

Personality Traits of Frontal Lobe-Damaged Patients before and After Injury

Patria E. Sembrana¹, Rosalito G. de Guzman²

¹National Center for Mental Health; ²University of Santo Tomas, Manila, PHILIPPINES.

¹reaesembrana@yahoo.com, ²rosalitodeguzman@yahoo.com

ABSTRACT

This study is conducted following a new direction in the University of Santo Tomas Graduate School researches in the field of neuropsychology. As basic research, it aimed to determine the personality traits of 30 Filipino patients with frontal lobe damage before and after brain injury. It employed case study which uses qualitative and quantitative data to establish the pre-and-post injury personality traits of the participants with frontal lobe damage. Qualitative data were derived from MRI findings and life history interview with the participants and significant others focusing on the pre-morbid and current personality functioning of the participants. Quantitative evidence was obtained from the administration of neuropsychological tests namely Frontal System Behavior Scale and Neuropsychological Behavior and Affect Profile. Findings showed that majority of the frontal lobe-damaged participants possessed these pre-injury personality traits: low in apathy, disinhibition, executive dysfunctions, indifference and mania but high in inappropriateness, pragnosia and depression. After the frontal injury and neurosurgery, they remained low in apathy, disinhibition, executive dysfunctions, indifference and mania, and lowered in inappropriateness, pragnosia and depression.

Keywords: neuropsychology; frontal lobe damage; brain injury; pre-injury personality traits; post- injury personality traits

INTRODUCTION

Today, neurologists, neuropsychologists and other allied professionals are continually involved in studying the frontal lobes the “Senior Executive” of the brain and personality (Joseph, 1999)- its functions and processes, effects of the damage on the functioning of the brain injured survivors and the intervention techniques. This assists the survivors in their social adaptation following the injury as well as provides information to their immediate families to understand the effects of the injury in their personalities and social interaction.

Frontal lobes modulate and shape character, personality and other functions such as engaging in decision-making, goal formation, direct attention, maintain concentration, and in information storage and memory retrieval (Joseph, 1999; Kirshner, 2002). Functional frontal lobes are demonstrated by various aspects of behavior making up one’s personality or defining one as an individual and not cognitive per se (Risser, 2002). It is suggested by one’s ability to adapt to new situations and cope with stress, frustrations and conflicts; regulate one’s social behavior and manage one’s emotions; and deal with challenges and problems in daily living (Larsen & Buss, 2008).

Frontal lobes are most common region of injury following traumatic brain injury due to their large size and their location. McGee (2004) stated that frontal lobes are relatively vulnerable as they are affected in more brain disorders than any other parts of the brain and its functioning appears to have low threshold for injury or “breakdown”.

Traumatic brain injury is the most frequent cause of frontal lobe dysfunction (Kirshner, 2002) of which the undersurface of the frontal lobes is commonly injured. Although head injuries show no visible physical “scars”, there are significant changes in behavior and emotion which are often noticeable by significant others or people close to the victim (Zillmer, 2007). Rao and Lyketsos (2000) concluded that patients with traumatic brain injury are called “the walking wounded” for they appeared physically “normal” but are disabled personally, socially and occupationally.

Frontal lobe damage is a common result of moderate to severe head injury wherein deficits in psychological and psychosocial functioning are observed after injury. These are manifested in a broad range of frontal lobe disturbances which are not more on cognitive/executive deficits as inflexibility, difficulty in problem-solving or in interpreting feedback from the environment, motor changes like apraxia, abulia or motor perseveration but on emotional and personality changes (Hennings & Welter, 2008; Espay, 2008; Liporace, 2006; Kirshner, 2002; Risser, 2002, Stuss, et al., 2001; Risser, 1999; Joseph, 1999). It gives rise to clinical syndromes- impulsiveness - impairment on one’s ability to formulate plans, indifference, disinhibition, lack of guilt, distractibility; aggression; increased sensitivity to alcohol; mood disorders – depression or mania; psychiatric disorders – schizophrenia, delusional; anxiety disorder - obsessive-compulsive disorder; personality disorder - borderline and antisocial; and social and occupational disability (Risser, 2002; Fitzgerald & Demakis, 2007). The frontal lobe personality change is in mixed form, that is, a patient who is generally apathetic and indifferent may manifest irritability, impulsivity or frank outbursts at times or fluctuate unpredictably in mood – euphoric or depressed.

