vigilance and working memory were investigated to determine their influence on memory performance.

Results—HR-AFF and HR-SCZ exhibited similarly impaired memory profiles and elevated levels of psychopathology compared to CC. HR-SCZ were significantly impaired on both verbal and visual-spatial memory, while HR-AFF in verbal memory only. However, effect sizes, in the medium range, were largely comparable between the two HR groups. Deficits in verbal recall and in visual memory organization remained significant after adjustment for confounders.

Conclusions—Youth at FHR for psychosis present relatively common memory deficits across both visual-spatial and verbal modalities that are not explained by current psychopathology, vigilance or working memory deficits. Deficits in organizing information to be recalled represent a promising trait of psychosis vulnerability.

Keywords

family high-risk; psychosis; memory; psychopathology; vulnerability

Introduction

The degree of overlap between schizophrenia and affective psychosis is a recurring question, with differences in diagnostic symptoms and clinical outcomes conceptualized both categorically and dimensionally (Kraepelin, 1920) and with increasing evidence of some shared genetic susceptibility (Craddock et al., 2005). Neurocognitive compromise, while not part of the diagnostic criteria for schizophrenia or psychotic mood disorders, is a key part of the schizophrenia syndrome, beginning with the concept, “dementia praecox”. This observation has overwhelming support in chronic (Heinrichs and Zakzanis, 1998) and first-episode cases (Mesholam-Gately et al., 2009) with schizophrenia. On the other hand, neurocognitive impairment in affective psychosis has traditionally been considered a relatively mild component of the illness (Goodwin and Jamison, 1990) because deficits were not commonly observed before onset, pointing to the possibility of subsequent deterioration of neuropsychological functions associated with the disorder. Nevertheless, although studies of neurocognition in bipolar disorder (BD) and major depressive disorder (MDD) are not as exhaustive as for schizophrenia, both BD and MDD patients have been increasingly observed to present neurocognitive impairments that intensify with the degree of psychosis (Rubinsztein et al., 2000; Dittmann et al., 2008). Moreover, in direct comparisons, patients with schizophrenia (SCZ) or affective psychosis (AFF) present similar neurocognitive impairments (Goldberg et al., 1993; Schretlen et al., 2007), although the level of severity is greater in SCZ (Seidman et al., 2002; Lewandowski et al., 2011; Zilles et al., 2011).

Determining whether neurocognitive dysfunctions are specific to type of psychosis is confounded by the effects of psychosis and by various medications these patients receive. An alternative strategy is to test nonpsychotic, unmedicated, first-degree relatives of psychotic individuals who share approximately 50% of genes with their ill relatives, but are typically free of psychosis confounds that could affect neurocognition (Glahn et al., 2010; Jabben et al., 2010). The genetic or familial high-risk (FHR) approach of evaluating relatives of patients builds upon the knowledge that the best-known risk factors for the psychosis are susceptibility genes (Gottesman and Gould, 2003) and one expression is by neurocognitive dysfunctions (Faraone et al., 1995). Some studies have assessed neurocognition in first-degree relatives of individuals with SCZ and AFF directly in the same study, but these vary in the neurocognitive functions assessed and the literature is still relatively limited, especially in FHR youth (Kremen et al., 1998; Erlenmeyer-Kimling et al., 2000; McIntosh et al., 2005; Pirkola et al., 2005; Seidman et al., 2006, 2012a).

Declarative memory in psychotic disorders and in HR individuals is one of the most promising functions to study because it has been studied extensively in patients and there are few direct comparisons in relatives of SCZ vs AFF. Verbal declarative memory is prominently impaired in SCZ and AFF psychosis (Aleman et al., 1999; Fossati et al., 2004). Moderate size memory impairments are also consistently reported in both nonpsychotic adult relatives of patients with SCZ (Kremen et al., 1994; Snitz et al., 2006; Trandafir et al., 2006) and AFF psychosis (Kieseppä et al., 2005; Robinson et al., 2006; Arts et al., 2008). Difficulties in spontaneously organizing information during the encoding stage are considered to be one of the primary dysfunctional cognitive mechanisms of verbal memory in individuals with SCZ and in their relatives (Cirillo and Seidman, 2003).

