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A comparative profile analysis of neuropsychological functioning in patients with schizophrenia and bipolar and normal group based on stroop test and Benetton visual retention test

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ABSTRACT

The relation between brain and mind is quite evident. Neuropsychological instruments have made considerable contributions in evaluating cognitive functions among healthy individuals and those patients suffering from psychiatric and brain syndromes. In this research, Stroop and Benton neuropsychological assessments have been used. Stroop test is a common test to assess executive functions, selective attention and concentration. In that test, the subject should state the color of words which have been written in various colors without consideration of their meanings. The test is also used to assess frontal lobe. Benton test is used to assess visual memory, visual perception and visual organization capability. Qualitative interpretation of the results of this test provides useful information concerning the type and possible location of brain lesion in those who are suspected to brain lesion. In the present research, performances of people with schizophrenia, bipolar patients and ordinary people have been compared by the aforesaid two tests. One of the scientific goals of this research is to compare visual memory, cognitive memory and fundamental capabilities as well as the function of frontal lobe in schizophrenia and bipolar patients and ordinary people. One of the practical goals of this research is that by using Stroop and Benton neuropsychological tests, we can better understand the function and severity of cognitive defects in schizophrenia and bipolar patients and ordinary people and we can use the obtained findings in treating schizophrenia and bipolar patients. By using this research, we will know the exact place of brain lesions and traumatic brain injuries. Research findings will lead us to better treatment of schizophrenia and bipolar patients. Statistical methods in this research are of post-event (causal-comparative) type. Available cluster sampling method has been selected by which 30 schizophrenia patients, 30 bipolar patients and 30 ordinary people were selected and their performances were compared by using Benton and Stroop tests. Results in this research indicate that performance of schizophrenia and bipolar patients in Benton and Stroop tests did not differ significantly; however, it was significantly different from ordinary people. Results of the present research indicate that schizophrenia and bipolar patients have defective frontal lobe. In this way, although schizophrenia and bipolar disorders are two separate issues in psychiatry, they can be closed in neuroanatomical, neurochemical and psychopharmacological levels. The results of studies conducted in abroad in this regard conform to the results obtained in this research. In this research, performances of schizophrenia and bipolar patients did not differ so much and were close, but the performances of the two groups in the two tests were significantly different from the performance of ordinary people.

Keyword: neuropsychological functioning, schizophrenia, bipolar, stroop test, Benetton visual retention test

INTRODUCTION

One of the symptoms of schizophrenia is multiple deficits in cognitive processes including genetics, attention, and reaction time in these patients, which might increase their vulnerability to this disorder due to genetic factors (Filbey et al, 2008). In addition, there is evidence suggests cognitive problems and sustainable attention deficits in patients suffering from bipolar mood disorder. However, it has been reported that cognitive impairments are more severe in schizophrenia patients compared to bipolar mood disorder patients (Malouf et al, 2010). Attention is a complicated concept considered as one of the initial stages of information processing and cognition. It refers to components such as concentration, vigilance, response inhibition to irrelevant stimuli, or selective attention, and shift in attention. Attention is one of the most important neurocognitive deficits reported in patients suffering from mental disorders, especially schizophrenic and bipolar patients (Current et al, 1996). In general, it seems that schizophrenic patients are unable to concentrate selectively on important aspects of sensory inputs (Pourafkari, 2006). Additionally, another cognitive impairment in schizophrenic patients is reaction time so that Nikpour et al (2008) found that schizophrenic patients spend much time in responding to light and sound stimuli compared to normal people. According to studies conducted in this regard, it seems that the key problem in schizophrenic patients is inability to ignore irrelevant stimuli. We can concentrate selectively in most of the case and select the stimulus relevant to our task among large volume of sensory information that we receive and ignore other stimuli. A schizophrenic patient seemingly cannot ignore irrelevant or extraneous stimuli or detect the relevant data among the inputs. In addition, these patients might realize that their actions are adaptive leading to reduced concentration on stimuli and increased delay in reaction time (Wolwer et al, 2005). Additionally, researchers have reported evidence on neuropsychological deficits such as disorder in attention and memory in patients with mood disorders (Jones et al., 2001; Van Gorp et al., 1998). Some researchers have proposed impairment in neurological functions, while others have proposed sustained impairment in cognitive functions during the acute phase of bipolar disorder (Clark et al., 2002; Cavanagh Vhmcran, 2002). Distractibility and impaired concentration are also seen commonly in patients with bipolar disorder that might be associated with problems in psychomotor rate, learning, memory, and cognitive function (Bearden et al., 2001).