It has been known that frontal lobe damage significantly changed personalities (Stuss, et al., 2001). These personality changes according to Sylvia Behnish in her article “ Personality Changes following a Brain Injury in 2004, are sometimes exaggerations of the person’s pre-injury personality particularly negative traits increased by frustration and a sense of loss or complete reversal of the pre-injury personality. For instance, he was once easy-going and thoughtful but now, he is easily angered and self-absorbed or he had interpersonal problems before and now, a chaotic relationship. It could be attributed to pre-injury coping style and responses to stressful events. It does seem reasonable that there are factors within an individual’s psychological make-up which may affect reaction to the injury (Umphred, 2007) or just exaggerations of the pre-morbid functioning (Behnish, 2004).

Numerous foreign researches often deal with changes in personality as a result of brain injury in children, adolescents and adults. However, there were few attempts to establish the pre-injury personality traits and post-injury personality traits of brain –injured individuals. Furthermore, no study has been done in the Philippines. In fact, this motivated the researcher to replicate these studies in Philippine setting thus, this is a pioneering effort. The researcher is interested in looking into the personality of the Filipino patients with brain injury. It is in this view that this study is made to determine the pre-and post-injury personality traits in an adult Filipino brain-injured sample.

METHODS

Participants

Thirty Filipino adults referred by the neurosurgeon were 20 - 60 years old at the time of the first and only injury with moderate to severe damage in any of the frontal area reflected from the MRI finding and have no psychiatric/neurological illness, pre-existing physical conditions

or substance use problem. Sixty significant others are their family members and co-workers who have no psychiatric history.

Materials and Procedures

Explanatory Statement and Informed Consent Forms for Participants and their Significant Others in English/Filipino version were signed before the interview and administration of neuropsychological rating scales namely Frontal Systems Behavior Scale (Self and Family Rating Forms) and Neuropsychology Behavior and Affect Profile (Form O - participant and Form S- significant others) which was done in a single or two-day session. To establish the pre-and-post-injury personality traits of the brain-injured participants the data obtained from their interview and the results of neuropsychological examination were validated through an interview and completion of the rating scales related to their previous and current conditions by significant others.

RESULTS

Interview with the participants and their significant others

Participants maintained close ties with their families, superiors, co-workers, and community. Being in an average income bracket, financial matter is not the source of conflict. As family men, they support their wives in providing the needs, rearing and setting good examples to their children. Being members of the community, they are willing to support the community's program. They remain well-mannered, even-tempered, humble, and compassionate. Both the participants and their significant others have good remarks and strongly support each other in their endeavors, interests, and trials; and accept who they really are.

Twenty three are employed full time with commendable performance. They are hardworking, dedicated, persevering, and enthusiastic in carrying out their duties; conforming to the orders of their superiors; dynamic in leading fellow workers in civic programs; and flexible to changing schedules. In line to duty, they became less or unconcern of their health condition, pessimistic about their capacities to face work challenges, unreasonable and bad-tempered when stressed in dealing with work matters but always ready to sacrifice everything in the realization of their missions. Only seven are self-employed who tried to cope with difficulties in their daily living.

Participants and significant others affirmed that they do not have medical, psychiatric/neurological illness or substance use problem.

Neuropsychological Tests

Self-Rating

Majority of the participants manifested positive personality traits before and after the injury which support the proposition of Malec, et al. (2004) that over-all personality variables are within normal limits. In the follow-up study of Rush, et al. (2006), still personality function was normal for all groups and stable over time as fifteen participants reported no change in their personality after the injury with strong agreement with their significant others. The other fifteen had incurred positive changes in their personality functioning after the injury and neurosurgery as reflected in the low FrSBe ratings. This confirms the interpretation of Grace and Malloy of the FrSBe scales that there is a possibility to obtain lower AFTER scores than BEFORE scores, that is, there are more abnormal behavior BEFORE than AFTER. They also mentioned that the rationale for psychosurgery is to eliminate problematic behavior.