However, visual memory has been relatively under-explored and, therefore, the mechanisms that are responsible for these deficits are poorly understood (Tracy et al., 2001; Kalinowski et al., 2003; Seidman et al., 2003). As in schizophrenia patients, adult first-degree relatives demonstrate impaired visual memory (Tuulio-Henriksson et al., 2003; Skelley et al., 2008). In affective psychosis, deficits in visual patterns and spatial memory support evidence of impaired visual memory (Sweeney et al., 2000; Bearden et al., 2006). Because prefrontal cortex is strongly implicated in the activation of deep categorizing and semantic memory strategies, and in organization and planning (Cirillo and Seidman, 2003), we assume that organizational processing is impaired in both verbal and visual-spatial memory in both disorders. Thus, a deficit in strategic and organizational processing could play a significant role in verbal and visual memory impairments in HR youth.

The study of youth at FHR enhances the important goal of identifying neurocognitive vulnerability indicators for later disability or illness. There are far more studies of neurocognition in youth at FHR for schizophrenia (HR-SCZ) than for affective psychoses. A recent quantitative literature review of neurocognition yielded 28 studies of HR-SCZ (aged <30 years) appropriate for quantitative analysis and far fewer in HR-AFF subjects (Agnew-Blais and Seidman, 2012). The largest average effect sizes (ESs) using Cohen's d (1988) were for full-scale IQ ($d=-0.777$), vocabulary ($d=-0.749$), single word reading ($d=-0.698$) (often used as IQ estimates), and verbal declarative memory ($d=-0.541$) in HR-SCZ. Schubert and McNeil (2005) suggested that verbal memory is a specific trait marker for schizophrenia liability since impairments were present in offspring of mothers with schizophrenia and not in offspring of affective patients. Thus far, however, the few studies that compared youth at HR for different psychoses are inconclusive as to specificity of memory dysfunction (e.g. Maziade et al., 2009) and none have focused on memory tasks highlighting spontaneous organization.

The goal of this study was to identify whether there are distinct or common memory impairments in HR-SCZ and HR-AFF. To investigate verbal and visual memory, and to assess the role of strategic and organizational processes in memory we used a visual memory and perceptual organization test (Rey-Osterrieth Complex Figure [ROCF], Rey, 1941; Osterrieth, 1944) and a context-aided verbal memory test (Miller-Selfridge [MS], Miller and Selfridge, 1950; Manschreck et al., 1997). Our first hypothesis was that both high-risk groups would be impaired on verbal and visual memory measures compared to controls as tested by the MS Total score and the organizational memory scores on the ROCF. Secondly, we expected to find a linear trend such that the HR-SCZ group would perform worse than the HR-AFF group. In particular, we expected that HR-SCZ would present more problems on the organization of the ROCF (cf. Jones et al., 2003). Thirdly, we expected HR-SCZ to show greater vulnerability to low semantic context on the MS word lists, reflecting their hypothesized weakness in self-organizing words. Finally, we sought to assess whether the hypothesized memory deficits could be explained by concurrent psychopathology or by high load auditory attention-executive processing.

Methods

Subjects

Study data were collected as part of the Harvard Adolescent Family HR Study between 1998 and 2007. This sample and its ascertainment procedures and some neurocognitive analyses were described previously (Seidman et al., 2006, 2012b); the ROCF data has not been published previously in these samples and the MS data has not been published in HR-AFF nor in most of the HR-SCZ participants. In a functional neuroimaging study, we briefly reported the MS Total score for 26 controls and 21 HR-SCZ, roughly 50% of those samples reported here (Thermenos et al., 2007). The present study comprises nonpsychotic first-degree relatives of patients with a DSM-IV (APA, 1994) diagnosis of schizophrenia or schizoaffective disorder, depressed type (HR-SCZ), bipolar psychotic disorder or Major Depressive Disorder with psychotic features (HR-AFF) and a community control group (CC). Probands were diagnosed using the Diagnostic Interview for Genetic Studies (DIGS; Nurnberger et al., 2004) and the Family Interview for Genetic Studies (FIGS; Maxwell, 1996). Nonpsychotic relatives were ascertained through adult probands.

