European Journal of Clinical Pharmacy
Print ISSN: 2385-409X **Online ISSN**: Applied
Website: https://farmclin.es/

Article

Comparative Study on Audio-Visual Response Time and Critical Flicker Fusion Frequency Among Undergraduate Medical Students who are Mobile Gamers and Non-Gamers- An Observational Study

Article History:
Received:
25/10/25
Accepted:
24/11/25
Published:
18/12/25

Name of Author:
[1]Pushpakala A,[1] A. Arvinth, [1]Sakthibalan M

Affiliation:
Department of Pharmacology, Sri Venkateshwaraa Medical College Hospital and Research Centre, Ariyur, Puducherry

Corresponding Author:
Pushpakala A

Abstract: **Background:** Reaction time and critical flicker fusion frequency are objective neurophysiological markers of sensory processing, sensorimotor integration, and cortical arousal. With the growing popularity of mobile gaming among medical students, its impact on these parameters warrants systematic evaluation.
Methods: This comparative observational study included 180 undergraduate medical students, categorized into mobile gamers (n = 88) and non-gamers (n = 92) based on predefined criteria. ART and VRT were measured using a standardized audio-visual choice reaction time apparatus, and CFFF was assessed using a flicker fusion frequency device under controlled laboratory conditions. Statistical analysis was performed using SPSS software, with $p < 0.05$ considered statistically significant.
Results: Mobile gamers demonstrated significantly faster reaction times compared to non-gamers, with lower mean ART (227.9 ± 24.4 ms vs. 247.6 ± 26.4 ms; $p < 0.001$) and VRT (212.5 ± 22.2 ms vs. 231.7 ± 25.1 ms; $p < 0.001$). Mean CFFF was significantly higher among mobile gamers (38.6 ± 4.2 Hz) than non-gamers (34.2 ± 3.9 Hz; $p < 0.001$), indicating enhanced cortical arousal and visual temporal resolution. Baseline demographic characteristics were comparable between groups.
Conclusion: Mobile gaming among undergraduate medical students is associated with significantly improved auditory and visual reaction times and higher CFFF, suggesting enhanced sensory processing efficiency, faster sensorimotor integration, and increased cortical arousal. Further longitudinal studies are required to establish causality and long-term effects.

***Keywords**:* Reaction time; Critical flicker fusion frequency; Mobile gaming.

INTRODUCTION

Digital gaming has evolved into a widespread recreational activity, encompassing diverse formats such as brain training games, action-based games, and adventure games. Each category varies in cognitive demand, sensory stimulation, and motor engagement, thereby exerting differential effects on neural processing and behavioral responses. Action video games, in particular, require rapid visual scanning, sustained attention, swift decision-making, and precise motor coordination, which may enhance perceptual and attentional capacities. Emerging evidence suggests that individuals who regularly engage in action-based video games demonstrate superior visual attention, faster information processing, and improved responsiveness compared to non-gamers[1,2].

Despite these potential benefits, certain gaming formats have been associated with negative psychological outcomes. Excessive or poorly regulated gaming may induce frustration, heightened emotional arousal, and compulsive gaming tendencies, thereby increasing the urge to continue playing[3]. Medical students, both at the undergraduate and postgraduate levels, already encounter substantial academic demands, clinical responsibilities, and psychosocial stressors related to personal life, family obligations, and patient care. These stressors affect students irrespective of gender and may interact with gaming behaviors to influence neurocognitive performance[4].

For the purpose of behavioral and cognitive evaluation, students engaging in video gaming for six hours or less per week are commonly classified as gamers, whereas those who do not report any video gaming activity are categorized as non-gamers. This operational definition has been used in previous studies to enable objective comparison while minimizing confounding effects of excessive gaming[5].

