Cognitive Features of High-Functioning Adults with Autism and Schizophrenia Spectrum Disorders

Öykü MANÇE ÇALIŞIR[1], Eşref Cem ATBAŞOĞLU[2], Halise DEVRİMCİ ÖZGÜVEN[3], Şenay ÖLMEZ[4]

SUMMARY

Objective: Autism Spectrum Disorder (ASD) and schizophrenia share common features in terms of pathophysiology and clinical appearance. Cognitive deficits are also present in both disorders. However, ASD and schizophrenia are heterogeneous syndromes, and few studies have addressed patients with these disorders who have above average educational attainment. In this study, we assessed the cognitive functions of a group of adult ASD patients with adequate mental development and verbal communication skills (High Functioning Autism, HFA) and compared them with a group of Schizophrenia patients matched for level of education.

Method: Three groups of patients and controls [(HFA, n= 32), Schizophrenia (n= 17), Controls (n= 23)], all with at least a high school education, were assessed with the Wechsler Adult Intelligence Scale (WAIS), Wisconsin Card Sorting Test (WCST), and Rey Auditory Verbal Learning Test (RAVLT). For the assessment of HFA, scores on the Autism Spectrum Disorders in Adults Screening Questionnaire were taken into consideration. Clinical diagnoses were based on DSM-IV TR and DSM-5 criteria.

Results: High Functioning Autism and Schizophrenia groups performed similarly in all subtests except for WAIS Comprehension and Digit Symbol, WCST Perseveration, and RAVLT Learning.

Conclusion: Comprehension abilities of educated adults with HFA could be higher than average in situations that do not involve social interaction. Tendency to perseveration in the presence of adequate concept formation ability may reflect the clinical symptoms of rigidity and repetitive behavior. In patients with higher levels of functioning and education, their diagnosis appears to be weakly associated with cognitive functioning. The potential roles of other variables, such as environmental factors, during development deserve further exploration in future studies.

Keywords: Autism, autism spectrum disorder, cognition, schizophrenia.

INTRODUCTION

Autism spectrum disorder (ASD) is defined as a neurodevelopmental disorder that is characterized by restricted, repetitive patterns of behavior, interests, or activities, and persistent deficits in social communication and social interaction across contexts (American Psychiatric Association 2013). The definition of ASD in the Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) corresponds to those in the DSM-IV (American Psychiatric Association 1994) and DSM-IV-TR Pervasive Developmental Disorders (PDD's), which designates three of the five PDD's as Autistic disorder (AD), Asperger's disorder (AS), and Pervasive Developmental Disorder - Not Otherwise Specified (PDD-NOS). ASD affects about 1% of the population with a male to female ratio of 4 to 1 (Geschwind 2009).

Autism spectrum disorder displays heterogeneity among individuals in terms of symptom severity, cognitive profile, and adaptive capacity. Cognitive functioning ranges from above average to intellectual disability (ID). Symptoms are apparent

Received: 06.02.2017- **Accepted:** 02.05.2017

[1]M.D, Ankara University Brain Research Center, Ankara University, Faculty of Educational Sciences, Department of Psychological Services in Education, Psychological Counseling and Guidance Unit. Ankara, [2], [3]M.D., [4]M.A., Ankara University School of Medicine, Department of Psychiatry, Ankara, Turkey.

e-mail: *ocalisir@education.ankara.edu.tr*

in the first years of life, although individuals with ASD may come to the clinician's attention later in life, depending on symptom severity, adaptive capacity, cultural norms for expected social functioning, and degree of social support (American Psychiatric Association 2013).

Schizophrenia is a chronic disorder characterized by psychosis, including delusions and hallucinations, disorganized speech and behavior, and negative symptoms (i.e., poverty of thought, diminished interest, motivation and sociality, impairment in initiating and maintaining goal-directed behavior, and restricted affect) (Andreasen 1984; American Psychiatric Association 2013). Its onset is typically in adolescence or early adulthood. Symptoms, course, and treatment response vary across individuals (van Os and Kapur 2009).

Schizophrenia and ASD share several clinical features. This similarity is particularly apparent when ASD is diagnosed in a verbal adult, in which symptoms tend to be mild and atypical compared to those diagnosed with autistic disorder in childhood (Dykens et al. 1991). Deficits in language pragmatics in patients ASD may appear similar to the impairments in goal-directed speech and loose associations observed in schizophrenia and defined as disorganization symptoms. Stereotypical and overinclusive speech, and the idiosyncratic use of language have been described for both disorders (Solomon et al 2008). The spectrum of disorganized behavior in schizophrenia ranges from mildly bizarre social communication to grossly inappropriate behavior, which is similar to the wide range of social communication deficits typical for ASD (Konstantareas and Hewitt 2001).

ASD patients often have restricted, repetitive patterns of behavior, circumscribed or perseverative interests, resistance to change, and insistence on sameness, which are traits comparable to the negative and disorganized symptoms of schizophrenia.

Cognitive impairments typically observed in schizophrenia range from mild to moderate severity, and include deficits in vigilance (sustained attention), working memory, verbal learning, and executive functions corresponding to group differences of 1.5-2 standard deviations below the mean in age-matched controls (Saykin et al 1991, Mohamed et al 1999).