Tables 1 & 2. Frequency and Percentage of Participants and Significant others' Ratings

Frontal System Behavior Scale (N=45 - with change)	Pre-injury								Post-injury							
	Self (N=15)				Significant Others (N=30)				Self (N=15)				Significant Others (N=30)			
	Low	%	High	%	Low	%	High	%	Low	%	High	%	Low	%	High	%
Apathy	13	87	2	13	22	73	8	27	9	60	6	40	13	43	17	57
Disinhibition	15	100			26	87	4	13	10	67	5	33	21	70	9	30
Executive Dysfunctions	11	73	4	27	27	90	3	10	7	47	8	53	17	57	13	43
Total	13	87	2	13	26	87	4	13	9	60	6	40	18	60	12	40
(N=45 - without change)																
Apathy	12	80	3	20	26	87	4	13	12	80	3	20	26	87	4	13
Disinhibition	13	87	2	13	28	93	2	7	13	87	2	13	28	93	2	7
Executive Dysfunctions	10	67	5	33	26	87	4	13	10	67	5	33	26	87	4	14
Total	9	60	6	40	26	87	4	13	9	60	6	40	26	87	4	14
Neuropsychology Behavior and Affect Profile																
	Pre-injury								Post-injury							
	Self (N=30)				Significant Others (N=60)				Self (N=30)				Significant Others (N=60)			
	Low	%	High	%	Low	%	High	%	Low	%	High	%	Low	%	High	%
Inappropriateness			30	100			60	100	30	100			60	100		
Indifference	30	100			60	100			30	100			60	100		
Pragnosia			30	100			60	100	30	100			60	100		
Depression			30	100			60	100	30	100			60	100		
Mania	30	100			58	97	2	3	30	100			59	98	1	2

All of them reported no change on Indifference and Mania signifying within normal limits despite the injury proving the outcome of the study of Malec, et.al. (2004). Mania is at low level before and after the injury thus, it is not considered as another complication of brain injury as posited by McAllister and Ferrell (2002) and opposed by Joseph (1999) in which patients developed mania following trauma to the right frontal lobe. However, changes are in the 3 scales - Inappropriateness, Pragmatics and Depression with high ratings prior to injury to low after the injury. These imply that after their injury and brain surgery they are aware of what is socially appropriate as they responded appropriately to social/interpersonal cues, social rules/conduct, sensitive, respectable, modest, concern for others' evaluation and feedback. Such manifestations opposed the finding that brain-injured patients lack insight/awareness of social appropriateness or social knowledge (Bechara, 2002), failure to respond appropriately to social/interpersonal cues, rules and conduct (Milne & Grafman, 2001), unconcern for others' feedback and not embarrassed by their inappropriate behavior (Beer, et al, 2003). Participants did not experience depression with the low rating after being injured. Therefore, it does not support several studies associating depression with (Reekum, et al., 2000) or as a common complication of traumatic brain injury (Kim, et al., 2007, Silver, 2004, Jorge, et al., 2004, Rao & Lyketsos, 2002 and that depression and diminished life satisfaction are persistent problem among brain-injured survivors (Underhill, et al., 2003). Since they did not have major depressive episodes, accompanying psychotic features - hallucination and delusions are not experienced as mentioned by McAllister and Ferrell (2002) in their study with TBI patients.

Family Rating: Final effort was to validate the personality traits of the participants before and after the injury through the observation of the significant others. Seventeen (57%) significant others observed that the participants had high apathy level confirming the finding of Rao, et al. (2007) that patients who have suffered traumatic brain injury often develop apathy syndrome characterized by disinterest in daily activities, lack of future goals, poor participation in rehabilitation activities and limited ability to appreciate recovery made after brain injury. It is common across a number of disorders of the brain (van Reekum, et al., 2005) in which frontal system cognitive dysfunction is associated with apathy.