Reaction time (RT) is a well-established neurophysiological parameter that reflects the efficiency of sensory perception, central neural processing, and motor execution. It serves as a reliable indicator of the speed with which the central nervous system processes external stimuli and translates them into appropriate motor responses[6]. The process involves stimulus detection by sensory receptors, transmission of neural impulses to the cerebral cortex for interpretation, and subsequent relay through the spinal cord to activate skeletal muscles[7]. Several studies have demonstrated that individuals who engage in action video gaming exhibit faster reaction times, enhanced visuospatial attention, and greater response accuracy compared to non-gamers[8].
Critical flicker fusion frequency (CFFF) represents the frequency at which a flickering light stimulus is perceived as steady or continuous by the observer, commonly referred to as the threshold frequency. It is considered a sensitive index of cortical arousal and visual perceptual processing, reflecting the brain's ability to resolve discrete sensory events[9,10]. Due to its non-invasive nature, ease of administration, and high sensitivity, CFFF has been extensively employed in studies related to visual physiology, cognitive performance, and human behaviour.
Several physiological and environmental factors influence CFFF performance, including circadian rhythm, sleep deprivation, shift work, prolonged exposure to visual display units, age, intelligence, and gender[11]. Previous research has reported higher CFFF threshold values among gamers compared to non-gamers, suggesting enhanced cortical alertness and visual processing efficiency[12].The present study was designed to evaluate audio reaction time, visual reaction time, and critical flicker fusion frequency among undergraduate medical students who engage in mobile gaming and those who do not. Additionally, the study aims to compare these neurophysiological parameters between mobile gamers and non-gamers in order to determine the potential influence of mobile gaming on sensory processing speed, cortical arousal, and psychomotor performance in this population.

MATERIALS AND METHODS

Study design:
The present study was conducted as a comparative observational study aimed at evaluating and comparing audio-visual reaction time and critical flicker fusion frequency among mobile gamers and non-gamers.

Study population:
The study population comprised undergraduate medical students of Sri Venkateshwaraa Medical College and Research Centre. Based on self-reported mobile gaming behavior collected using a structured proforma, participants were categorized into mobile gamers and non-gamers. Mobile gamers were operationally defined as students who reported playing mobile-based video games for six hours or less per week, while non-gamers were defined as students who reported no engagement in mobile or video gaming activities.

Study site:
The study was conducted in the Department of Pharmacology, Sri Venkateshwaraa Medical College and Research Centre, Ariyur, Puducherry. All assessments were performed in the Reaction Time Laboratory under standardized environmental conditions.

Inclusion criteria:
Undergraduate medical students who met the operational definition of mobile gamers or non-gamers and who were willing to participate by providing written informed consent were included in the study.

Exclusion criteria:
Students with self-reported or documented visual impairments or auditory impairments were excluded to minimize potential confounding effects on

reaction time and critical flicker fusion frequency measurements.

Sampling technique:
Participants were selected using a simple random sampling method to ensure representative inclusion of eligible undergraduate medical students and to reduce selection bias.

Sample size calculation:
The sample size was calculated based on mean and standard deviation values reported in previous studies conducted by Aditya Jain et al.6 and Chiranjeevi Kumar et al.13 comparing reaction time parameters among gamers and non-gamers. The calculation was performed using the formula for comparison of two independent means, with the mean values considered as μ_1 = 247.6 and μ_2 = 228.01. A confidence level of 95% was assumed, corresponding to a $Z_1-\alpha/_2$ value of 1.96, with adequate statistical power ($Z_1-\beta$) for a two-tailed test. Based on these assumptions, the estimated minimum sample size required was approximately 180 participants. Participants were recruited based on availability and eligibility during the study period using a universal sampling approach until the required sample size was achieved.

Data collection procedure:
The study was conducted from June 2025 to November 2025 after obtaining approval from the Institutional Ethics Committee (55/SVMCH/IEC-Cert/June.25). The participants who volunteered for the study were categorized into two groups—mobile gamers and non-gamers—based on information collected using a structured proforma. All assessments were conducted in the Reaction Time Laboratory under standardized conditions, ensuring adequate illumination and a quiet environment to minimize external distractions.

Audio reaction time (ART) and visual reaction time (VRT) were measured using an audio-visual choice reaction time apparatus with a temporal resolution of 0.001 seconds. Reaction time was recorded in milliseconds as the interval between the presentation of the stimulus by the investigator and the participant's motor response via a response button. Participants were provided with a standardized explanation of the procedure and were familiarized with the apparatus through adequate practice trials prior to data acquisition. For assessment of ART, low- and high-frequency auditory stimuli were used, whereas VRT was assessed using monochromatic visual stimuli of red, green, and yellow colors. Participants were instructed to respond as quickly as possible following stimulus presentation. For both simple and choice reaction time tests, three trials were recorded, and the lowest reaction time value was considered for analysis. Mean values were subsequently calculated for ART and VRT.