In schizophrenia, relatively mild cognitive deficits including many functions have been shown, (Mohamed ve ark. 1999) and there is little study on the characteristics of schizophrenia patients with higher cognitive functions. There is no consensus on the nature and severity of cognitive deficits in the Autism Spectrum Disorder with no Mental Developmental Disorder (IQ above 70). Furthermore, a limited number of studies have reported that some schizophrenia patients are intellectually superior and have an atypical cognitive profile (MacCabe et al 2012, Heinrichs et al 2008, Heinrichs 2001). Comparison of specific, as well as general, cognitive abilities in schizophrenia and ASD or PDD have revealed controversial findings. Inconsistency across studies may be the result of different methods of case ascertainment and of cognitive assessment. Furthermore, both disorders are heterogenous, and there is a need for studies comparing the ASD or PDD groups and schizophrenia groups with sufficient / high cognitive functions,

Goldstein et al. (2002) compared cognition in high functioning autism (HFA) and schizophrenia using the WAIS-R. They included HFA patients with a full IQ of at least 70, and divided the schizophrenia group into 4 subgroups based on a cluster analysis. High functioning autism was characterized by a worse performance in Comprehension, but a better performance in Block Design compared to three of the four schizophrenia subgroups. The authors concluded that a profile of worse abstract verbal judgement and better visuospatial ability in comparison to schizophrenia could be prototypical of HFA. In another study, Bölte et al (2002) found that the combined subtest scores of the WAIS-R or WISC-R accurately discriminated HFA from schizophrenia in young adults and adolescents, although the mean full IQ was almost the same (about 83) in both groups. However, the differences in the individual subtest scores were not statistically significant; the highest contribution in the discriminant analysis came from Similarities and Comprehension subtests, with the former better in the HFA group, and the latter better in those with schizophrenia.

In their comparison of patients with schizophrenia and verbal adults with ASD, Eack et al (2013) found that processing speed, attention, problem-solving, and memory were impaired with similar differences compared to controls. However, a recent study by Boer et al (2014) reported no group difference between schizophrenia and autism on any subtest of the WAIS-III. The only significant difference was on the Processing Speed Factor (which includes Digit Symbol Coding and Symbol Search), where the schizophrenia group performed worse compared to those with autism or controls.

Mentalizing deficits are common to both ASD and schizophrenia. Theory of mind (ToM, or mentalizing) is a complex manifestation of many higher cortical functions, among which executive functioning (EF) is central. This umbrella term comprises a number of interrelated abilities, such as cognitive flexibility, planning, inhibitory control, attention shifting, monitoring, generativity, and working memory.

Although mentalizing deficits are characteristics of ASD, inconsistent results in the literature make it hard to claim that any dysfunction in executive functions is prototypical of autism. In addition, no particular subtype of executive dysfunction is unique to ASD, as almost all types of executive dysfunction have been reported in other neuropsychiatric disorders (Lai et al 2014).

In schizophrenia, there is ample evidence to a moderate group difference in terms of a general level of EF as well as many components of this general ability as compared to nonclinical samples. EF in schizophrenia has been studied with various patient groups, using tasks with a wide range of difficulty levels (Atbasoglu et al 2005). In ASD, however, many of these detailed studies were conducted with children, and evidence of a group difference from typically developed nonclinical controls in adults is not as well supported as in schizophrenia. On the Wisconsin Card Sorting Test (WCST), autistic children had a higher number of perseverative responses compared to typically developing non-clinical groups matched for IQ and age (Rumsey 1985, Ozonoff and McEvoy 1994).

Although cognitive deficits have previously been studied in schizophrenia and ASD, the heterogeneity of both disorders necessitates the study of subsets with varying levels of global intellectual and social functioning.

Therefore, the first aim of this study was to identify patterns of cognitive deficits in high-functioning individuals whose global intellectual functioning was within or above the norm for age and culture. In this study, the cognitive functions of patients with Schizophrenia and ASD who completed high school and were similar in terms of socioeconomic status were compared, and their relations with clinical characteristics were assessed. Within the scope of cognitive evaluation, we aimed to evaluate working memory, attention, perseveration, visual spatial processing, construction, reasoning, and verbal judgment. Specifically, we sought to investigate whether similarities in the clinical presentation and overlap in the genetic vulnerability pattern of the two disorders extended to cognitive functioning in selected subgroups that were equally functional and intellectually advantaged. We hypothesized that the pattern of cognitive abilities in the two clinical groups would reflect a high level of functioning, and would minimize the differentiation in cognitive features typically expected from the clinical diagnoses.

METHOD

Participants

We compared cognitive functioning in our cohorts of schizophrenia and ASD, excluding patients with an educational attainment of less than 12 years. The cut-off corresponds to at least one year of higher (i.e., undergraduate) education following high school. Acceptance to an undergraduate program is based on one's performance on a standardized test designed to measure both the level of information and cognitive abilities of high school graduates. Our aim in using this criterion was to rely on real-life performance in terms of general intelligence, rather than resorting to statistical correction with a full IQ score for the potential effect of education. As of the year 2000, the level of educational attainment in the region in which this study was conducted is 7.43 years of schooling (Tomul 2011). Therefore, the inclusion of at least one year at a university is a reliable indicator of at least average global intellectual functioning.

The schizophrenia group was comprised of individuals from another one of our studies on cognition in the early phase of schizophrenia, which included 40 consecutive patients in the first 5 years of illness, and 60 controls recruited through a newspaper advertisement (Atbasoglu et al 2003, Atbasoglu et al 2005). The control group was assessed to exclude major psychotic DSM-IV TR Axis I disorders as well as mental retardation or any other major neurological disorder. Although specific screening for a PDD was not performed, we relied in this analysis on our previous assessments, and assumed that we would have detected any PDD in the screening phase. All individuals in the PDD cohort were reassessed clinically for the DSM-5 diagnosis of ASD, and all of them fulfilled the ASD diagnostic criteria.