On the other hand, increasingly development of neuropsychology tests has enhanced the role of these tests in diagnosing, determining the location, and severity of vulnerability, patient care, treatment planning, and research objectives (Biglar and Stymne, 1981, Mazuky, 1979, and Vayzebri, quoted by Lezak 1995). These studies were conducted to distinguish responses of patients to neuropsychology tests (Frangv et al., 2006). By indirect inferring of brain dysfunction, complexity of brain dysfunction is determined based on functional disorders and behavioral manifestations through cognitive and neuropsychology tests (Liddell and Morris 1991).

The cause of cognitive dysfunctions in schizophrenic and bipolar patients is lack of cognitive disorders treatment by neuroleptic drugs and psychiatric treatments. Lack of treatment of these disorders indicates specific characteristics in these patients that have been closely investigated so far. For this reason, assessment and treatment of cognitive processes are extremely important (Fink, Konun, 1996, quoted by Michel Vegrin 2006). Additionally, considering the relationship between cognitive function and quality of life, correlation between cognitive deficits and poor performance, and knowing type of correlation, we can investigate the cognitive deficits in these patients using psychological interventions to help them improve their life quality and create considerable changes in their rehabilitation styles, especially cognitive rehabilitation (Diwadkar et al, 20110).

Therefore, we aim to investigate cognitive deficits (reduced selective attention and increased reaction time) in schizophrenic and bipolar patients and compare them with normal people using neuropsychology tests such as Benetton and Stroop tests.

MATERIALS AND METHODS

Population and sample of study: This is a causal-comparative study and its population includes female schizophrenic and bipolar patients of Tehran psychiatric hospitals and healthy female people. Among the all of psychiatric hospitals in Tehran that we had the complete list of them, Razi psychiatric hospital was selected Randomly as sample, and subjects selected using available Cluster sampling method and they were voluntarily included in the study after the psychiatrist's clinical interview with them. Sample of study included 90 people, which 30 patients had schizophrenia, 30 of them had bipolar disorder, and 30 of them were healthy people as a control group. It is obvious that subjects must meet certain criteria to be included in the study. Inclusion criteria of the study included knowing Persian language, schizophrenia and bipolar diagnosis and non-diagnosis of mental disorders in healthy subjects,

and willingness to participate in research. The tests used in this study included the color words test of Stroop and visual-motor tests of Benton. Stroop is one of the well-known and highly efficient tests to assess executive function, selective attention, and concentration. In its standard form, color words (such as yellow, red, green, and blue) are written other than their (for example the word blue is written in red color). Subject is asked to ignore reading the word and to state the color of the word printed. Stroop test is a common test to evaluate executive functions, selective attention, and concentration.

This test is also used to assess the performance of the frontal lobe. Benton retention test is a visual test that its primary is to evaluate cognitive status of the individuals. Additionally, it is used to screen people in order to detect brain impairments. Benton test is a clinical and research tool developed to assess visual perception, visual memory, and basic visual abilities. There are three parallel forms of this test. Each form contains 10 cards and each card includes one or more geometric shape. Time required to implement each form is 5 minutes. This test is scored using two methods of counting the correct reconstitutions or counting the number of errors. The following processes are involved in Benton test: 1. visual perceptual, motor coordination, perceptual-motor integration.

RESULTS

First, we investigate the demographic characteristics of the sample of study. Table 1 shows the demographic characteristics including age, education, and handedness,

Table 1- Descriptive statistics of the sample

	gender	n	Living place	handedness	mean		SD	
					age	education	age	education
control group	female	30	Tehran	Right-handed	07/25	12/4	5/96	1/40
Schizophrenic group	female	30	Tehran	Right-handed	32/63	8/77	7/69	1/92
Bipolar group	female	30	Tehran	Right-handed	30/87	11/53	7/01	2/48

Then, results of hypotheses testing are presented.

The main first hypothesis: there is difference between the distribution of selective attention and working memory (reaction time - the number of errors) scores in the Stroop test in three schizophrenic, bipolar, and control (healthy) groups.

Three sub-hypotheses emerged from the main hypothesis as follows:

Sub-hypothesis 1-1:

There is difference between the distribution of selective attention and working memory (reaction time - the number of errors) scores in the Stroop test in control and schizophrenic groups. Results of "U Mann Whitney" and "Wilcoxon" tests are shown in Tables 2 and 3.

Table 2: Results obtained by comparing schizophrenic and control groups in three Stroop (reaction time) states

Test	Coordinated state	non-coordinated state	Neutralized state
U Mann Whitney	44/5	26	12
Wilcoxon	509/5	491	477/5
Z	-5/99	-6/27	-6/47
Significance	0/000	0/000	0/000

Table 3: results of the comparison of schizophrenic and control groups in the number of errors - Stroop test

Test	Coordinated state	non-coordinated state	Neutralized state
U Mann Whitney	120	0/000	0/000
Wilcoxon	585/000	465	465
Z	-5/651	-6/711	-6/783
Significance	0/000	0/000	0/000

As seen in the above tables, there is significant difference between schizophrenic and control groups in terms of response time and the number of errors. In other words, attention and working memory are significantly different in the two groups.