Critical flicker fusion frequency (CFFF) was assessed in the same participants using a flicker fusion apparatus presenting green light stimuli at frequencies ranging from 12 to 120 Hz. Participants were seated at a distance of approximately 80 cm from the light source in a semi-darkened room. Following an initial adaptation period, the frequency of the flickering stimulus was gradually increased from the minimum threshold until the participant reported perception of the flickering light as steady or fused. The frequency at which fusion was perceived was recorded as the CFFF threshold and used for statistical analysis.

Statistical analysis:
Data were cleaned, coded, and entered into a computerized database prior to analysis. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) software. Continuous variables were summarized and expressed as mean ± standard deviation (SD), while categorical variables were presented as frequency and percentage. Comparisons between mobile gamers and non-gamers were performed using appropriate statistical tests, including the chi-square test for categorical variables. A p-value less than 0.05 was considered statistically significant for all analyses.

RESULTS

During the study period, a total of 180 undergraduate medical students who met the eligibility criteria were enrolled and included in the final analysis. Participants were categorized into two groups based on their self-reported mobile gaming behaviour using the operational definitions: 88 students (48.9%) were classified as mobile gamers and 92 students (51.1%) were classified as non-gamers. All participants completed the full study protocol, including assessment of audio reaction time (ART), visual reaction time (VRT), and critical flicker fusion frequency (CFFF). No participants were excluded due to incomplete data, withdrawal, or protocol deviations.

The mean age of the study participants was 18.7 ± 0.6 years in the mobile gamer group and 18.9 ± 0.5 years in the non-gamer group, with no statistically significant difference between groups ($p > 0.05$). The study population had a male predominance, with 60 males and 28 females in the gamer group and 65 males and 27 females in the non-gamer group. Other baseline characteristics, including sleep patterns, study hours per week, and prior exposure to reaction time tests, were comparable between the two groups, indicating that the cohorts were well-matched and that observed differences in ART, VRT, and CFFF were unlikely to be influenced by these variables (Table 1).

Table 1. Baseline characteristics of study participants (n = 180)

Characteristic	Mobile Gamers (n = 88)	Non-Gamers (n = 92)	p-value
Age (years, mean ± SD)	18.7 ± 0.6	18.9 ± 0.5	0.08
Gender (Male:Female)	60:28	65:27	0.72
Study hours per week (mean ± SD)	28.4 ± 4.5	29.1 ± 4.8	0.32
Sleep duration (hours/night, mean ± SD)	6.9 ± 0.8	7.0 ± 0.7	0.45
Prior exposure to reaction time tests (Yes/No)	12/76	10/82	0.64

Data are expressed as mean ± standard deviation (SD); p-value < 0.05 was considered statistically significant

Audio Reaction Time:

Audio reaction time (ART) was assessed in all 180 participants using a standardized audio-visual choice reaction time apparatus under controlled laboratory conditions with adequate lighting and minimal external distractions. Each participant was familiarized with the procedure before recording to ensure reliable measurements. ART represents the time interval between the presentation of an auditory stimulus and the participant's motor response.

In the present study, mobile gamers demonstrated a lower mean ART of 227.9 ± 24.4 ms, reflecting faster auditory response, compared to 248.1 ± 26.5 ms among non-gamers. This difference was statistically significant ($p < 0.001$), indicating that students engaging in mobile gaming exhibited more rapid processing and execution of auditory stimuli than non-gamers. The distribution of ART values was approximately normal in both groups, with a slightly narrower range among gamers, suggesting more consistent auditory reaction performance in this group (Table 2).

Table 2. Audio reaction time (ART) comparison between mobile gamers and non-gamers

Group	n	Mean ART (ms) ± SD	Range (ms)	p-value
Mobile Gamers	88	227.9 ± 24.4	190–280	< 0.001*
Non-Gamers	92	248.1 ± 26.5	200–310	

Data are expressed as mean ± standard deviation (SD); *p-value was statistically significant

Visual Reaction Time:

Visual reaction time (VRT) was measured in all participants using a standardized visual stimulus apparatus under controlled laboratory conditions. Participants were seated comfortably in front of the device, and the visual stimuli consisted of red, green, and yellow monochromatic lights. Each participant was familiarized with the testing procedure and performed practice trials to ensure accurate and consistent responses. VRT represents the time interval between the presentation of a visual stimulus and the participant's motor response.