Of these individuals, 17 patients with schizophrenia and 23 controls met the inclusion criterion for education. In this report, the control sample will be referred to as "the typically developed nonclinical" group (tDnC), referring to the absence of both ASD and schizophrenia. As detailed in our previous reports (Atbasoglu et al 2003, Atbasoglu et al 2005), the control group was recruited through newspaper advertisements in 2002, and all of the controls were screened before enrollment to exclude major psychiatric disorders and mental retardation by two of the authors of this report.

In this study, the ASD group included 32 patients who were initially diagnosed with Asperger Disorder (n= 12) or PDD-NOS (n= 20). The duration of follow-up ranged between 1 and 17 years (mean= 4±3.46, median= 3). The mean educational attainment in the ASD group was 16.13 years (sd: 2.64), while in the schizophrenia group it was 13.41 years (sd: 1.12), and in the typically developed non-clinical groups was 14.13 (sd: 1.14) years (Table I). All cases were assessed in detail throughout their follow-up with a pedigree as well as additional information on the pedigree and clinical history from a family member, and physical examination when necessary. None of the ASD diagnoses were secondary, i.e., due to another medical condition known to manifest with ASD, such as Fragile X syndrome or premutation, VCFS, Angelman syndrome, etc.

Participants in this study had no history of any other central nervous system disorder, mental retardation, substance use disorder, or head injury.

This study was ethically approved by the Ankara University Ethics Committee. Informed consent was obtained from all individual participants included in the study.

MATERIALS

Clinical symptom severity was assessed for schizophrenia patients with the Scale for the Assessment of Negative Symptoms (SANS, Andreasen 1983, Erkoc et al 1991) and the Scale for the Assessment of Positive Symptoms (SAPS, Andreasen 1984, Erkoc et al. 1991), while ASD patients were assessed with the Autism Spectrum Quotient (AQ, Baron-Cohen et al 2001, Kose et al 2010) and The Autism Spectrum Disorder in Adults Screening Questionnaire (ASDASQ, Nylander and Gilberg 2001). In addition, the ASD group was also assessed with the Reading the Mind in the Eyes Test (Baron-Cohen et al. 2001,Yıldırım et al 2011) as a valid indicator of social communication ability.

In order to confirm the level of functioning for all patients at the time of cognitive assessment, we used scores from the Social and Occupational Functioning Scale (SOFAS), a standard measure of functioning that is independent from symptom severity (Morosini et al 2000).

The neuropsychological battery included the subtests of the Wechsler Adult Intelligence Scale (WAIS; Wechsler 1955), the subtests of the Wisconsin Card Sorting Test (WCST; Heaton et al 1981, Karakas et al 1998) and the delayed recall, immediate memory, and learning subtests of the Rey Auditory Verbal Learning Test (RAVLT; Rey 1964, Genc-Acikgoz and Karakas, 1996).

WAIS is effectively used for neuropsychological evaluations other than IQ assessment. In our current study, the most commonly used sub-tests for neuropsychological assessment were chosen from the WAIS subtests (Öktem 1994). The subtests Vocabulary, Object Assembly, Picture Completion, and Picture Arrangement were not included.

Literature suggests that the subtest scores of Digit Symbol (working memory, attention), Arithmetic (working memory, qualitative reasoning), and Block Design (visuospatial processing, problem solving, configuration) are relatively sensitive to differences in cognitive functioning (Russell et al 2000, Senturk et al 2007). These subscales correspond to psychomotor speed, working memory, and visuospatial abilities, respectively (Bilder et al 1985).

Index scores of individual WAIS subscales were used for group comparisons, which were prioritized for the evaluation of working memory (Digit Symbol, Arithmetic), perceptual organization and configuration (Block Design), and verbal reasoning and abstract thinking skills (Similarities, Comprehension).

The WCST was used for the assessment of executive functions. Verbal memory functions were assessed with the RAVLT, and included 1) Immediate Memory, 2) Delayed Recall, and 3) Learning.

To assess attention deficiency problems during childhood, The Wender Utah Rating Scale (Ward et al 1993) was used, and to check the symptoms related to Attention deficit /hyperactivity disorder, the Adult ADHD Self-Rating Scale (ASRS) was given to the ASD group. (Kessler et al 2007, Doğan et al 2009).

Procedure

Written informed consent was obtained from all subjects. Both the schizophrenia group and the typically developed non-clinical group had already been assessed for previous research.

Statistical Analyses

After groups were matched for education level, preliminary analyses were done for normality, homogeneity, and linearity. Because the data was not normally distributed, non-parametric tests were applied. Descriptive statistics, Kruskal Wallis tests, and Mann Whitney U tests were conducted in SPSS Version 20.

For the patient groups, bivariate correlations of the Social and Occupational Functioning Assessment Scale (SOFAS, Morosini et al. 2000) scores with all available cognitive tests scores were analyzed.

In order to explore potentially selective cognitive strengths and weaknesses in each group, individual test scores were compared with the mean of the standardized scores on the remaining tests in the battery. Bonferroni correction for multiple testing was applied by modifying the acceptable p value to 0.05.

RESULTS

Subtests of WAIS

The overall difference among groups was significant for the WAIS subtests of Digit-Symbol [$H(2)= 17.68$ $p=.000$] and *Comprehension* [$H(2) = 12.67$ $p= .002$] (Table 2). Pairwise comparisons were corrected for multiple testing by setting the significance threshold at 0.017. These comparisons revealed that on the Comprehension subtest, the tDnC and ASD group performances were similar, and both were better than that of the schizophrenia group. On the Digit Symbol subtest, all pairwise differences were significant; the tDnC group performed best, followed by the ASD group (Table 2).

Within-group Comparisons for the WAIS subtests

In order to examine the relative strengths and weaknesses within each group, performance within groups was compared for each WAIS subtest with the mean of the remaining 6 subtests. The results are summarized in Table 3.