The HR-SCZ group consisted of 41 relatives (40% offspring, 60% siblings) of SCZ probands, whereas the HR-AFF group consisted of 24 relatives (62.5% offspring, 37.5 % siblings) of patients with AFF psychosis. The CCs consisted of 54 children of parents diagnosed according to DSM-IV criteria with no mental illness (n=25), major depressive disorder (n=8), mood disorder due to a general medical condition (n=1), or cannabis abuse (n=1) using the DIGS and FIGS. The adult control probands were drawn from respondents to local newspaper advertisements and announcements posted in the sites from which HR probands were recruited (e.g., local hospital and clinics). All HR youth assessed were between 13 and 25 years old.

Exclusion criteria—HR and CC participants were excluded if they had: a lifetime diagnosis of psychotic illness, substance dependence, neurological disease, head injury or medical illness with documented cognitive sequelae, sensory impairments, current psychotropic medication use, or a full-scale IQ less than 70 based on eight sub-tests of the WISC-III or WAIS-III (Wechsler, 1991, 1997). CCs had an additional exclusion criterion of any first- or second-degree biological relatives with lifetime psychosis. Relatives of control and psychotic probands were screened for psychosis with the Washington University Kiddie SADS (KSADS; Geller et al., 1994). The Psychosis, Substance Abuse and Mood Disorders modules of the WASH-U-KSADS were administered along with a Neurodevelopmental Questionnaire (Faraone et al., 1995) to establish other inclusion and exclusion criteria. The reading subtest of the Wide Range Achievement Test – Third Edition (WRAT-3; Wilkinson, 1993) estimated intellectual ability.

Participants aged 18 and older gave informed consent. Minors (<18 years) gave assent in conjunction with parental informed consent. Subjects received an honorarium. The human studies committees of the Massachusetts Mental Health Center, Harvard Medical School and other recruitment sites approved this study.

Neurocognitive Tests

Testing and scoring of tests was done blind to diagnostic status.

Rey-Osterrieth Complex Figure (ROCF)—The ROCF is a visual complex figure that requires several abilities connected with visuo-spatial memory and executive functions to copy it and reproduce it from memory. We administered a Copy of the figure and subsequently, without any notice, Immediate Recall, and then after 30 minutes, Delayed

Recall. The Miller Selfridge and a visual vigilance test were given during the interpolated delay time. Each condition was assessed by a developmental, qualitative process-oriented scoring system that yields organizational and accuracy measures for structural and incidental elements (Bernstein and Weber, 1996).

Miller Selfridge (MS)—The MS test assesses the ability to employ syntactic and semantic context to recall words. This is a test of context-aided short-term verbal memory that includes four unrelated lists of 20 words with increasing context, aurally presented in order from the least (List 1) to the most related (List 4) words. Subjects speak the words out loud that they recall immediately after the examiner is finished reading the list. Number of correct words recalled for each list was scored.

Auditory Vigilance and Working Memory—Several auditory Continuous Performance Tests (CPT) were used (Seidman et al., 1998, 2012b) to study the effect of attention (vigilance) and working memory plus interference (WM+INT) on visual and verbal memory.

Psychopathology measures

Participants were administered the Symptom Checklist 90-Revised (SCL-90-R; Derogatis, 1993), a self-report questionnaire of 90 items, clustered in 9 specific and 3 total subscales. We evaluated whether measures of mild psychotic-like thinking (paranoia and psychosis subscales, and positive symptom total/PST) could account for the memory problems.

Statistical Analyses

Groups were compared on demographic, neurocognitive and psychopathology measures. Statistical significance was set at $p < .05$. Demographic characteristics were compared among the 3 samples using one-way analyses of variance (ANOVAs) for continuous variables and Chi-Square for categorical variables. Our primary, hypothesized memory variables were MS Total for verbal memory, and the ROCF immediate and delayed recall organization scores. Our secondary measures were the four MS Lists (1-4) and the four ROCF Copy and accuracy scores. For each domain using the four “secondary” scores, we used Bonferroni corrections ($p < .05/4 = .0125$). Age was a covariate in all analyses, as it differed among the groups and because performance improves with age in the age-range we studied. Analyses using age corrected scores are our central test of hypotheses. A multivariate Analysis of covariance (ANCOVA) investigated group differences in neurocognitive variables and psychopathology. Cognitive differences were further tested after controlling for psychoticism, paranoia and PST, in separate models. We followed the same covariance strategy using the two auditory CPT measures. Pearson correlations explored the relationship among attention, memory and psychopathology. Effect sizes were calculated with Cohen’s d (Cohen, 1988) on age adjusted scores.

