Mind and Society ISSN 2277-6907
Vol. 11, No.II June, 2022, Page No.90 to 98

A comparative study of executive functioning and personality of young adults with alcohol use disorder and internet gaming disorder

***Chilka Mukherjee &**
****Ushri Banerjee**

Received: 25 April 2022
Revision Received 15 June 2022
Accepted :15 June 2022
DOI:10.56011/mind-mri-112-202210

Abstract

The present study attempted to compare young adult males with Alcohol Use Disorder (AUD), Internet Gaming Disorder (IGD) and their normal counterparts with respect to their Executive Functioning and Personality. A detailed information schedule, General Health Questionnaire (GHQ-28), Alcohol Use Disorder Identification Test, Game Addiction Scale, Temperament and Character Inventory and Wisconsin Card Sorting Test were administered to males aged 18-32 years with Alcohol Use Disorder, Internet Gaming Disorder and normal healthy males (N=30). Nonparametric statistical analyses were carried out – Kruskal Wallis test for comparing the mean ranks of three groups (AUD, IGD and Control) taken together. The mean ranks of individuals with Alcohol Use Disorder, Internet Gaming Disorder and control group were found to differ significantly with respect to their total number of errors and the number of categories completed in WCST with the IGD group making the least number of errors and completing the highest number of categories followed by the control group and the AUD group. The mean ranks of the three groups differed significantly with respect to their Cooperativeness with the AUD group scoring the lowest followed by the IGD group and the control group. Individuals with Internet Gaming Disorder were to found to perform better in WCST with respect to the Alcohol Use Disorder as well as the control group and the individuals with Internet Gaming Disorder seem to be similar to those with Alcohol Use Disorder based on their Character dimension of Cooperativeness but not Temperament dimensions.

Key words: Alcohol Use Disorder, Internet Gaming Disorder, Executive Functioning, Personality

Introduction

The term addiction has been derived from the Latin word "addicere", loosely translated as "assent" or "assign to". The term did not necessarily indicate pathology until about the beginning of the 20th century. The Romans used the word 'addictus' to denote a person, who on account of being a debt-defaulter was assigned as a slave to his creditor. The most widely used definition of addiction according to a consensus by experts on the area in 2001 goes as follows:

Addiction is a "chronic neurobiological disease…characterized by behaviours that include one or more of the following: impaired control over drug use, compulsive use, continued use despite harm, and craving".

The substance-related disorders include 10 separate classes of drugs: alcohol; caffeine; cannabis; hallucinogens; inhalants; opioids; sedatives, hypnotics, and anxiolytics; stimulants; tobacco; and other or unknown substances. A common fact about all drugs that are taken in excess is that they directly activate the brain reward system, which is involved in the reinforcement of behaviors and the production of memories. The effect is so intense that normal activities may be neglected. Instead of achieving reward system activation through adaptive behaviours, drugs of abuse directly activate the reward pathways. In addition, individuals with lower levels of self-control, which may reflect impairments of brain

**Research student, Clinical Psychology Centre of University of Calcutta, Kolkata, West Bengal, India.*
***Assistant Professor, Department of Applied Psychology, University of Calcutta and Coordinator and Core Faculty Member, Clinical Psychology Centre of University of Calcutta, Kolkata, West Bengal, India*

inhibitory mechanisms, may be predisposed to develop substance use disorders, suggesting that the roots of this condition for some persons can be seen in behaviours long before the onset of actual substance use itself.

Any source, which is capable of stimulating an individual, could become addictive and the sources are not necessarily drugs and chemical substances such as alcohol and nicotine but certain obligatory behaviours as well such as gambling and computer gaming or chatting. According to Peele (1979), addicted individuals are dependent on a particular set of experiences, of which the reactions to a specific chemical substance is only an example. In order to make a diagnosis of behavioral addiction, functional impairments must be present at work, in social relationships, or in other social situations (Griffiths M., 2006). Evidence indicates that gambling behaviours activate reward systems similar to those activated by drugs of abuse and produce some behavioural symptoms that appear comparable to those produced by the substance use disorders. Other excessive behavioural patterns, such as Internet gaming, have also been described by classificatory systems, but the research on these and other behavioural syndromes is less clear. In comparison to substance use disorders, behavioural addictions are not confounded by drug-induced neuroadaptation. Perhaps they are relatively untarnished manifestations of intrinsic compulsivity, reward dependence, impulsivity, and low self-directedness, all traits that we tend to see as underpinnings for substance use disorders.