Tabel 1. Demographic and Clinical Characteristics

	ASD (n=32)			Schizophrenia (n=17)			Typically developed nonclinical group (n= 23)			
Gender (M/F)	**17/15**			**8/9**			**13/10**			**H(2) = .349 p= .840***
	mean	**Sd**	**range**	**mean**	**Sd**	**range**	**mean**	**Sd**	**range**	
Age	33.88	9.38	22-58	24.59	3.20	20-33	27.39	4.09	21-34	H(2) = 15.57p<.001*
Duration of education (years)	16.13	2.64	13-22	13.41	1.12	12-15	14.13	1.14	12-15	H(2) = 20.14 p< 0.001*
Mother's duration of education (years)	12.89	3.96	5-22	9.18	4.42	5-17	9.22	3.66	0-15	H(2) = 11.59 p=.003*
Psychosis (SAPS)	-	-	-	15.35	13.73	0-40	-	-	-	-
Disorganization (SAPS)	-	-	-	4.59	7.31	0-24	-	-	-	-
Negative symptoms (SANS)				45.35	18.54	7-72	-	-	-	-
The Autism Spectrum Quotient	26.15	5.73	9-37	-	-	-	-	-	-	-
ASDASQ	7.33	1.24	5-9	-	-	-	-	-	-	-
Reading the Mind in the Eyes	24.17	3.19	18-31	-	-	-	-	-	-	-
Social and occupational functioning	54.84	12.79	30-80	41.62	13.99	25-71	-	-	-	U=108.000 p=.012 **

SAPS: Scale for the Assessment of Positive Symptoms, SANS: Scale for the Assessment of Negative Symptoms
ASDASQ: The Autism Spectrum Disorder in Adults Screening Questionnaire
* Kruskal Wallis Test
** Mann- Whitney U Test

Table 2. Group performances and statistical comparisons for sub-tests of the WAIS

	ASD mean ± SD median range	**Schizophrenia mean ± SD median range**	**Typically developed nonclinical group mean ± SD median range**	**Analysis**
Information	13.38 ± 2.23 13 7-17	13.76±2.49 13 10-18	13.87±2.12 14 9-17	H(2) = 1.09 p= .580*
Arithmetic	11.66 ± 3.59 12 4-17	9.76 ± 2.49 10 5-16	11.70 ± 2.80 12 7-17	H(2)= 5.08 p=.079
Similarities	13.16 ± 2.85 13 7-17	12.88 ± 2.09 13 10-18	14.04 ± 1.99 14 10-17	H(2) =2.865 p=.239
Digit Span	10.56 ± 3.17 10 6-19	9.29 ± 2.89 10 6-16	10.17 ± 2.57 11 6-16	H(2) =1.484 p= .476
Comprehension‡	12.63 ± 3.24 13 4-18	9.47 ± 3.15 9 5-18	13.17± 3.20 14 8-19	H(2) = 12.67 p= .002 U= 123.500 p= .002 ASD – Schz** U=338.500 p= .613 ASD - tDnC U= 79.000 p= .001 tDnC - Schz
Block Design	10.25 ± 2.95 10.5 4-17	8.29 ± 3.20 8 3-14	10.09±2.23 11 5-14	H(2)= 4.534 p= .104*
Digit-symbol ‡	9.84 ± 2.46 10 6-17	8±2.24 8 4-14	11.52 ± 2.57 12 8-17	H(2)= 17.68 p<.001 U=146.500 p=.008** ASD – Schz U= 229.500 p= .017 ASD – tDnC U= 54.00 p<.001 tDnC –Schz

ASD: Autism Spectrum Disorder, Schz: Schizophrenia, tDnC: Typically developed, nonclinical
* Kruskal Wallis Test
** Mann- Whitney U Test
‡p<.01

Table 3. Comparison of Individual Subtest Scores with the Mean of the Remaining Subtests on the WAIS

WAIS sub-tests	ASD patients t(df=31)	p	95% of Confidence Interval of the difference	
			Lower	Upper
Information	-.308	.760	-.3199	.2359
Arithmetic	-1.66	.107	-.6729	.0694
Similarities	657	.516	-.3924	.7653
Digit Span	-1.69	.102	-.7505	.0712
Comprehension	.138	.891	-.2823	.3234
Block Design	-1.06	.297	-.5648	.1784
Digit-symbol	4.58	<.001	.3714	.9678
WAIS sub-tests	**Schizophrenia patients t(df= 16)**	**p**	**95% of Confidence Interval of the difference**	
			Lower	**Lower**
Information	-4.042	.001	-1.2432	-.3878
Arithmetic	-.658	.520	-.5245	.2760
Similarities	-.969	.347	-.7288	.2715
Digit Span	-1.165	.261	-.9701	.2822
Comprehension	2.761	.014	.1262	.9605
Block Design	.347	.733	-.4588	.6385
Digit-symbol	3.733	.002	.3799	1.3786
WAIS sub-tests	**Typically developed nonclinical group t(df=22)**	**p**	**95% of Confidence Interval of the difference**	
			Lower	**Lower**
Information	-.455	.654	-.4829	.3092
Arithmetic	-.785	.441	-.4038	.1820
Similarities	-.768	.451	-.4681	.2152
Digit Span	.271	.789	-.2779	.3615
Comprehension	.186	.854	-.3649	.4368
Block Design	.490	.629	-.2742	.4439
Digit-symbol	.809	.427	-.2526	.5759

The ASD group had significantly worse performance on the D*igit-Symbol* subtest as compared to the mean performance on the rest of the subtests. The schizophrenia group performed significantly worse on the comprehension as well as digit symbol subtests, but performed better on the Information subtests as compared to the rest of the 6 subtests. The tDnC group had similar performance in all subtests across the whole WAIS.