Hypothesis 2-1: There is significant difference distribution of scores of selective attention and working memory (reaction time - the number of errors) in bipolar and the control groups. The results of "U Mann Whitney" and "Wilcoxon" tests are shown in Tables 4 and 5 below.

Table 4: Comparison of reaction time in bipolar group and control group (Stroop test)

Test	Coordinated state	non-coordinated state	Neutralized state
U Mann Whitney	134.5	53.5	71.5
Wilcoxon	499.5	581.5	583.5
Z	-6.245	- 5.76	-4.91
Significance	0/000	0/000	0/000

Table 5: Comparison of error in the bipolar group and control group (Stroop test)

Test	Coordinated state	non-coordinated state	Neutralized state
U Mann Whitney	146	102	315
Wilcoxon	471	567	770
Z	-4.93	-5.22	-3.31
Significance	0/000	0/000	0/000

Hypothesis 3-1: there is difference between distribution of scores in selective attention and working memory (reaction time - the number of errors) in bipolar and schizophrenic groups. The results of "U Mann Whitney" and "Wilcoxon" tests are shown in Tables 6 and 7.

Table 6: comparing reaction time in schizophrenic and bipolar groups (Stroop test)

Test	Coordinated state	non-coordinated state	Neutralized state
U Mann Whitney	398	321	304
Wilcoxon	5863	786	796
Z	-7/69	-1/9	-2/152
Significance	0/442	0/056	0/31

Table 7: Comparison of the number of errors in schizophrenic and bipolar groups (Stroop)

Test	Coordinated state	non-coordinated state	Neutralized state
U Mann Whitney	265/5	266/5	166/5
Wilcoxon	721/5	731/5	631/5
Z	-3/04	-2/71	-4/19
Significance	0/002	0/007	0/000

Based on the results of above tables, schizophrenic and bipolar patients are not significantly different in terms of reaction time. In other words, selective attention performance in these two groups is not different, but there is difference between two groups in terms of working memory estimated by number of errors. This difference is remarkable in coordinated and neutralized states in the Stroop test.

Second main hypothesis

There is difference between distribution of visual memory scores (number of errors) in the Benton test in three schizophrenic, bipolar and control groups. Sub-hypotheses derived from the above hypothesis are as follows:

Sub-hypotheses 2-1:

There is difference between distribution of visual memory scores (number of errors) in Benton test in schizophrenic group and the control groups.

Table 8: Comparison of error in the Benton test between schizophrenic and control groups

Test	Benton test
U Mann Whitney	51
Wilcoxon	5/6
Z	-5/92
Significance	0/000

Based on the results presented in Table 8, there is significant difference between schizophrenic patients and normal subjects in terms of visual memory

Sub-hypothesis2-2:

There is difference between distribution of visual memory (number of errors) in Benton test in schizophrenic group and the control groups. Results of comparison with non-parametric tests are shown in Table 9.

Table 9- error comparison in Benton test between bipolar and control groups

test	Benton error
U Mann Whitney	59/5
Wilcoxon	524/5
Z	-5/79
Significance	0/000

Based on the results listed in Table 9, visual memory of bipolar patients and healthy individuals differ significantly. Hypothesis 2-3:

There is difference between Benton visual memory scores (number of errors) in schizophrenic and bipolar groups. Table 8 shows the results of comparison between the two groups.

Table 10: Comparison of error in Benton test between schizophrenic and bipolar groups

Test	Benton error
U Mann Whitney	365/5
Wilcoxon	830/5
Z	-1/25
Significance	0/211

Based on the results listed in Table 10, schizophrenic visual memory is not different in bipolar patients and healthy individuals. In other words, while error rate in Benton test is different between two groups, but this difference is not statistically significant.

DISCUSSION AND CONCLUSION

In this section, research hypotheses are presented and their findings are explained. Confirmation of two sub-hypotheses derived from the main hypothesis means that there is significant difference between schizophrenia patients and normal individuals in terms of attention and working memory. This finding is consistent with recent results obtained by using Stroop test and Benton tests on schizophrenic patients (Barch and Carter, 2004). The results of the review as well as assumptions made by Cohen et al (1997) are consistent. In addition, results obtained from these hypotheses are consistent with results of Cohen et al (1997). In most of studies conducted in recent years, schizophrenic patients compared to normal individuals show deficits in cognitive processes that lead to reduced performance compared to ordinary people (Macler and Shar, 1998).