Results

Demographics

CCs were significantly younger than HR-SCZ, and parental SES was lower in HR-SCZ than in CCs. HR-AFF’s WRAT-3 Reading scores were significantly lower than those of CCs. No significant association between education, sex, ethnicity and group status was found.

Memory

Neurocognitive results are corrected for age, and for age and parental SES. Only age-corrected analyses (ANCOVA) are reported because results with and without SES correction was similar and, more statistical power is retained with only one covariate.

Rey Osterrieth Complex Figure—As predicted the groups differed significantly for immediate ($p < .026$) and delayed recall ($p < .003$) organization. Only the HR-SCZ was significantly impaired in comparison with CCs ($p < .01$, $d = 0.58$), on organization measures of recall, but not on copy organization. Accuracy did not significantly differ in copy, immediate or delayed recall conditions. There were no significant differences between HR groups ($p > .05$).

Miller-Selfridge—As predicted the ANCOVA was significant for MS Total ($p = .006$). Both HR groups performed significantly lower than CCs with medium effects ($d = 0.51$ - 0.62). HR-SCZ was significantly lower than controls on List 1, List 2 and the Total score. HR-AFF was significantly lower than controls on List 3 and Total score. There were no significant differences between HR groups ($p > .05$).

Clinical functioning and correlations between clinical and neuropsychological measures

HR-SCZ differed significantly from CCs in the psychoticism subscale of the SCL-90R, while HR-AFF displayed elevated scores compared to CCs in obsessive-compulsive and phobic anxiety scales. No significant differences were detected between HR groups. There were very few significant correlations between SCL-90R clinical scales and ROCF or MS measures. Pearson correlation coefficients showed modest, significant negative correlations ($p < .05$) only between the paranoid subscale and 3 neurocognitive measures: ROCOPY ($r = -.33$), TDLY ($r = .34$) and MSTOT1 ($r = -.32$) in the HR-SCZ group. In the HR-SCZ group, the auditory CPT measures had no significant correlations with the ROCF (all r 's $< .25$), but the vigilance task was significantly correlated ($p < .05$) with MS Tot 1 ($r = .39$), MS Tot 3 ($r = .32$) and MS Total ($r = .32$). In the combined HR and control samples, 28 out of 30 correlations between the ROCF and MS variables were statistically significant (r 's between .21 and .41) suggesting they are tapping into a common mechanism.

Relationship between memory tests, attention and working memory and psychopathology—Most of the group differences (12 of 18) on the ROCF and MS remained significant after separately controlling for the paranoid, psychoticism and PST subscales. Similarly, using auditory CPT measures of vigilance and WM+INT as covariates, 11 of 12 possible significant results were retained at $p < .05$.

Discussion

Our first hypothesis was largely confirmed. The main finding in this study is that HR-SCZ and HR-AFF groups performed significantly worse than controls on verbal memory tests, while only the HR-SCZ performed significantly worse on the ROCF. However, effect sizes were comparable for delayed recall organization ($d = 0.58$ and 0.52 respectively). Regarding the second hypothesis, there were no significant differences between the two HR groups in direct comparisons. Thus, our findings do not support the idea of a linear trend of severity of memory dysfunction, showing that, at least in this developmental stage, the HR-AFF group displays a memory profile largely comparable to the HR-SCZ group. The third hypothesis received support, as the HR-SCZ group was significantly impaired on the first two lists, i.e., those with the least semantic context. The potentially confounding factors of dysfunctional attention, working memory/interference, and psychopathology, did not attenuate the significant impairments in HR groups. This suggests that memory impairments are robust to

both groups. This is the first study, to our knowledge, that investigated HR-SCZ and HR-AFF youth concurrently with the same sampling and assessment methods, the same measures of verbal and visual memory, and addressed possible neurocognitive and psychopathological confounders. Our findings are consistent with previous studies showing that adolescents at risk for affective disorder exhibited neurocognitive deficits similar to those of adolescents at risk for schizophrenia (Maziade et al., 2009). They are also consistent with previous studies of patients and their adult first-degree relatives in schizophrenia (Conklin et al., 2000, 2002; Pirkola et al., 2005), and in affective psychosis (Ferrier et al., 1999, 2004; Christensen et al., 2006; Balanza-Martinez et al., 2008).