WCST

On the WCST, the overall difference was significant between groups for the number of categories completed (WCST 4) [H(2)= 8.98 p= .011], perseverative errors (WCST 6) [H(2)=9.49 p=.009], and trials to complete the first category (WCST 9) [H(2)= 29.71 p= .000]. There was no significant difference among the groups in *number of total correct scores* and *number of total non-perseverative errors*.

Follow up pairwise comparisons indicated that individuals with ASD were significantly different from both the schizophrenia group (U= 107.000 p=.003 for ASD vs. Schz) and the typically developed non-clinical group (U= 53.000 p<.001), with lower performance in the *trials to complete 1st category* sub-score.

Only the schizophrenia group was significantly different from the control group in both the *categories completed* sub-score (U=101.000 p=.004 for tDnC vs Schz) and the *number of total perseverative error* sub-score (U= 77.000 p= .004 for tDnC vs Schz). Individuals with ASD showed no significant difference from the schizophrenia group or the non-clinic control group (Table 4) in these categories.

Verbal Memory

On the RAVLT, immediate memory and delayed recall were similar, while the learning subscore differed significantly across groups. All three pairwise comparisons indicated significant differences, with the highest performance in the ASD group, and the lowest performance in the Schizophrenia group (Table 4).

Correlation Analyses

In the schizophrenia group, there was no significant correlation between the SANS, SAPS, and WAIS sub-tests. In the schizophrenia and ASD groups, there were no correlations between the subtests of the WAIS and SOFAS.

Seventeen adults with ASD were also diagnosed with Attention deficit hyperactivity disorder (ADHD). In the Wender Utah Rating Scale, the mean ASD group total score

Table 4. Group performances and statistical comparisons for the WCST and verbal memory

	ASD mean ± SD median range	Schizophrenia mean ± SD median range	Typically developed nonclinical group mean ± SD median range	
WCST 2	23.84±17.76	44.07±29.12	17.52±10.76	H(2)=9.35 p=.009*
Total Incorrect Number‡	17	39	14	U=134.500 p=.022 ASD – Schz**
	7-69	4-95	7-45	U= 284.500 p= .207 ASD - tDnC
				U= 76.500 p= .004 tDnC –Schz
WCST 3	69.77±8.62	68.00±18.22	70.04±10.39	H(2)=.12 p=.940
Total Correct Scores	67	68	66	
	59-91	33-114	58-91	
WCST 4	5.48±.1.15	4.40±2.03	5.87±.46	H(2)= 8.98 p= .011
Categories Completed ‡	6	6	6	U= 164.500 p=.044 ASD-Schz
	2-6	0-6	4-6	U=314.500 p=.234 ASD- tDnC
				U=101.000 p=.004 tDnC -Schz
WCST 5	14.97 ±12.93	32.53 ±25.61	12.13±9.11	H(2)= 7.28 p= 0.26
Perseverative response number ‡	10	36	8	U=142.000 p=.034 ASD- Schz
	5-50	2-81	4-40	U= 297.500 p= .300 ASD - tDnC
				U= 89.500 p=.013 tDnC - Schz
WCST 6	12.77±10.82	25.93±20.92	8.57±5.39	H(2)=9.49 p=.009
Total perseverative error ‡	8	21	7	U=142.500 p=.034 ASD-Schz
	4-41	2-68	4-26	U= 266.500 p=.113 ASD - tDnC
				U= 77.000 p= .004 tDnC - Schz
WCST 7	10.87±7.49	20.60±22.94	8.96±6.53	H(2)=2.95 p=.229*
Total non-perseverative error	9	16	7	
	2-28	1-90	3-26	
WCST 9	19.35±16.82	16.20±32.78	3.48±5.30	H(2)= 29.71 p= .000
Trials to complete 1st category ‡	12	3	1	U= 107.000 p=.003 ASD-Schz
	10-76	0-128	1-22	U= 53.000 p< .001 ASD- tDnC
				U= 124. 000 p= .131 tDnC - Schz
RAVLT	7.74±1.88	7.33±2.77	6.65± 2.64	H(2)= 2.33 p=.312
Immediate memory	8	7	7	
	5-12	2-13	2-13	
RAVLT	11.26±2.07	9.80 ± 2.93	11.09 ± 1.88	H(2)= 2.74 p=.255
Delayed recall	11	10	11	
	7-15	2-14	7-15	
RAVLT	13.77 ± 1.71	11.93 ± 1.83	13.13±1.58	H(2)= 14.00 p=.001
Learning ‡	14	12	14	U= 103.500 p=.000 ASD-Schz
	10-15	8-14	10-15	U= 263.000 p=.062 ASD- tDnC
				U= 122.000 p=.041 tDnC - Schz

ASD: Autism Spectrum Disorder, Schz: Schizophrenia, tDnC: Typically developed, nonclinical
* Kruskal Wallis Test
** Mann- Whitney U Test
‡p<.05

was 40.37 (median: 43), and 16 patients were over the cut-off score for the Wender Utah. In the ASRS, the mean ASD group score was 38.35 (median: 39.50), and 23 patients were over the cut-off score. No significant correlation was found between the subtests of the WAIS and ASRS in the ASD group. For the Wender Utah Rating Scale scores, the only significant correlation in the subtests of WAIS were found in the Digit symbol subtest (r= -.402, p<.0.05).

DISCUSSION

This study aimed to identify patterns of cognitive deficits in individuals with ASD and to compare adult patients with schizophrenia or ASD in terms of cognitive functioning differences that might have implications in understanding and managing the clinical presentations of these disorders.