Significant others agreed on the self-rating on all scales in Neuropsychology Behavior and Affect Profile which do not confirm with what Milders, et al (2003) pointed out that the ratings on the NBAP of both patients and their significant others reflected unusual and inappropriate behavior, depression and decrease in communicative ability among head injured patients and that pre-injury behavioral problems predispose people to develop emotional and behavioral disturbances following brain injury. Further, they stressed that the patients and their significant others' ratings concerning their pre-morbid behavior which are not within the abnormal levels of behavioral problems before their injury do not hold true since only Indifference and Mania are within the normal range.

Mood disorders are not experienced based on the self-report and the evaluation of significant others contradicting the study of Reekum, et. al(2000) showing a strong association between traumatic brain injury and mood and anxiety disorders; and the findings that mood disorders are neuropsychiatric complication after traumatic brain injury (Silver, 2004; Jorge, et.al, 2004; Rao & Lyketsos, 2002; Mustafa, et.al, 2005; Jorge & Robinson, 2002; Reekum, et al, 2000; Kim, et. al, 2007).

Findings affirmed that psychopathology actually improving after neurologic insults (Grace & Malloy, 2001) as signified by low self-and-significant others' ratings in all scales after the injury suggesting that positive traits are manifested after the brain injury.

Finally, the researcher has come up with the list of the pre-and post-injury personality traits of the Filipino brain-injured participants presented in Table 3.

Table 3. Pre-injury and Post-injury Personality Traits of the Frontal Lobe Damaged Participants

<i>Self-Rating and Family Rating</i>	<i>Scales</i>	<i>Rating</i>	<i>Pre-injury Personality Traits</i>	<i>Rating</i>	<i>Post-Injury Personality Traits</i>
Frontal Systems Behavior Scale	Apathy	Low	initiative, enduring, dynamic, active, enthusiastic, persistent, concerned about self-care	Low	initiative, enduring, dynamic, active, enthusiastic, persistent, concerned about self-care
	Disinhibition	Low	calm, relaxed, even-tempered, conforming, tolerant, cautious	Low	calm, relaxed, even-tempered, conforming, tolerant, cautious
	Executive Dysfunctions	Low	attentive, organized in daily activities, flexible to changed routines, insightful about the impact of one's behavior, plan accordingly to achieve goal, good working memory, sustained performance	Low	attentive, organized in daily activities, flexible to changed routines, insightful about the impact of one's behavior, plan accordingly to achieve goal, good working memory, sustained performance
	Total	Low	no abnormalities	Low	no abnormalities
Neuropsychology Behavior and Affect Profile	Inappropriateness	High	arrogant, insensitive, tactless, careless, ill-mannered in dealings	Low	modest, sensitive, tactful, careful, well-mannered
	Indifference	Low	awareness of illness, compliant, accept disability, sensitive, responsive, alert	Low	awareness of illness, compliant, accept disability, sensitive, responsive, alert
	Pragnosia	High	bad-tempered, unreasonable, demanding, impractical	Low	even-tempered, reasonable, less demanding, practical
	Depression	High	pessimistic, unenthusiastic, hopeless	Low	optimistic, enthusiastic, hopeful
	Mania	Low	quiet, reserved, humble	Low	quiet, reserved, humble

CONCLUSIONS

It can be concluded that positive personality traits outnumbered the negative personality traits before the injury based on the participants' evaluation and significant others' observation; more positive personality traits are manifested by majority of the participants after their injury and neurosurgery; strong agreement on the self-report and significant others' observation was established; frontal lobe damaged participants are still insightful about their

personality after the injury for having similar ratings about their current condition with the significant others; and possible reasons of the positive outcome after injury are personality type, family support and training/experiences in life.

ACKNOWLEDGMENTS

My gratitude to the neurosurgeon that let me administer the research measures to his patients and their significant others, and my family for their support.