It is difficult to imagine life without internet nowadays because it has made our lives easier. However, more and more people are getting addicted to the internet because of the rewarding effects associated with its use. Games like "Blue Whale" are compelling adolescents and young adults across the world to get involved in dangerous pursuits and commit suicide, which is an indication that the personal, social and occupational lives of such individuals might be seriously disturbed.

The present study intends to focus on the executive functions of individuals with addictive behaviours. It also aims to explore the personality patterns of those individuals. These concepts are elaborated below.

Executive Functioning

The term executive functioning indicates a class of behavioral manifestations that may be directly or indirectly related to frontal lobe functioning. Executive functions include planning, flexible problem solving, working memory, attentional allocation, inhibition, and at the highest levels, the self-monitoring and self-assessment of behavior. So these are sets of higher order behavior, rather than a single type of behavior. According to Lezak et al. (2004), the executive functions consist of those capacities that enable a person to engage successfully in independent, purposive, self-serving behavior. These develop slowly from infancy through early childhood and adolescence, and may still improve into young adulthood. Executive dysfunction may be indicated by deficits in the ability to inhibit well-learned patterns of behaviour and derive new ways of solving problems. Individuals become trapped in repetitive cycles of well-learned behavior (perseveration) and lack flexibility to accommodate and re-accommodate their behaviour to novel situations. Cognitive control refers to the ability to control one's own actions, behavior, and thoughts. Reduction in cognitive control is sometimes regarded as the main component of impulsivity. Executive functions are control systems allowing people to regulate behavior that is planned, goal oriented, flexible, and effective (Shallice and Burgess, 1996). These functions are linked to the dorsolateral prefrontal cortex. The prefrontal cortex is connected to parts of the basal ganglia and for these connections, the term fronto-striatal loops is frequently used. These loops include a more cognitive loop, which mainly connects the nucleus caudatus and putamen with the dorsolateral section of the prefrontal cortex (via the thalamus) and the limbic loop connecting limbic structures, such as the amygdala, and structures that are linked to motivational aspects of behavior, such as the nucleus accumbens, with the orbitofrontal and ventromedial part of the prefrontal brain area. These circuits of the brain are involved in executive functions and other higher-order cognitions, and are also regarded as the main neural correlates of addictive behavior. During the initial stages of the voluntary and controlled usage of a substance, the decision to use the drug is made by specific brain regions, namely the prefrontal cortex and ventral striatum. As habituation to use and compulsion develops, brain activity changes in that the dorsal regions of the striatum become increasingly activated via dopaminergic innervation (*i.e.*, dopamine release). Long-term drug use leads to changes in the brain dopaminergic pathways, specifically the anterior cingulate, orbitofrontal cortex, and the nucleus accumbens, which may lead to a reduction of sensitivity to biological rewards and it decreases the individual's

control over seeking and eventually taking drugs. Deficits in executive functioning may put individuals at risk for the development of substance use disorders, make them more likely to experience problems as a result of substance use, and contribute to limited benefit from treatment.

Jacobus et al. (2013) and Silveri M.M. (2012) found that alcohol use, particularly heavy episodic or binge drinking, was associated with reduced attention, poorer working memory, and reduced visual–spatial skills. It was also associated with structural and functional brain changes including reductions in frontal, parietal, temporal, and cerebellar volumes, and in white matter volume and integrity.

Internet and gaming addicts appear to be constricted with regard to their cognitive functioning in various domains. The excessive Internet users in a study by Sun et al. (2009) had problems in performing the Iowa Gambling Task, indicating decision-making deficits, which had frequently been linked to addictive behaviors but they performed normally on a Go/No-Go Task, which measures response inhibition functions. Although it is widely accepted that multiple applications provided by the Internet can be addictively used such as gaming, gambling, cybersex, social networking, and so on, Internet Gaming Disorder has been incorporated in the "Conditions for further study" section in the DSM V and it is clear that more research is needed on this phenomenon to collect evidence for its clinical relevance and underlying mechanisms.