According to the general intellectual functioning results, the ASD and schizophrenia patient groups had similar performances in most of the sub-tests of the WAIS (Information, Arithmetic, Similarities, Digit Span, Block Design). The only differences between the schizophrenia and ASD groups appeared in the *comprehension* and *digit-symbol* subtests. For all three groups, the critical difference was in the *digit symbol* subtest.

In terms of WCST, the *categories completed* sub-score, the *perseveration error* sub-score, and the *complete 1st category* sub-score were significantly different among the groups. The only

significant difference between the ASD and schizophrenia groups appeared in the *learning sub-score of the RAVLT*.

The hierarchic distribution of the 3 groups in terms of psychomotor speed (as measured by the digit symbol sub-test) suggests that the cognitive deficit in the ASD group has a peculiar profile, with circumscribed deficits in one aspect, and typical or better than average cognitive functioning in other areas. When the age effect for each group was controlled with correlation analysis, there was no significant correlation found for the *information* subtest (similar for whole groups) or *the digit-symbol sub-test* (different for whole groups).

In the digit symbol subtest, high functioning individuals with ASD were more successful than the schizophrenia patients, but their performances were worse than those of the typically developed non-clinical group. The literature presents contradictory findings on the digit symbol subtest (Boer et al 2014, Eack et al 2013). It appears that those with neurodevelopmental disorders at different levels have difficulty in pairing symbols with numbers. It would be resulted from set shifting disability of these patients. It is not possible to claim that ASD patients having problems pairing symbols with numbers was independent from attention problems. In the current study, 53% of the ASD patients had an ADHD diagnosis. In the ASD group, half of the patients had scores above the cutoff for the Wender Utah, and more than half of the patients had scores above the cutoff from the ASRS. Although there was no correlation between ASRS and any WAIS subtest, the Wender Utah scores were significantly correlated with only the digit symbol subtest.The decreased mean score of the ASD group could be due to the poor performances of the patients who also had ADHD in the group. On the other hand, we have no information on the attention difficulties of the schizophrenia group or the control group. Therefore, it is not possible to say whether slowness in speed of processing could be related with the cognitive disturbance of neurodevelopmental disorders. In addition, the digit symbol subtest may trigger the obsessional checking tendency of patients with neurodevelopmental disorders. In this case, performance may be slowed due to obsession.

In the comprehension subtest, the ASD group had higher performance than the schizophrenia group. This is surprising, as this result is different from the common findings in the literature (Asarnow et al 1987, Prior and Ozonoff 1998; cited in Bölte et al 2002). This difference could be due to the fact that the groups were matched in terms of education level (12 years and more). This also might be the indirect consequence of a compensatory effort in the ASD group, as patients with ASD are known to be impaired in social cognition with varying levels. Adaptive capacity is one of the most heterogeneous aspects in the heterogeneous ASD groups. Adaptive capacity might be uniformly better in the high functioning groups, arguably explaining their defining feature, that being "having relatively better social and occupational functioning." The subtest comprehension includes questions that 1) present either abstract reasoning with little relevance to social communication, 2) present little novelty that would require flexibility in problem solving, or 3) rely heavily on putting into use semantic information regarding the social codes. (i.e., those that referred to well taught and repeatedly practiced social codes). The comprehension subtest probably is also less of a challenge in that it requires little use of language pragmatics and expressive ability. Subjects receive full scores if they report the expected solution to the problem presented, and their accuracy in linguistic expression is not considered in scoring. In addition, impairment in language use may appear mostly in the context of social relations, and may not be evident in interaction based only on knowledge (Asarnow et al 1987).

In terms of executive functions, patients with schizophrenia showed lower performance in perseveration error scores, which is in line with the literature findings. No significant differences were found between the ASD group and the schizophrenia group in terms of both the perseveration error subscore and the categories completed sub-score. Interestingly, individuals with ASD had significantly higher scores than both the schizophrenia patients and the typically developed non-clinical group in *trials to complete first category*. This could be the result of the repetition tendency of autistic individuals. Although they understand the category pattern, disturbances in cognitive flexibility may affect their test performance. It is not possible to say that this finding is result of attention deficiency, because no significant correlation was found between ASRS and Wender Utah Scores with any category scores of the WCST. On the other hand, it may be a result of the similar difficulties of the ASD group with the Digit symbol subtest.

On the RAVLT, high functioning individuals with ASD were significantly better at the learning sub-test than the schizophrenia group, but not the control group. This may be due to the manifestation of a higher capacity for rote memory, which is evident in some high functioning individuals with ASD. Some authors have suggested that high functioning ASD patients have more efficient semantic strategies, which can serve as an explanation of this capacity (Öktem 1994).

The education level of the sample group is quite important when assessing cognitive functions. The performance of highly educated patients could be differentiated from patients with low education, mainly due to the amount of information learned during the school years. In Turkey, the education system is challenging, especially lessons related to mathematics and arithmetic, which are not easy and have comprehensive content. For example, in this study, matched education level of the groups made patients have similar performances in arithmetic sub-test with control.It is important to cautiously evaluate the results of studies on adults with high functioning

autism. Since it is quite critical to select an appropriately matched group with the ASD patients when assessing executive functions. According to matched sample, it would be overestimation or underestimation of any other the abilities of the autistic group. For instance, it is generally accepted that individuals with autism will show high performance in visual-spatial nonverbal tests and low performance in verbal ability. When younger or older comparison typically developed non-clinical group are assessed with autistic group in the tasks, inconsistent results may appear, and the interpretation of the autistic patients' performance may change (Russo et al 2007). This comment also would be valid for our study because of age mean difference of between the groups. Therefore, future studies should take into account a matching criterion of the groups.