REFERENCES

- [1]. Bechara, A.(2002). The neurology of social cognition. *Brain*, 125, 1673-1675.
- [2]. Behnisch, S. (2004). Personality Changes following a Brain Injury. *Brain*, 127.
- [3]. Beer, J.S., et al. (2003). The Regulatory Function of Self-Conscious Emotion: Insights from Patients with Orbitofrontal Damage. *Journal of Personality and Social Psychology*, 85(4), 594-604.
- [4]. Bird, C.M., et al. (2004). The impact of extensive medial frontal lobe damage on 'Theory of Mind and cognition. *Brain*, 127,914-928.
- [5]. Brower, M.C., & Price, B.H.(2001). Neuropsychiatry of frontal lobe dysfunction in violent and criminal behavior. A critical review. *Journal of Neurological Neurosurgery Psychiatry*. 71(6), 720-726.
- [6]. Burmuss, J.W., et al. (2000). Functional Neuroanatomy of the Frontal Lobe Circuits. *Radiology*. 214(1), 227-230.
- [7]. Cervone, D., & Pervin, L. (2008) *Personality Theory and Research*. (10th ed.) USA: New York.
- [8]. Deb, S., & Burns, J. (2007). Neuropsychiatric consequences of traumatic brain injury: a comparison between two age groups. *Brain Injury*, 21(3), 301 – 307.
- [9]. Eslinger, P.J.(1999). Neurological and Neuropsychological Bases of Empathy. *European Neurology* 39,193-19.
- [10]. Espay, A.J.(2008). *Frontal Lobe Syndromes*
- [11]. Fitzgerald, K.L., & Demakis, G.J. (2007) The Neuropsychology of Antisocial Personality Disorder. *Disease-a-month* 53(3), 177- 183.
- [12]. Floden, D. & Stuss, D.T. (2006). Inhibitory Control is Slowed In Patients with Right Superior Medial Frontal Damage. *Journal of Cognitive Neuroscience* 18(11), 1843-1849.
- [13]. Floden, D., et al. (2008). Impulsivity and risk-taking behavior in focal frontal lobe lesions. *Neuropsychologica*, 46(1), 213-223.
- [14]. Golden, Z., & Golden, C. J. (2003). Impact of brain injury severity on personality dysfunction. *International Journal Neuroscience* 113(5), 733-745.
- [15]. Goldberg, E. (2001). *The Executive Brain: Frontal Lobes and the Civilized Mind*. New York: Oxford University Press.
- [16]. Goldstein, F.C., et al. (1999) Cognitive and Behavioral Sequelae of Closed Head Injury in Older Adults According to Their Significant Others. *Journal of Neuropsychiatry Clinical Neuroscience* 11, 38-44.