Selective attention deficit in schizophrenia patients is generally caused by malfunction of control or inhibition, resulting from damage to the frontal lobe or dysfunction of this lobe, since lateral-medial frontal lobe is involved in spatial recognition and perception of features such as color and it is effective in executive function (Shar, 1998). Anabel and Martinez et al. (2005) investigated the relationship between neuropsychological functions and cerebral blood flow in bipolar patients. They reported that there is relationship between cerebral blood flow in the frontal, complex core, singular and parietal and occipital areas respectively performances of performing the command, memory, attention, verbal learning, and general intelligence. Kroeber et al (2004) found that bipolar patients have cognitive neurological damages during their disease. They also found that impaired attention, memory working, learning, verbal and nonverbal information, and verbal-mental information depend on factors examined by neuropsychological tests.

Additionally, many studies have been conducted to compare performance of schizophrenia and manic patients such as studies conducted by Morris (1990) and Goldberg et al (1993). They found that perceptual memory, perceptual span, and attention shift functions in patients with schizophrenia are different compared to manic patients. At the same time, both manic and schizophrenic patients had more distraction compared to control group, but this difference was not significant. Schizophrenia patients gained lower score compared to mood disorder patients in attention shift and psychomotor activities (Goldberg, 1993).

One considerable finding in recent research suggests that both bipolar patients, schizophrenia patients have more deficits in working memory and attention compared to normal subjects. This finding could explain that prefrontal cortex receives both adrenergic inputs and dopaminergic inputs. According to psychiatry and psychopharmacology literature, mesocortical pathway is discussed in describing negative symptoms of schizophrenia and endpoint of dopaminergic fibers in the frontal area is approximate to endpoint of adrenergic neurons arriving to this area from lateral tegmental area (Stoll, 2001).

Current studies suggest that patients with bipolar and schizophrenia experience dysfunction in executive functions, working memory and attention (Johnson et al., 2007). Cognitive symptoms in schizophrenia are considered an important factor in predicting this disease, since continued psychosis exaggerates negative and cognitive symptoms (Grant, 1998).

Researcher of this study found significant difference between patients with schizophrenia and bipolar in terms of attention and working memory. Comparing cognitive functions of patients with schizophrenia and mania could be an answer to the question of whether cognitive dysfunction is special for mania or it is due to general pathology, such as psychosis. Review of neurological research in bipolar disorder shows that differences in attention and memory in patients with schizophrenia and mania have been observed in a few studies. However, in most studies in terms of performance in cognitive tests (such as selective attention and perceptual span), it is impossible to distinguish deficit in mania with that in schizophrenia (Murphy and Sahakyan, 2001).

Another important issue confirming these findings is that 5-hydroxytryptamine or serotonin has been considered important not only in aetiology of mood disorders including bipolar disorder, but also in schizophrenia.

The second hypothesis of this study, which is divided into three sub-hypotheses, examined possible differences between schizophrenic and bipolar patients with normal individuals. The test used to examine the hypotheses was derived from second hypothesis of Benton visual memory. According to the research conducted, Benton test scores in impaired brain people were lower than that in normal people (Lyasaker et al., 2004). However, unlike the Stroop test used in large number of studies on schizophrenic and bipolar population, Benton test has not been used widely in this regard. In this study, results suggest that there are differences between schizophrenia and bipolar groups compared with normal individuals significantly. However, the difference is not significant in comparing schizophrenic and bipolar groups. Bender was one of those who reported basic disorders in visual-motor area in schizophrenic patients. He examined schizophrenic patients by his well-known test that is very similar to Benton test. One of recent studies that its finding is consistent with result of this study is a study conducted by Nickels who found no significant difference between performance of bipolar and schizophrenic patients using Benton test. Results obtained in this section are in line with new findings in this area. Abayashi et al (2003) found that mentality of patients with schizophrenia displayed specific pattern of visual behavior in each card, while ordinary people use single pattern in this regard. Moduza et al (2008) conducted an interesting study in Russia on paranoid schizophrenia in acute phase and after completion of treatment of Benton test and they found a significant difference in performance of these patients before and after the treatment. Getz et al (2003) examined deficits in recognition of affective states in bipolar patients and they found significant differences in performance of bipolar patients with normal individuals in Benton test. Additionally, Cleary and Scott (2007) found disorder in the right hemisphere function and visual memory and attention problems in bipolar patients using Benton test. The above-mentioned results are in line with results of two sub-hypotheses derived from the second hypothesis of this study. It means that schizophrenia and bipolar patients differ significantly with normal individuals in Benton test, while the difference between the two groups is not significant. One of the reasons for the non-significant difference in the performance observed in Benton test is that disorder in right hemisphere function and visual memory and attention problems have been reported in both schizophrenic and bipolar patients (Scott, 2007). Using the Stroop and Benton tests, Brokufska et al (2002) found similarities in bipolar and schizophrenic patients and justified that frontal lobe is involved in both of these patients. Right hemisphere dysfunction in both of these patients has been also reported in a study conducted by Kuchareska et al (2004).

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