Personality

Personality is a pattern of relatively permanent traits and unique characteristics that give both consistency and individuality to a person's behavior. Gordon Allport (1961) defined personality as *"the dynamic organization within the individual of those psychophysical systems that determine his characteristic behavior and thought"*.

Cloninger's Biological Model of Personality

Robert Cloninger proposed a psychobiological theory of personality, which includes seven personality dimensions. His theory is based on combining findings from a series of family, psychometric, neuropharmacologic and neuroanatomical studies of behavioral conditioning and learning in man. The dimensions are broken down into four temperament domains - Novelty-seeking, Harm avoidance, Reward dependence, and Persistence, and three character domains - Self-directedness, Cooperativeness, and Self-transcendence. The temperament domains are linked to biological systems and are thought to be inherited. The four temperaments are thought to be organized as independent brain systems aligned to specific nerve cells or fibers that transmit nerve impulses by neurotransmitters. Cloninger linked our personality to those neurotransmitters that are responsible for the activation and inhibition of our behavior and the learning and responses to both real and perceived rewards and punishments. The four temperament dimensions are:

1) Novelty-seeking – This dimension reflects impulsive behavior and activation of behavior. Novelty-seeking is a tendency to like excitement, responding to novel stimuli. It is thought to be connected to the **dopamine** neurotransmitter, which is crucial to the parts of the brain that control our movements and is commonly associated with the pleasure aspects of the brain, providing feeling of enjoyment and motivation to do things.

2) Harm avoidance – This dimension reflects cautious and low-risk-taking behavioral traits, i.e., behavior inhibition. Harm avoidance includes a tendency to respond intensely to aversive stimuli or to inhibit behavior in order to avoid punishment or novelty. It is thought to be connected to the **serotonin** neurotransmitter that is known to modulate mood, emotion and sleep.

3) Reward dependence – This dimension reflects friendliness and a tendency for seeking rewards. The key term to describe reward dependence is 'behavior maintenance'. It is thought to be connected to **norepinephrine**, which is a stress hormone that affects parts of the human brain where attention and impulsivity are controlled. It is related to activation of the sympathetic nervous system, which regulates our responses to stress.

4) Persistence – This dimension reflects a tendency to persevere in behavior despite frustration and tiredness. It emerged from the reward dependence dimension. So it also represents behavior maintenance and is thought to be connected to **norepinephrine**.

The character traits in Cloninger's theory contrast to temperaments because they are not biological in origin, but rather refer to how individuals understand themselves in their social world. They represent our emotions, habits, goals and intellectual abilities that we have formed in response to the outside world. The three character traits are:

1) Self-directedness – This trait reflects the individual's own concept of how autonomous a person

is; for example, the extent to which they are independent in mind or judgment. In this dimension people show feelings such as self-esteem, personal integrity and leadership.

2) Cooperativeness – This trait is based on the person's self-concept of how they fit into humanity or society. Feelings of morality, ethics, community and compassion are included in this dimension.

3) Self-transcendence – This trait reflects individuals' self-concept in terms of their common beliefs about mystical experiences. Concepts such as religious faith and spirituality are formed within this dimension.

The relationship between personality and addictive behavior intrigues people and a number of studies have shown relationships between the two. High Novelty-Seeking has often been implicated as a trait predisposing to addictive behavior (Cloninger et al., 1995). In a study conducted by Basiaux et al. (2001), patients aged 35-53 years with alcohol dependence were characterized by higher novelty seeking and lower self-directedness than non-psychiatric control subjects. In addition, impulsivity seems to characterize many people suffering from substance or behavioural adiction. Social anxiety also plays an important role for substance users and problematic gamblers, who describe themselves as having rather low social anxiety. However, problematic computer gamers have been found to report higher social anxiety.