Rey-Osterrieth Complex Figure

Previous studies (Sullivan et al., 1992; Kalinowski et al., 2003) found that recall accuracy in SCZ patients was influenced by copy strategy, suggesting that processes contributing to memory deficits in schizophrenia include an ineffective use of organizational strategies. The organization measure includes the ability to align elements and to connect them laterally into the resulting whole structure of the original pattern. Seidman et al (2003) showed that SCZ patients performed worse in ROCF organization than bipolar patients, who in turn performed worse than normal controls. In this study, HR-SCZ were significantly more impaired than CC in Immediate and Delayed Recall organization, and the HR-AFF group performed comparably to HR-SCZ, based on similar effect sizes. Furthermore, no significant impairments in accuracy on copy, immediate or delayed recall were found, suggesting that the deficit is primarily organizational and not a visual-spatial impairment per se, and that it occurs in memory. This result is consistent with the conclusion by Cirillo and Seidman (2003), who in their review of more than 100 memory studies on individuals with schizophrenia, and several studies on relatives, found that organizational features were a central part of the memory dysfunction.

Miller-Selfridge

The HR-SCZ group was impaired on most of the overall recall efficiency measures compared with CC. However, they were significantly impaired only on the first two lists, where the semantic context is lowest, suggesting that they are especially dependent on context to aid their memory. On the other hand, the HR-AFF were only impaired on the third list, raising the possibility of impaired sustained attention over the learning trials. However, because there were no significant differences between the HR groups, thus our discussion of specific qualitative differences is speculative and must be confirmed by future research (Glahn et al., 2006). Consistent with Zilles et al (2009), our data suggest that individuals susceptible to psychosis have a similar dysfunction as the patients (albeit milder), in that they do not optimally spontaneously organize information to be remembered.

Memory and Executive functions

The memory processes tested with the ROCF and MS tasks, involve the executive ability to spontaneously employ strategies in order to remember information. Thus, consistent with Maziade et al (2009) a shared weakness involving initiation and planning, could be an expression of that organizational deficit that affect both the visual and verbal memory domains. However, we did not find a direct impact of covarying attention and executive functions (based on the auditory CPT) on the memory performance, suggesting that these processes did not additionally impair memory. Overall, in agreement with Tremont et al (2000) the data support the idea that both HR memory performances are influenced primarily by aspects of organizational difficulties.

Psychopathology

Both HR groups presented increased levels of psychopathology compared to CC. The relation between clinical symptoms and cognitive profiles in first-degree relatives and in young HR subjects of schizophrenia probands has not been well investigated (Jabben et al., 2010). In one study that co-varied psychopathology, delayed visual recall organization and most of the verbal memory performances were still distinguishable between groups, showing that cognitive deficits between HRs and CCs were not explained by psychopathology (de la Serna et al., 2010). In our study, the SCL-Paranoid subscale was the only measure that correlated significantly (though weakly) with some cognitive performances in HR-SCZ. The weak relationship between memory performance and psychopathology, and the failure of psychopathological measures to attenuate the significant impairments in HR groups, suggests that neurocognitive deficits and psychopathology in HR populations are largely independent traits.

Auditory CPT

We did not address CPT performance *per se* between groups in this paper because it is reported elsewhere (Seidman et al., 2012b). Here we used these measures to demonstrate that the organizational disorder across visual and verbal memory is attributable neither to vigilance nor to working memory. Thus, the absence of a significant attenuation of statistical significance suggests the memory deficit is robust.

Limitations of the study

The main limitation of this study is the small sample size of the HR-AFF group, which reduces statistical power. Indeed, the 2 HR samples show similar memory performances, even though only the HR-SCZ group shows a statistically significant difference from the control group on some memory measures. Thus, the power limitations might account for the findings in which statistically significant differences between HR-AFF and CC were not found.

Non-linear effects of age on memory performance over the developmental age range of the subjects could also represent a shortcoming. However, no significant age by diagnosis interactions were found. Some age differences between groups were found, so we covaried age systematically in all analyses.

An additional limitation concerns the diagnostic heterogeneity of the HR-AFF sample, which comprises individuals at HR for BD (n=18) and for MDD (n=6). We decided to combine these groups, considering them as different expressions of the same vulnerability, based on literature indicating a positive history of affective illness was associated with BP disorder and vice-versa (Bearden et al., 2006). Nevertheless, we cannot be certain that they have identical cognitive risk profiles, and moreover, the small number of subjects at risk for MDD clearly limits evaluating this issue in the current study.