- [17]. Grace, J., & Malloy, P.F.(2001). *Frontal System Behavior Scale*. USA: Psychological Assessment Resources.
- [18]. Handel, S.F., et al. (2007). Affective Disorder and Personality Change in a Patient with Traumatic Brain Injury. *Psychosomatics* 48(1); 67-70.
- [19]. Hennings, J. M., & Wetter, T.C.(2008). Frontal Lobe Syndrome in a Patient without Structural Brain Abnormalities. *Journal of Neuropsychiatry and Clinical Neuroscience*, 20, 244-245.
- [20]. Jorge, R., & Robinson, R.G. (2002). *Mood Disorders following traumatic brain injury*. *NeuroRehabilitation* 17, 311-324.
- [21]. Jorge, R.E., Robinson, R.G., Moser, D.; Tateno, A., Crespo-Facorro, B. & Arndt, S.(2004). *Major Depression following Traumatic Brain Injury*, 61, 42-50.
- [22]. Joseph, R. (1999). The Frontal Lobes. *Psychiatry* 62, 138-172.
- [23]. Kendall, E. (2003). Predicting vocational adjustment following traumatic brain injury: A test of a psychosocial theory. *Journal of Vocational Rehabilitation* 19, 31-45.
- [24]. Kendall, E. (2006). Vocational Rehabilitation following traumatic brain injury: A quantitative synthesis of outcome studies. *Journal of Vocational Rehabilitation* 25, 149-160.
- [25]. Kim, E. (2002). Agitation, aggression and disinhibition syndromes after traumatic brain injury. *Neurorehabilitation*, 17(4), 297-310.
- [26]. Kim, E., et al. 2007). Neuropsychiatric Complications of Traumatic Brain Injury: A Critical Review of the Literature (A Report by the ANPA Committee on Research). *Journal of Neuropsychiatry and Clinical Neuroscience*, 19(2), 106 – 127.
- [27]. Kirshner, H.S. (2002). *Behavioral Neurology Practical Science of Mind and Brain*. (2nd ed.) USA: Boston.
- [28]. Klonoff, P.S., & Dawson, L.K. (2004). Commentary- neuropsychological evaluation of patients with traumatic brain injury: polarization versus holistic integration. *Archives of Clinical Neuropsychology* 19, 1095-1101.
- [29]. Larsen, R.J., & Buss, D.M. (2008). *Personality Psychology*. (3rd ed.) USA: New York.
- [30]. Levin, H.S., et al. (2008). Predicting Depression Following Mild Traumatic Brain Injury. *Archives General Psychiatry* 62, 523-528.
- [31]. Liporace, J. (2006). *Crash Course in Neurology*. USA: Philadelphia.
- [32]. Lyketsos, C.G., Rosenblatt, A. & Rabins, P. (2004). Forgotten Frontal Lobe Syndrome or “Executive Dysfunction Syndrome”. *Psychosomatics* 45(3), 247-255.
- [33]. Malec, J.F., et al. (2004). Personality Factors and Injury Severity in the Prediction of Early and Late Traumatic Brain Injury Outcomes. *Rehabilitation Psychology*, 49(1), 55-61.
- [34]. McAllister, T.W., & Ferrell, R.B.(2002). Evaluation and treatment of psychosis after traumatic brain injury. *Neuro-Rehabilitation* 17, 357-368.
- [35]. McGee, J. M.(2004). *Neuroanatomy of Behavior after TBI*.

- [36]. Milders, M., et al. (2003). Neuropsychological Impairments and changes in Emotional and Social Behavior following Severe Traumatic Brain Injury. *Journal of Clinical and Experimental Neuropsychology*, 5(2), 157-172.
- [37]. Miller, L.J., & Donders, J. (2001). Subjective symptomatology after traumatic head injury. *Brain Injury* 15(4), 297-304.
- [38]. Milne, E., & Grafman, J. (2001). Ventromedial Prefrontal Cortex Lesions in Humans Eliminate Implicit Gender Stereotyping. *The Journal of Neuroscience*, 21, 1-6.
- [39]. Mustafa, B., et al. (2005). Secondary Mania Following Traumatic Brain Injury. *Journal of Neuropsychiatry Clinical Neuroscience*, 17(1); 122-123.
- [40]. Nelson, L., et al. (1994). *Neuropsychology Behavior and Affect Profile*. USA: California.
- [41]. Nelson, L.D., et al. (1998). Personality Change in Head Trauma: A Validity Study of the Neuropsychology Behavior and Affect Profile. *Archives of Clinical Neuropsychology*, 13(6), 549-560.
- [42]. Nishio, Y., et al. (2007). Frontal-lobe syndrome and psychosis after damage to the brainstem dopaminergic nuclei. *Journal of Neurological Sciences* 260, 271-274.
- [43]. Neylan, T. C. (1999) Frontal Lobe Function: Mr. Phineas Gage's Famous Injury. *Journal of Neuropsychiatry Clinical Neuroscience*, 11(2), 280-281.
- [44]. Nolin, P., & Heroux, L. (2006). Relations among socio-demographic, neurologic, clinical and neuropsychologic variables, and vocational status following mild traumatic brain injury: A Follow-up Study. *Journal Head Trauma Rehabilitation* 21(6), 514-526.
- [45]. Obonsawin, M.C., et al. (2008). A model of personality change after traumatic brain injury and the development of the Brain Injury Personality Scales. *Journal of Neurology, Neurosurgery Psychiatry* 78, 1239-1247.
- [46]. Rains, D. (2002). *Principles of Human Neuropsychology*. USA: New York.
- [47]. Rao, V., & Lyketsos, C.G (2000). Neuropsychiatric Sequelae of Traumatic Brain Injury. *Psychosomatics*, 41(2), 95-103
- [48]. Rao, V., & Lyketsos, C.G. (2002). Psychiatric aspects of traumatic brain injury. *Psychiatric Clinical North America*. 25(1), 43-69.
- [49]. Rao, V., et al. (2007). Apathy Syndrome after Traumatic Brain Injury Compared with Deficits in Schizophrenia. *Psychosomatic* 48,3.
- [50]. Rao, V., et al. (2008). Clinical Correlates of Personality Changes Associated with Traumatic Brain Injury. *Journal of Neuropsychiatry Clinical Neuroscience* 20(1), 118 –119.
- [51]. Rapoport, M. J., et al. (2003). Age and Major Depression after Mild Traumatic Brain Injury. *American Journal of Geriatric Psychiatry*, 11(3), 365 – 369.
- [52]. Reekum, R., et al. 2000). Can Traumatic Brain Injury Cause Psychiatric Disorders?. *Journal of Neuropsychiatry Clinical Neurosciences* 12(3), 316-327.
- [53]. Reekum, R., et al. 2005). Apathy: Why Care? *Journal of Neuropsychiatry Clinical Neurosciences* 17(1), 7-19.