Studies comparing the personality of individuals with Internet Gaming Disorder with that of individuals with substance use disorders are scarce and clearly warrant research in this area since similarities have been observed in some of the behavioural as well as psychological manifestations of substance and behavioural addicts such as withdrawal symptoms, development of tolerance, loss of interest in other activities, continued excessive use despite knowledge of the consequences. The present study is exploratory in nature as it attempts to explore whether or not similarities or differences exist between individuals with Alcohol Use Disorder and Internet Gaming Disorder with respect to their Executive Functioning and Personality.

Aim of the present study: To compare young adult males with Alcohol Use Disorder and Internet Gaming Disorder with their normal counterparts with respect to their Executive Functioning and Personality.

In this study, the following hypotheses were formulated:

1. There is no significant difference between the mean ranks of individuals with Alcohol Use Disorder, Internet Gaming Disorder and their normal counterparts with respect to their executive functioning.

2. There is no significant difference between the mean ranks of individuals with Alcohol Use Disorder, Internet Gaming Disorder and their normal counterparts with respect to their personality.

Materials and Methods

The variables incorporated in the present study are:

1. Executive Functioning – Executive functioning encompasses a network of cognitive operation involving mental coordination of behavior including planning, monitoring and mental tracking; self-regulation of behavior including mental flexibility and the capacity to shift mental set; and complex purposive action involving self-initiated and goal-directed behaviour. In the present study, the ability to plan strategically, search in an organized manner, to utilize environmental feedback to shift cognitive sets, to direct behavior toward achieving a goal and to modulate impulsive responding have been measured using the Wisconsin Card Sorting Test (WCST).

2. Personality- Personality is a pattern of relatively permanent traits and unique characteristics that give both consistency and individuality to a person's behavior. Temperament domains, which are linked to biological systems and are thought to be inherited along with character which are not biological in origin but refer to how individuals understand themselves in their social world have been measured in the present study using the Temperament and Character Inventory (TCI).

Sample

The sampling technique used in the present study was **Purposive Sampling**.

In the present study, male subjects ranging from 18 to 32 years of age with minimum educational qualification being class VIII pass were taken. Both married and unmarried males belonging to middle class family in the urban society of Kolkata and adjacent semi-urban areas with a family income of Rs. 10,000-60,000 per month were chosen.

1) Selection of males with Alcohol Use Disorder

Young adult males aged 18-32 years fulfilling the criteria for Alcohol Use Disorder as per DSM-V and scoring greater than 8 in Alcohol Use Disorders Identification Test (AUDIT) and staying in rehabilitation centers were selected for the present study

2) Selection of males with Internet Gaming Disorder

Young adult males aged 18-32 years fulfilling the criteria for Internet Gaming Disorder as per DSM-V and as per Game Addiction Scale (GAS) were selected for the present study. Those who responded "Sometimes" or more to at least 4 of the 7 items thus fulfilling the criteria for Excessive Gaming were considered for the present study.

Individuals with a history of any acute physical illness, physical handicaps or chronic illness having residual effect or past diagnosed psychiatric illness or severe neurological disorder were excluded.

TOOLS - Information schedule, General Health Questionnaire (GHQ-28), Alcohol Use Disorder Identification Test (AUDIT), Game Addiction Scale (GAS), Wisconsin Card Sorting Test (WCST), Temperament and Character Inventory (TCI)

Statistical Treatment of Data

The following statistical techniques were used:

1. **Descriptive Statistics**: Means and Standard Deviations of all the variables for all the groups were calculated.
2. **Non-Parametric Statistics**: Kruskall Wallis Test was carried out to determine if any significant difference exists between the three groups of individuals, Alcohol Use Disorder, Internet Gaming Disorder and control group with respect to their Executive Functioning and Personality.

The level of significance was set at 0.05 level. Post hoc analyses were carried out along with Bonferroni correction to minimize Type 1 error.

Results

Quantitative statistical analysis was carried out on IBM SPSS Statistics 20.