Conclusion

Consistent with McIntosh et al (2005), our findings support the position that alterations in memory functioning are more related to a general increased liability for psychosis rather than to a specific diagnostic category. Both HR groups presented verbal and visual memory impairment, likely related to subtle organization deficits that are substantially independent from attention measures and from current psychopathology. The ESs were consistent (d= 0.50-0.60) with prior work on memory dysfunction in young FHR-SCZ samples (Agnew-Blais and Seidman, 2012).

Future longitudinal studies with larger sample sizes are necessary to demonstrate more rigorously the nature of impairments that have come to light in the present study, and to see if these memory differences are predictive of subsequent psychosis. The present study supports the hypothesis that young HR relatives of persons with schizophrenia and affective disorders show impaired memory functioning that is not explained by illness-related clinical effects. Furthermore, our findings support the notion that memory dysfunction in affective psychosis can also be identified during the prepsychotic phase, and that at least some of its features may overlap clinically and neurocognitively with schizophrenia vulnerability.

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Table 1
Sample Demographics of Youth at Familial Risk for Schizophrenia or Affective Psychoses and Community Controls

	Groups					Statistics (one way ANOVA)	Post-hoc Statistics			
	0 CC		1 HR-SCZ		2 HR-AFF		0 vs 1	0 vs 2	1 vs 2	
	N	M (SD)	N	M (SD)			p	p	p	
Age	54	17.0 (3.6)	41	19.4 (3.8)	24	18.6 (3.6)	F= 5.12 (<.01)	<.01	.17	.72
Education	54	10.8 (3.2)	41	11.4 (2.7)	24	11.4 (3.2)	F=0.54 (.58)	-	-	-
Parental SES	54	47.9(15.5)	38	38.4 (16.5)	19	39.8 (18.2)	F=4.23 (.02)	.02	.16	.95
WRAT-R Reading	53	106.9(9.3)	40	102.5 (10.3)	24	99.9 (14.8)	F=3.86 (.02)	.14	.03	.63
Caucasian (N/%)	54	34 (63.0)	41	24 (58.5)	24	20 (83.3)	$\chi^2=4.41$ (.11)	-	-	-
Male (N/%)	54	24.0 (44.4)	41	20 (48.8)	24	9 (37.5)	$\chi^2=0.78$ (.67)	-	-	-

0=CC= Community Controls, 1=HR-SCZ = High Risk for Schizophrenia, 2=HR-AFF = High Risk for Affective Psychosis

ANOVA = Analysis of Variance for continuous variables, Chi-Square for categorical variables

Parental SES – parents' social economic status (Hollingshead, 1975)

WRAT-3 = Wide Range Achievement Test – Three (Wilkinson, 1993)

Post-hoc statistics: Tukey HSD

Bolded p values: significant results at $p < .05$

Visual and Verbal Memory Performance in Youth at Familial Risk for Schizophrenia or Affective Psychoses and Community Controls

Table 2

Memory test	Groups			Statistics Adjusted for Age	Post-hoc Statistics and Effect Sizes on adjusted Scores for Statistically Significant ANCOVA's					
	CC 0 N=52 ROCF, N= 54 MS	HRSCZ 1 N=41 ROCF, N= 38 MS	HRAFF 2 N=22 ROCF, N= 18 MS		0 vs 1		0 vs 2		1 vs 2	
	M (SD)	M (SD)	M (SD)	F (p')	p	d	p	d	p	d
ROCF										
TCPY	64.3 (1.7)	63.7 (2.4)	63.8 (2.8)	0.68 (.500)	-	-	-	-	-	-
OCY	11.0 (2.5)	10.6 (3.0)	9.5 (3.5)	2.25 (.110)	-	-	-	-	-	-
TRCL	52.1 (9.8)	49.1 (10.2)	50.9 (9.7)	0.92 (.403)	-	-	-	-	-	-
ORCL	9.7 (3.5)	8.7 (4.0)	8.2 (3.9)	3.77 (.026)	.06	.26	.08	.40	1.00	.13
TDLY	53.2 (9.2)	50.1 (10.7)	50.3 (9.8)	1.26 (.286)	-	-	-	-	-	-
ODLY	10.4 (3.0)	8.5 (3.6)	8.7 (3.5)	6.01 (.003)	<.01	.58	.07	.52	1.00	.06
MS	M (SD)	M (SD)	M (SD)							
TOT1	8.9 (2.4)	7.6 (2.4)	7.8 (2.3)	4.71 (.011)	.01	.54	.14	.47	1.00	.08
TOT2	8.4 (1.9)	7.4 (2.4)	8.1 (1.8)	5.05 (.008)	<.01	.46	.83	.16	.36	.33
TOT3	12.4 (3.0)	11.4 (3.4)	10.1 (3.0)	4.55 (.012)	.30	.31	.01	.74	.40	.41
TOT4	12.9 (3.5)	11.6 (4.1)	10.9 (4.6)	2.43 (.093)	-	-	-	-	-	-
TOTS	42.6 (8.2)	38.0 (9.8)	37.1 (9.8)	5.35 (.006)	.02	.51	.03	.62	1.00	.09