In this study, mobile gamers demonstrated a mean VRT of 212.5 ± 22.2 ms, which was significantly shorter than the 231.8 ± 25.1 ms observed among non-gamers. The difference in VRT between the two groups was statistically significant ($p < 0.001$), indicating faster visual processing and motor response execution among students who engage in mobile gaming. The range of VRT values among gamers was slightly narrower than in non-gamers, suggesting more consistent visual response performance in this group (Table 3).

Table 3. Visual reaction time (VRT) comparison between mobile gamers and non-gamers

Group	n	Mean VRT (ms) ± SD	Range (ms)	p-value
Mobile Gamers	88	212.5 ± 22.2	180–260	< 0.001*
Non-Gamers	92	231.8 ± 25.1	190–280	

Data are expressed as mean ± standard deviation (SD); *p-value was statistically significant

Critical Flicker Fusion Frequency:

Critical flicker fusion frequency (CFFF) was assessed in all study participants using a standardized flicker fusion apparatus in a semi-darkened room. Participants were seated approximately 80 cm from the light source, and the frequency of the green light stimulus was gradually increased from 12 Hz until the participant reported perceiving the flickering light as steady or fused. The CFFF value represents the threshold frequency at which the intermittent light is perceived as continuous, serving as an index of cortical arousal and central nervous system processing efficiency.

In the present study, mobile gamers exhibited a higher mean CFFF of 38.6 ± 4.2 Hz, compared to 34.2 ± 3.9 Hz in non-gamers. This difference was statistically significant ($p < 0.001$), indicating that students engaging in mobile gaming demonstrated enhanced visual perceptual processing and higher cortical arousal. The range of CFFF values was slightly broader among non-gamers, suggesting more variability in central visual processing within this group (Table 4).

Table 4. Critical Flicker Fusion Frequency (CFFF) comparison between mobile gamers and non-gamers

Group	n	Mean CFFF (Hz) ± SD	Range (Hz)	p-value
Mobile Gamers	88	38.6 ± 4.2	30–46	< 0.001*
Non-Gamers	92	34.2 ± 3.9	28–42	

Data are expressed as mean ± standard deviation (SD); *p-value was statistically significant

DISCUSSION

The present study provides a systematic evaluation of audio-visual reaction time (ART and VRT) and critical flicker fusion frequency (CFFF) among undergraduate medical students, stratified according to their engagement in mobile gaming. Our findings demonstrate that students who regularly engage in mobile gaming exhibit significantly faster auditory and visual reaction times and higher CFFF thresholds compared to their non-gaming peers. These results indicate that mobile gaming is associated with enhanced efficiency of sensory processing, more rapid sensorimotor integration, and elevated cortical arousal, reflecting a heightened readiness of the central nervous system to respond to external stimuli. The observed enhancements in ART, VRT, and CFFF likely represent experience-dependent neuroplastic adaptations, including strengthened attentional networks, improved synaptic connectivity within sensorimotor circuits, and optimized processing in visual cortical pathways. Collectively, these neurophysiological modifications contribute to improved perceptual discrimination, faster decision-making, and more precise motor execution, underscoring the potential of moderate gaming activities to positively influence cognitive and psychomotor performance in young adults[6,13].

Reaction time is a widely accepted neurophysiological marker of central nervous system efficiency, reflecting the integrated processes of sensory perception, cognitive evaluation, and motor execution[14]. In the present study, undergraduate medical students who engaged in mobile gaming demonstrated significantly faster auditory and visual reaction times, with a mean ART of 227.9 ± 24.4 ms and a mean VRT of 212.5 ± 22.2 ms, compared to their non-gaming counterparts. These findings corroborate earlier evidence indicating that exposure to action-oriented video games is associated with enhanced visuospatial attention, superior hand–eye coordination, and accelerated information processing speed[1,2]. The repeated exposure to rapidly changing auditory and visual stimuli inherent to mobile gaming may induce experience-dependent neural adaptations, strengthening synaptic efficiency and functional connectivity within attentional and sensorimotor networks. Such adaptations likely facilitate faster stimulus detection, improved response selection, and more efficient motor execution, thereby contributing to reduced reaction times. These findings support the premise that moderate mobile gaming may enhance psychomotor performance through adaptive neuroplastic changes in the central nervous system, particularly in young adults with high cognitive demands.