Table 1

Table showing the Kruskal Wallis H values (in terms of chi square) to test whether or not any significant difference exists between the mean ranks of three groups – Alcohol Use Disorder, Internet Gaming Disorder and control group with respect to their WCST findings

Variables	Groups Alcohol (n=12) Gaming (n=8) Control (n=10)	Mean Ranks	Chi Squa
Total Number of Errors	Alcohol	19.88	
	Gaming	9.75	6.445*
	Control	14.85	
Preservative Responses	Alcohol	18.21	
	Gaming	13.44	1.946
	Control	13.90	
Preservative Errors	Alcohol	19.33	
	Gaming	10.56	4.860
	Control	14.85	
Non preservative Errors	Alcohol	17.67	
	Gaming	10.06	4.194
	Control	17.25	
Conceptual Level Responses	Alcohol	12.13	
	Gaming	20.25	4.106
	Control	15.75	
Number of Categories Completed	Alcohol	11.79	
	Gaming	22.63	8.397*
	Control	14.25	
Trials to complete 1st category	Alcohol	12.63	
	Gaming	17.81	2.239
	Control	17.10	
Failure to Maintain Set	Alcohol	16.13	
	Gaming	17.63	1.500
	Control	13.05	
Learning to learn	Alcohol (n=10)	11.70	
	Gaming (n=8)	17.38	2.175
	Control (n=10)	15.00	

indicates $p<0.05$

Note: Learning to learn scores could be calculated for 10 out of 12 individuals with Alcohol Use Disorder.

Post hoc analysis with respect to the total number of errors revealed a significant difference between the mean ranks of individuals with AUD and IGD with the IGD group making significantly lesser number of errors as compared with the AUD group. However, no significant difference was found between the groups – AUD and control group; IGD and control group in terms of the total number of errors.

Post hoc analysis with respect to the mean ranks of number of categories completed revealed significant difference between the groups – AUD and IGD, IGD and control group. However, no significant difference was found between the groups – AUD and control group.

Table 2

Table showing the Kruskal Wallis H values (in terms of chi square) to test whether or not any significant difference exists between the mean ranks of three groups – Alcohol Use Disorder, Internet Gaming Disorder and control group with respect to their Temperament and Character domains

VariablesTemperament	GroupsAlcohol (n=12) Gaming (n=8) Control (n=10)	Mean Ranks	Chi Square
Novelty Seeking	Alcohol	19.75	
	Gaming	12.56	4.697
	Control	12.75	
Harm Avoidance	Alcohol	18.83	
	Gaming	13.00	2.901
	Control	13.50	
Reward Dependence	Alcohol	18.29	
	Gaming	10.63	3.740
	Control	16.05	
Persistence	Alcohol	11.54	
	Gaming	19.50	4.506
	Control	17.05	
Character			
	Alcohol	12.29	
Self Directedness	Gaming	14.06	5.052
	Control	20.50	
	Alcohol	10.21	
Cooperativeness	Gaming	17.69	7.619*
	Control	20.10	
	Alcohol	15.21	
Self Transcendence	Gaming	17.25	0.474
	Control	14.45	

* indicates $p < 0.05$

Post hoc analysis with respect to the Character dimension of Cooperativeness revealed significant difference between the groups – AUD and IGD, AUD and control group.

However, no significant difference was found between the groups – IGD and control group.

Discussion

The present study attempted to compare young adult males with Alcohol Use Disorder and Internet Gaming Disorder with respect to their Executive Functioning and Personality.

Three groups compared on the basis of their Executive Functioning – Alcohol Use Disorder, Internet Gaming Disorder and Control group

The mean ranks of the three groups were found to differ significantly with respect to the total number of errors and the number of categories completed in WCST.

Post hoc analysis with respect to the total number of errors revealed a significant difference between the mean ranks of individuals with AUD and IGD with the IGD group making significantly lesser number of errors as compared with the AUD group thus indicating better performance by the IGD group.

Post hoc analysis with respect to the mean ranks of number of categories completed revealed significant difference between the groups – AUD and IGD, IGD and control group. However, no significant difference was found between the groups – AUD and control group. The mean of number of categories completed was highest in the IGD group followed by the control and the AUD group.