d= effect size (Cohen, 1988), Bolded p values represent significant results Post-hoc statistics: Bonferroni

0=CC = Community Controls, 1=HR-SCZ = High Risk for Schizophrenia, 2=HR-AFF = High Risk for Affective Psychosis.

Rey-Osterreith Complex Figure measures. TCPY: total accuracy of the copy; OCPY: organization of the copy; TRCL: immediate recall total accuracy; ORCL: immediate recall organization; TDLY: delayed recall total accuracy; ODLY: delayed recall organization.

Miller-Selfridge measures. TOT1: words correctly recalled on the list 1; TOT2: words correctly recalled on the list 2; TOT3: words correctly recalled on the list 3; TOT4: words correctly recalled on the list 4; TOTS: total recall score (sum of lists 1, 2, 3, 4).

Table 3

Measures of Current Psychopathology Using the Hopkins Symptom Checklist-Revised (SCL-90-R) in Youth at Familial Risk for Schizophrenia or Affective Psychoses and Community Controls

SCL-90R Dimensions	Groups			Statistics Adjusted for Age	Post-hoc Statistics on adjusted Scores		
	CC 0	HR-SCZ 1	HR-AFF 2	ANCOVA	0 vs 1	0 vs 2	1 vs 2
	M (SD)	M (SD)	M (SD)	F (p)	p	p	p
Somatization	45.0 (10.5)	48.4 (13.9)	48.3 (12.2)	0.32 (.730)	-	-	-
Obsessive-Compulsive	43.5 (9.6)	49.9 (14.2)	53.2 (11.9)	3.49 (.034)	.606	.031	.370
Interpersonal Sensitivity	41.6 (9.4)	48.1 (13.9)	48.3 (12.6)	1.43 (.245)	-	-	-
Depression	43.3 (9.5)	50.4 (13.7)	47.3 (10.9)	1.42 (.247)	-	-	-
Anxiety	42.1 (8.2)	48.1 (13.5)	49.5 (11.6)	2.76 (.067)	-	-	-
Hostility	44.5 (9.2)	49.9 (12.7)	48.9 (9.2)	0.88 (.416)	-	-	-
Phobic anxiety	45.2 (7.4)	49.8 (11.2)	52.8 (9.7)	4.00 (.021)	.290	.002	.532
Paranoid Ideation	43.1 (8.9)	49.2 (13.7)	49.1 (10.9)	2.03 (.136)	-	-	-
Psychoticism	41.5 (7.9)	49.8 (13.2)	46.7 (11.1)	3.12 (.048)	.046	.631	1.00
Global Severity Index (GSI)	40.6 (11.3)	45.7 (14.6)	48.3 (12.9)	1.45 (.238)	-	-	-
Positive Symptom Distress Index (PSDI)	46.3 (11.2)	49.0 (12.1)	49.1 (12.5)	0.13 (.874)	-	-	-
Positive Symptom Total (PST)	40.3 (11.7)	46.6 (15.2)	47.7 (13.3)	1.29 (.277)	-	-	-

0=CC= Community Controls, 1=HR-SCZ = High Risk for Schizophrenia, 2=HR-AFF = High Risk for Affective Psychosis

SCL-90. Symptom Checklist-90-R (Derogatis, 1993).

Note: means and sd are unadjusted, raw scores. *p* values based on ANCOVAs

Bolded *p* values: significant results, Post-hoc statistics: Bonferroni corrected