Critical flicker fusion frequency (CFFF) represents the temporal threshold at which an intermittently presented light stimulus is perceived as steady, and is widely regarded as a sensitive indicator of central nervous system processing efficiency and cortical arousal[15]. In the present study, mobile gamers demonstrated a significantly higher mean CFFF (38.6 ± 4.2 Hz) compared to non-gamers (34.2 ± 3.9 Hz), corroborating previous reports that have documented enhanced visual temporal resolution and perceptual sensitivity among individuals engaged in video gaming[16,17]. The elevated CFFF observed in mobile gamers likely reflects more efficient temporal integration within the visual cortex, enhanced attentional modulation, and increased sensory alertness, all of which are indicative of optimized cortical processing. Repeated exposure to rapidly fluctuating visual stimuli during gaming may promote experience-dependent plasticity in visual and attentional networks, thereby improving the ability to discriminate high-frequency sensory input. These neurophysiological enhancements may translate into superior rapid information processing, quicker decision-making, and improved multitasking capacity, attributes that are particularly advantageous in demanding academic environments and clinical settings where sustained attention and swift responses are critical.

Several neurobiological mechanisms may underlie the observed differences in reaction time and critical flicker fusion frequency between mobile gamers and non-gamers. Engagement in mobile gaming necessitates continuous monitoring of rapidly changing visual and auditory stimuli, swift decision-making, and precise motor coordination, which may lead to strengthening of frontoparietal attentional networks and enhanced visual–motor integration[18]. Such sustained cognitive and perceptual demands are known to promote functional reorganization within neural circuits responsible for attention allocation and sensorimotor control. Furthermore, repeated exposure to high-speed audiovisual stimuli inherent to gaming may facilitate temporal processing efficiency, predictive coding, and anticipatory motor responses, thereby contributing to faster reaction times and higher CFFF thresholds. These adaptations likely reflect experience-dependent neuroplasticity, potentially involving increased synaptic efficacy, enhanced myelination, and reinforced functional connectivity within sensorimotor pathways and visual attention circuits. Collectively, these neuroplastic changes may optimize neural processing speed and sensory integration, resulting in improved psychomotor performance and heightened cortical responsiveness.

The findings of the present study are in concordance with existing literature demonstrating shorter auditory and visual reaction times among gamers[1,14], as well as higher critical flicker fusion frequency thresholds when compared to non-gamers[17,19]. Aditya Jain et al.[6] reported significant reductions in auditory reaction time among undergraduate students who engaged in video gaming, suggesting enhanced auditory processing and faster sensorimotor responses. Similarly, Chiranjeevi Kumar et al.[13] documented improvements in visual attention, reaction time, and overall psychomotor performance in gaming populations, attributing these benefits to sustained engagement with visually demanding and fast-paced tasks. In contrast, some studies have highlighted potential adverse cognitive and behavioral effects associated with excessive or prolonged gaming, including attentional fatigue, reduced executive control, and impaired academic performance[20]. These divergent findings underscore the importance of gaming duration, intensity, and context in determining cognitive outcomes, and suggest that while moderate gaming may confer neurocognitive benefits, excessive exposure could negate these advantages. Collectively, this body of evidence emphasizes the need for a balanced approach to gaming, particularly among medical students with high cognitive and academic demands.

Strengths of this study include the well-defined, homogeneous sample, standardized measurement of ART, VRT, and CFFF, and inclusion of objective neurophysiological parameters. Limitations include its cross-sectional design, which precludes causal inference, and reliance on self-reported gaming behaviour, which may be subject to reporting bias. The study did not account for potential confounders such as caffeine intake, circadian rhythm variations, or academic stress. Future longitudinal studies incorporating neuroimaging, electrophysiology, or controlled gaming interventions could provide further mechanistic insights.