The mean scores obtained by the Alcohol Use Disorder group were greater than that of the control group with respect to the total number of errors, perseverative errors, nonperseverative errors and failure to maintain set and lesser in terms of the conceptual level responses, number of categories completed and learning to learn thus indicating poorer performance by the AUD group as compared with the control group.

Studies have suggested that Executive Functioning deficits may put individuals at risk for the development of substance use disorders (Finn et al., 1999), make them more likely to experience problems as a result of substance use (Day et al., 2013), and contribute to limited benefit from treatment (Bates, 2000). In the present study, the mean scores of the AUD group in terms of the total number of errors, nonperseverative errors and conceptual level responses were found to fall in the "Below Average" category and that in the perseverative responses and perseverative errors were found to fall in the "Above Average" and "Mildly impaired" category based on the Normative Data. The mean scores of the IGD group in terms of the total number of errors, perseverative errors, nonperseverative errors, and conceptual level responses were found to fall in the "Average" category and that in the perseverative responses was found to fall in the "Above Average" category.

The mean score of individuals with IGD in failure to maintain set in WCST was 1 (Percentile > 16) thus indicating no difficulty in inhibiting responses. In the present study, individuals with IGD were found to perform better in WCST than the AUD and control group thus indicating better ability of strategic planning, organized searching, and utilizing environmental feedback to shift cognitive sets, directing behavior towards achieving a goal, and modulating impulsive responding. This finding leads to two distinct conclusions, first, the individuals with IGD may not only respond better to treatment but chances of relapse are also expected to be lessened; and second, cognitive retraining focusing on executive functioning may be incorporated in the treatment protocol for individuals with AUD to facilitate healing. However, these findings are subject to test and may be taken up as hypotheses in future research works.

Three groups compared on the basis of Personality – Alcohol Use Disorder, Internet Gaming Disorder and Control group

The mean ranks of the three groups were found to differ significantly with respect to their Cooperativeness. Post hoc analysis with respect to the character dimension of Cooperativeness revealed significant difference between the groups – AUD and IGD, AUD and control group. However, no significant difference was found between the groups – IGD and control group. The mean Cooperativeness scores of the three groups, i.e., AUD, IGD and control group were found to fall in the categories "Very Low", "Low" and "Average" respectively. Individuals who are low in Cooperativeness tend to be self-absorbed, intolerant, critical, unhelpful, revengeful, and opportunistic. They primarily look out for themselves and consequently, they tend to be inconsiderate of other's rights or feelings. Low cooperativeness is characteristic of many people who prefer to be solitary, but is a handicap in social relations among peers. A finding by Steingrimsson et al. (2020) indicated that the personality traits of low self-directedness and cooperativeness are associated with increased alcohol and drug use. As we have seen that character is not biological in origin and it refers to how individuals understand themselves in their social world, it makes us wonder how low cooperativeness is incorporated in the self-schema of an individual with addictive behaviours and it warrants for further research in this area. It also opens avenue to explore social isolation and loneliness in individuals with addictive behaviours. In addition, social skills training may not only facilitate recovery in addicts but if started from an early age, it may act as a protective factor as well.

Conclusion

The results indicated better performance in the Wisconsin Card Sorting Test by the individuals with Internet Gaming Disorder as compared with their alcoholic and normal counterparts, the poorest performers being the individuals with Alcohol Use Disorders thus indicating deficits in executive functioning. The findings may be utilized for treatment planning. Executive functioning is involved in day to day activities and better performance in this area may be an added advantage for Internet gamers which might help them benefit from treatment and also act as buffer against stressors. On the contrary, deficits in executive functioning in individuals with Alcohol Use Disorders may worsen the course of the disorder. So, treatment focusing on training in the area of executive functioning is recommended.

The personality profile, on the other hand, hinted at some similarities between the two groups, i.e., Alcohol Use Disorder and Internet Gaming Disorder, the mean scores in two out of the three Character dimensions of the Temperament and Character Inventory – Self-Directedness and Cooperativeness falling in the "Low" category. Autonomy and self regulation are the key features of Self-Directedness and these functions are found to be impaired in addicts. In addition, character traits refer to how individuals understand themselves in their social world. In this context, low score in Cooperativeness, which is an individual's self-concept of how he fits into society, may be considered in future research as either an antecedent or a consequence of addictive behaviours.