Recently, there have been several new studies on individuals diagnosed with ASD in adulthood. Their cognitive performances would be quite different from patients diagnosed with autism in childhood. Their performances may be better because they went through learning process to overcome difficulties since childhood, or their performances may be worse due to misdiagnosis / multi-diagnosis/ and /or high comorbidity with other disorders.

Lai et al (2014) indicated that the cultural effect on autism needs to be studied in addition to the education effect. This study needs to be performed, as it would be important to show whether the cognitive profile of neurodevelopmental disorders in Turkish culture is similar among cultures throughout the world.

Our current study was conducted with the aim of comparing the cognitive skills of the groups by repeating the same cognitive evaluations in all three groups. However, this caused some limitations in our methods. First, the cognitive battery was applied to the HFA group within the scope of our previous study. Therefore, we were not able to evaluate other cognitive domains that have not been adequately studied in the ASD literature and this situation limited the possibility of comparison in the broader sense. Another limitation is the low sample size. The lack of comparative studies on adults with high functioning autism inhibits the ability to create a sample by performing a power analysis.

However, this study is important as preliminary work, bringing notice to the cognitive differences among the groups. We hope that other centers will see this study, and that it will encourage them to conduct research on HFA and schizophrenia in adulthood. In addition, it is rarely seen in the literature that a single team from the same center performs a comparison study by working with both adult patients with high-functioning autism and schizophrenia. In future studies, it is emphasized that other neurodevelopmental disorders that overlap with schizophrenia and ASD should also be studied (Stone et al 2011).

Lastly, it should be noted that it is not enough to discriminate between multidimensional and heterogeneous disorders, such as schizophrenia and ASD, with only a behavioral assessment. These are multi-factorial disorders, and therefore, future studies should evaluate neuropsychological results with findings in genetics (endophenotypes) and neuroscience (neuroimaging, pharmacology, anatomy, etc.).

REFERENCES

American Psychiatric Association (1994) DSM-IV - Diagnostic and Statistical Manual of Mental Disorders – 4th Ed. American Psychiatric Association, Washington DC.

American Psychiatric Association (2000) DSM-IV – TR Diagnostic and Statistical Manual of Mental Disorders – 4th Ed. American Psychiatric Association, Washington DC.

American Psychiatric Association (2013) DSM-V - Diagnostic and Statistical Manual of Mental Disorders – 4th Ed. American Psychiatric Association, Washington DC.

Andreasen NC (1983) The Scale for the Assessment of Negative Symptoms (SANS). Iowa City, Iowa, University of Iowa.

Andreasen NC (1984) The Scale for the Assessment of Positive Symptoms (SAPS). Iowa City, Iowa, University of Iowa.

Asarnow RF, Tanguay PE, Bott L et al (1987) Patterns of intellectual functioning in non-retarded autistic and schizophrenic children. J Child Psychol Psychiatry 28:273-80.

Atbasoglu, E.C., Ozguven, H.D., Olmez, S (2003) Dissociation between Inattentiveness during Mental Status Testing and Social Inattentiveness in the Scale for the assessment of Negative Symptoms Attention Subscale. Psychopathology, 36:263-68.

Atbasoglu, E.C., Ozguven, H.D., Saka, M.C., Olmez, S (2005) Relative sparing of executive functions in the early phase of schizophrenia. J Neuropsychiatry Clin Neuroscience 17510-6.

Baron-Cohen S, Wheelwright S, Skinner R et al (2001) The Autism Spectrum Quotient (AQ): Evidence from Asperger Syndrome/high functioning autism, males and females, scientists and mathematicians. Journal of Autism and Developmental Disorders 31:5-17.

Baron-Cohen S, Wheelwright S, Hill J et al (2001) Reading the Mind in the Eyes" Test revised version: a study with normal adults, and adults with Asperger's syndrome or high functioning autism. J Child Psychol Psychiatry 42:241-51.

Bilder RM, Mukherjee S, Rieder RO et al (1985) Symptomatic and neuropsychological components of defect states. Schizophr Bull. 11:409-19.

Boer De M, Spek AA, Lobbesteal J (2014) Comparing cognitive functioning in schizophrenia and autism using WAIS-III. Research in Autism Spectrum Disorders 8:737-45.

Bölte S, Rudolf L, Fritz P (2002) The cognitive structure of higher functioning autism and schizophrenia: A comparative study. Comp Psychiatry 43:325-30.

Doğan S, Öncü B, Varol- Saraçoğlu G et al (2009) Erişkin Dikkat Eksikliği Hiperaktivite Bozukluğu Kendi Bildirim Ölçeği (ASRS-v1.1): Türkçe formunun geçerlilik ve güvenilirliği. Anadolu Psikiyatri Dergisi 10:77-87.

Dykens E, Volkmar F, Glick M (1991) Thought disorder in high-functioning autistic adults. Journal of Autism and Developmental Disorders 21:291-301.

Eack SM, Bahorik AL, McKnight SA et al (2013) Commonalities in social and non-social cognitive impairments in adults with autism spectrum disorder and schizophrenia. Schizoph Res 148:24-8.

Erkoç Ş, Arkonaç O, Ataklı C et al (1991) Negatif semptomlan değerlendirme ölçeğinin güvenilirliği ve geçerliliği. Düşünen Adam 4: 16-19.

Erkoç Ş, Arkonaç O, Ataklı C et al (1991) Pozitif semptomları değerlendirme ölçeğinin güvenilirliği ve geçerliliği. Düşünen Adam 4:20-4.