CONCLUSION

The present study demonstrates that undergraduate medical students who engage in mobile gaming exhibit significantly faster auditory and visual reaction times and higher critical flicker fusion frequency thresholds compared to non-gamers. These findings suggest that moderate mobile gaming is associated with enhanced sensory processing, improved sensorimotor integration, and increased cortical arousal, reflecting experience-dependent neuroplastic adaptations within attentional and visual processing networks. While these results highlight potential cognitive and psychomotor benefits of mobile gaming in a young adult population, they also underscore the importance of balanced gaming practices. Further longitudinal and interventional studies are warranted to establish causality and to elucidate the long-term neurophysiological implications of mobile gaming in medical students.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

1. Green CS, Bavelier D. Action video game modifies visual selective attention. *Nature*. 2003;423(6939):534–537.
2. Dye MWG, Green CS, Bavelier D. Increasing speed of processing with action video games. *Curr Dir Psychol Sci*. 2009;18(6):321–326.
3. King DL, Delfabbro PH. The cognitive psychology of Internet gaming disorder. *Clin Psychol Rev*. 2014;34(4):298–308.
4. Dyrbye LN, Shanafelt TD. A narrative review on burnout experienced by medical students and residents. *Med Educ*. 2016;50(1):132–149.
5. Paulus FW, Ohmann S, von Gontard A, Popow C. Internet gaming disorder in children and adolescents: a systematic review. *Dev Med Child Neurol*. 2018;60(7):645–659.
6. Jain A, Bansal R, Kumar A, Singh KD. A comparative study of visual and auditory reaction times on the basis of gender and physical activity levels of medical students. *Int J Appl Basic Med Res*. 2015;5(2):124–127.
7. Shelton J, Kumar GP. Comparison between auditory and visual simple reaction times. *Neurosci Med*. 2010;1(1):30–32.
8. Hubert-Wallander B, Green CS, Sugarman M, Bavelier D. Changes in search rate but not in the dynamics of exogenous attention in action video game players. *Atten Percept Psychophys*. 2011;73(8):2399–2412.
9. Simonson E, Brozek J. Flicker fusion

frequency: background and applications. *Physiol Rev*. 1952;32(3):349–378.
10. Curran S, Wattis J. Critical flicker fusion threshold: a potentially useful measure for the early detection of cognitive impairment in dementia. *Hum Psychopharmacol*. 2000;15(2):103–112.
11. Smith JM, Misiak H. Critical flicker frequency (CFF) and psychopharmacology. *Psychopharmacologia*. 1976;47(2):175–182.
12. Mishra A, Singh D, Kumar R. Effect of video gaming on critical flicker fusion frequency and reaction time in young adults. *Indian J Physiol Pharmacol*. 2018;62(2):195–201.
13. Kumar Endukuru C, Maruthy KN, Deepthi TS. A study of critical flickering fusion frequency rate in media players. International Journal of Current Medical and Pharmaceutical Research. 2015 May;1(2):23-7.
14. Posner MI, Petersen SE. The attention system of the human brain. Annu Rev Neurosci. 1990;13:25–42.
15. Campos EC, Bedell HE. Critical flicker-fusion frequency as an indicator of human receptive field-like properties. Invest Ophthalmol Vis Sci. 1978 Jun;17(6):533-8. PMID: 659074.
16. Foerster FR, Chidharom M, Giersch A. Enhanced temporal resolution of vision in action video game players. Neuroimage. 2023 Apr 1;269:119906. doi: 10.1016/j.neuroimage.2023.119906. Epub 2023 Feb 3. PMID: 36739103.
17. Castel AD, Pratt J, Drummond E. The effects of action video game experience on the time course of inhibition of return and the efficiency of visual search. Acta Psychol (Amst). 2005 Jun;119(2):217-30. doi: 10.1016/j.actpsy.2005.02.004. Epub 2005 Mar 23. PMID: 15877981.
18. Boot WR, Kramer AF, Simons DJ, Fabiani M, Gratton G. The effects of video game playing on attention, memory, and executive control. Acta Psychol (Amst). 2008 Nov;129(3):387-98. doi: 10.1016/j.actpsy.2008.09.005. Epub 2008 Oct 16. PMID: 18929349.
19. Bavelier D, Green CS, Pouget A, Schrater P. Brain plasticity through the life span: learning to learn and action video games. Annu Rev Neurosci. 2012;35:391-416. doi: 10.1146/annurev-neuro-060909-152832. PMID: 22715883.
20. Daniel Kardefelt-Winther. The moderating role of psychosocial well-being on the relationship between escapism and excessive online gaming, Computers in Human Behavior. Vol 38, 2014, (68-74); ISSN 0747-5632.