A shortcoming of the present study is its small sample size. A larger sample would have helped in generalization of the findings. Moreover, executive functioning and personality of individuals with other forms of addiction – substance or behavioural, might provide a clearer understanding of the condition.

Nevertheless, the findings obtained from the present research open avenues for further research in this area. For instance, whether there are specific behavioural patterns underlying proneness to addiction and whether such patterns at an early stage of life indicate the possibility of development of addictive behaviours in later life. It is also known that the relapse rate of addiction is very high and the condition is perceived as a social evil by many. A clear understanding of the neuropsychological underpinnings of addictive behaviours and the psychopathology will not only help in reducing the stigma associated with the condition but in planning tailor-made intervention as well.

References

Alvarez, J. A., & Emory, E. (2006). Executive function and the frontal lobes: a meta-analytic review. *Neuropsychology review*, *16*(1), 17–42.

Amini Pozveh, Z., & Saleh, Z. (2020). The Role of Social Skills in the Prevention of Drug Addiction in Adolescents. *Advanced biomedical research*, *9*, 41.

Basiaux, P., le Bon, O., Dramaix, M., Massat, I., Souery, D., Mendlewicz, J., Pelc, I., & Verbanck, P. (2001). Temperament and Character Inventory (TCI) personality profile and sub-typing in alcoholic patients: a controlled study. *Alcohol and alcoholism (Oxford, Oxfordshire)*, *36*(6), 584–587.

Bates M. E. (2000). Utility of component-process approaches for understanding complex alcohol-related behavior within an executive functioning framework: comment on Giancola (2000). *Experimental and clinical psychopharmacology*, *8*(4), 598–617.

Bechara A. (2005). Decision making, impulse control and loss of willpower to resist drugs: a neurocognitive perspective. *Nature neuroscience*, *8*(11), 1458–1463.

Brand, M., Young, K.S. & Laier, C. (2014) Prefrontal control and Internet addiction: a theoretical model and review of neuropsychological and neuroimaging findings. *Frontiers in Human Neuroscience*, 8.

Caplan S. E. (2002). Problematic Internet use and psychosocial well-being: development of a theory-based cognitive-behavioral measurement instrument. *Computers in Human Behavior,* 18(5), 553–575.

Cloninger, C.R., Svrakic, D.M. and Przybeck, T.R. (1993) A psychobiological model of temperament and character. *Archives of General Psychiatry,* 50, 975-990.

Cooper, A., Delmonico, D.L., and Burg, R.(2000). Cybersex users, abusers, and compulsives: new findings and implications. *Sexual Addiction and Compulsivity,* 7, 5–29.

Day, A. M., Kahler, C. W., Ahern, D. C., & Clark, U. S. (2015). Executive Functioning in Alcohol Use Studies: A Brief Review of Findings and Challenges in Assessment. *Current drug abuse reviews*, *8*(1), 26–40.

Danovitch I. (Fall 2010) Behavioral Addictions. CSAM news, *Quarterly newsletter of the California Society of Addiction Medicine*. 37(2).

Diamond, A., & Goldman-Rakic, P. (1989). Comparison of human infants and rhesus monkeys on Piaget's AB task: Evidence for dependence on dorsolateral prefrontal cortex. *Experimental Brain Research*, 74, 24-40.

Dong, G., Zhou, H., and Zhao, X. (2011). Male Internet addicts show impaired executive controllability: evidence from a color-word Stroop task. *Neuroscience Letters,* 499(2), 114–118.

Finn PR, Justus A, Mazas C, Steinmetz JE. (1999) Working memory, executive processes and the effects of alcohol on Go/No-Go learning: Testing a model of behavioral regulation and impulsivity. *Psychopharmacology*, 146(4):465–472.

Griffiths, M. & Pontes, H. (2014). Internet Addiction Disorder and Internet Gaming Disorder are Not the Same. *Addiction Research and Theory,* 5(4).