- [54]. Risser, A.H. (2002). *Neuropsychology: An Introduction to Differential Diagnosis of Neurobehavioral Syndromes*.
- [55]. Rogers, J., & Read, C. (2007). Psychiatric comorbidity following traumatic brain injury. *Brain Injury* 21(13-14), 1321-1333.
- [56]. Rush, B. K., et al. (2006). Personality and Functional Outcome Following Traumatic Brain Injury. *Rehabilitation Psychology*, 51(3), 257-264.
- [57]. Silver, J. M. (2004). Neuropsychiatric Aspects of Post-TBI Depression. *Journal Watch Psychiatry*.
- [58]. Sguin, J. R. (2008). The Frontal Lobe and Aggression. *European Journal of Development Psychology*.
- [59]. Stuss, D. T., et al. (2001). The frontal lobes are necessary for the 'theory of mind'. *Brain*, 124, 279- 286.
- [60]. Stuss, D. T., & Levine, B. (2002) Adult Clinical Psychology: Lessons from Studies of the Frontal Lobes. *Annual Review Psychology* 53, 401-433.
- [61]. Umphred, D. A. (2007). Traumatic Brain Injury. *Neurological Rehabilitation*. (5th ed.): USA: Philadelphia.
- [62]. Underhill, A. T., et al. (2003) Depression and life satisfaction in patients with traumatic brain injury: a longitudinal study. *Brain Injury* 17 (11), 973-982.
- [63]. Upton, D., & Thompson, P.J. (1999). Twenty Questions Task and Frontal Lobe Dysfunction. *Archives of Clinical Neuropsychology* 14(2), 203-216.
- [64]. Vanderploeg, R., et al. (2003) Demographic, Medical and Psychiatric Factors in Work and Marital Status After Mild Head Injury. *Journal Head Trauma Rehabilitation* 18(2), 148-163.
- [65]. Warriner, E. M., & Velikonja, D.(2006). Psychiatric Disturbances after traumatic brain injury: neurobehavioral and personality changes. *Current Psychiatry Report*. 8(1), 73-80.
- [66]. Webman, P., et al. (2005) Productive Work and Employment for Persons with Traumatic Brain Injury. *Journal Head Trauma Rehabilitation* 20 (2), 115-127.
- [67]. Zillmer, E., & Spiers, M.V. (2001). *Principles of Neuropsychology*. USA: Wadsworth.