Genç-Açıkgöz D, Karakaş, S (1996) AVLT'nin Türk dilineuyarlanmasına ilişkin bir çalışma. IX. Ulusal Psikiyatri Kongresi Türk Psikologlar Derneği, İstanbul: Boğaziçi Üniversitesi Psikoloji Bölümü.

Geschwind DH (2009) Advances in autism. Annu Rev Med 60:367-80.

Goldstein G, Minshew NJ, Allen DN et al(2002) High-functioning autism and schizophrenia: a comparison of an early and late onset neurodevelopmental disorder. Arch Clin Neuropsychol 17:461-75.

Heaton RK (1981) A manual for the Wisconsin Card Sorting Test.Florida Psychological Assessment Resources Inc.

Heinrichs RW (2001) In Search of Madness: Schizophrenia and Neuroscience. New York: Oxford University Press.

Heinrichs RW, Miles AA, Smith D et al(2008) Cognitive, clinical, and functional characteristics of verbally superior schizophrenia patients. Neuropsychology 22(3):321-328. Karakaş S, Irak M, Ersezgin ÖU (1998) Wisconsin Kart Eşleme Testi (WCST) ve Stroop Testi TBAG formu puanlarının test içi ve testler-arası ilişkileri X. Ulusal Psikoloji Kongresi özet kitabı 44.

Konstantareas MM,Hewitt T (2001) Autistic disorder and schizophrenia: diagnostic overlaps. J Autism Dev Disord 31:19-28.

Köse S, Bora E, Erermiş, S et al (2010) Otizm-Spektrum Anketi Türkçe formunun psikometrik özellikleri. Anadolu Psikiyatri Dergisi 11:253-60.

Kessler RC, Adler LA, Gruber MJ et al (2007) Validity of the World Health Organization Adult ADHD Self-Report Scale (ASRS) Screener in a representative sample of health plan members. Int J Methods Psychiatr Res 16:52-65.

Lai MC, Lombardo MV, Baron-Cohen S (2014) Autism. Lancet 383: 896-910.

MacCabe JH, Brébion G, Reichenberg A et al (2012) Superior intellectual ability in schizophrenia: neuropsychological characteristics. Neuropsychology 26:181-90.

Mohamed S, Paulsen JS, O'Leary D et al (1999) Generalized cognitive deficits in schizophrenia. Arch Gen Psychiatry 56:749-54.

Morosini PL, Magliano L, Brambilla, L et al (2000) Development, reliability and acceptability of a new version of the DSM-IV Social and Occupational Functioning Assessment Scale (SOFAS) to assess routine social functioning. Acta Psychiatr Scand 101:323-9.

Nylander L, Gilberg C (2001) Screening for autism spectrum disorders in adult psychiatric out-patients: a preliminary report. Acta Psychiatr Scand 103:428-34.

Ozonoff S, McEvoy RE (1994) A longitudinal study of executive function and theory of mind development in autism. Development and Psychopathology 6:415–32.

Öktem Ö (1994) Nöropsikolojik testler ve Nöropsikolojik Değerlendirme. Türk Psikoloji Dergisi özel sayı 9:33-44.

Öncü, B, Ölmez Ş, Şentürk, V (2005) Wender-Utah Derecelendirme Ölçeği Türkçe formunun erişkin Dikkat Eksikliği Ve Hiperaktivite Bozukluğu'nda geçerlik ve güvenilirlik çalışması. Türk Psikiyatri Dergisi 16:252-9.

Rey A (1964) L'examen clinique en psychologie [The clinical exam in psychology] Paris, Presses Universitaires de France.

Rumsey JM (1985) Conceptual problem solving ability in highly verbal, nonretarded autistic men. Journal of Autism and Developmental Disorders 15:23–36.

Russell AJ, Munro J, Jones PB et al (2000) The National Adult Reading Test as a measure of premorbid IQ in schizophrenia. Br J Clin Psychol 39:297–305.

Russo N, Flanagan T, Iarocci G et al (2007) Deconstructing executive deficits among persons with autism: implications for cognitive neuroscience. Brain Cogn 65:77-86.

Saykin AJ, Gur RC, Gur RE et al (1991) Neuropsychological function in schizophrenia. Selective impairment in memory and learning. Arch Gen Psychiatry 48:618-24.

Senturk V, Goker C, Bilgic, A et al (2007) Impaired verbal memory and otherwise spared cognition in remitted bipolar patients on monotherapy with lithium or valproate. Bipolar Disord 9:136-44.

Solomon M, Ozonoff, S, Carter C et al (2008) Formal Thought Disorder and the Autism Spectrum: Relationship with Symptoms, Executive Control, and Anxiety. J Autism Dev Disord 38:1474.

Stone WS, Iguchi, L (2011) Do Apparent Overlaps between Schizophrenia and Autistic Spectrum Disorders Reflect Superficial Similarities or Etiological Commonalities? N Am J Med Sci 4:124–33.

Tomul E (2011) Educational Inequality in Turkey: An Evaluation by Gini Index. Education and Science 36:133-43.

Van Os J, Kapur, S (2009) Schizophrenia. Lancet 374:635-45.

Ward MF, Wender PH, Reimherr FW (1993) The Wender Utah Rating Scale: An aid in the retrospective diagnosis of childhood Attention Deficit Hyperactivity Disorder. Am J Psych 50:885-90.

Wechsler D (1955) Wechsler adult intelligence scale manual New York: The psychological corporation.

Yıldırım EA, Kasar M, Güdük M et al (2011) Gözlerden Zihin Okuma Testinin Türkçe Güvenirlik Çalışması. Türk Psikiyatri Dergisi 22:177-86.