Hoshi, E. (2013). Cortico-basal ganglia networks subserving goal-directed behavior mediated by conditional visuo-goal association. *Frontiers in Neural Circuits,* 7, 158.

Jacobus, J., & Tapert, S. F. (2013). Neurotoxic effects of alcohol in adolescence. *Annual review of clinical psychology*, *9*, 703–721.

Keepers G. A. (1990). Pathological preoccupation with video games. *Journal of the American Academy of Child and Adolescent Psychiatry*, *29*(1), 49–50.

Lemmens JS, Valkenburg PM, Peter J. (2009). Development and Validation of a Game Addiction Scale for Adolescents. Media Psychology, 12(1),77–95.

Lesieur, H. R., & Blume, S. B. (1993). Pathological gambling, eating disorders, and the psychoactive substance use disorders. *Journal of addictive diseases*, *12*(3), 89–102.

Lezak, M.D., Howieson, D.B. and Loring, D.W. (2004) *Neuropsychological Assessment*. 4th Edition, Oxford University Press, New York.

Mate, G. (2008). *In the realm of hungry ghosts: Close encounters with addiction*. Toronto: Knopf Canada.

Meerkerk, G. J., Van Den Eijnden, R. J., & Garretsen, H. F. (2006). Predicting compulsive Internet use: it's all about sex! *Cyberpsychology & behavior: the impact of the Internet, multimedia and virtual reality on behavior and society*, *9*(1), 95–103.

Müller, K. W., Beutel, M. E., Egloff, B., & Wölfling, K. (2014). Investigating risk factors for Internet gaming disorder: a comparison of patients with addictive gaming, pathological gamblers and healthy controls regarding the big five personality traits. *European addiction research*, *20*(3), 129–136.

Peele, S., Brodsky, A. (1975) *Love and Addiction*. New-York: Taplinger.

Shahini, N., Talaei, A., Salimi, Z. (2021). Temperament and character traits in substance use disorder in Iran: a case control study. *BMC Psychology,* 9**,** 138.

Shallice, T., & Burgess, P. (1996). The domain of supervisory processes and temporal organization of behaviour. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, *351*(1346), 1405–1412.

Silveri M. M. (2012). Adolescent brain development and underage drinking in the United States: identifying risks of alcohol use in college populations. *Harvard review of psychiatry*, *20*(4), 189–200.

Steingrimsson, S., Carlsen, H. K., Lundström, E., Lundström, S., Nilsson, T. (2020). Problematic Alcohol and Drug Use Is Associated with Low Self-Directedness and Cooperativeness. *European Addiction Research*, 26, 326-334.

Sun, D. L., Chen, Z. J., Ma, N., Zhang, X. C., Fu, X. M., & Zhang, D. R. (2009). Decision-making and prepotent response inhibition functions in excessive internet users. *CNS spectrums*, *14*(2), 75–81.

Walther, B., Morgenstern, M., & Hanewinkel, R. (2012). Co-occurrence of addictive behaviours: personality factors related to substance use, gambling and computer gaming. *European addiction research*, *18*(4), 167–174.

Welsh, M.C., Pennington, B.F., & Groisser, D.B. (1991). A normative-developmental study of executive function: A window on prefrontal function in children. *Developmental Neuropsychology*, 7, 131-149.

Widyanto, L., Griffiths, M. (2006) 'Internet Addiction': A Critical Review. *International Journal of Mental Health and Addiction* 4, 31–51.

Yee N. (2006). Motivations for play in online games. *Cyberpsychology & behavior : the impact of the Internet, multimedia and virtual reality on behavior and society*, *9*(6), 772–775.

Yuan, P., & Raz, N. (2014). Prefrontal cortex and executive functions in healthy adults: a meta-analysis of structural neuroimaging studies. *Neuroscience and biobehavioral reviews*, *42*, 180–192.

Zillmer, E.A., Spiers, M.V., Culbertson, W.C. (2008). *Principles of Neuropsychology*. Second Edition, Thomson Wadsworth.

✦