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Gaming habits, cognitive flexibility and sleep quality among gamers

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Abstract

In the modern era, gaming has emerged as a predominant recreational activity among young adults, prompting an examination into its impact on cognitive flexibility and sleep quality. The aim of the study was to assess the impact of gaming habits on cognitive flexibility and sleep quality among gamers and to understand the relationship between them. The study was conducted among individuals ranging from 18-26 of age range. The study used a convenient sampling method and data from 150 gamers were collected and analyzed utilizing statistical methodologies such as Spearman's correlation and Simple Linear Regression using IBM SPSS. The study uncovered significant correlations between gaming habits and both cognitive flexibility and sleep quality. Furthermore, it revealed a positive association, indicating that gaming habits have a positive influence on both cognitive flexibility and sleep quality. These findings provide valuable insights for taking initiatives aimed at promoting balanced gaming behaviors and enhance awareness about the importance of maintaining optimal sleep hygiene practices in gaming communities.

Keywords: Cognitive Flexibility Cognitive Performance; Gaming Habits; Sleep Quality

1. Introduction

In today's world, where technology is all around us, gaming has become a big way young adults have fun and connect and the excitement of imaginary digital places, stories you control, and exciting competitions has caused lots more people to start playing video games (Meriläine, 2023). This has made a huge number of people get into playing video games. Over the past few decades, playing video games has risen to become one of the most widespread sources of amusement across the globe. Amongst users, teenagers and young adults are the primary enthusiasts of video games (Meriläine, 2023). Adolescents dedicate around 3 hours each day to consuming various types of entertainment media, including television, the Internet, computers, and video games (Nagata et al., 2021). Specifically the numbers ascended during the pandemic where a lot of young minds were engrossed to an extent where it also affected them in some or the other way. (Nagata et al., 2021). Video games have become an integral aspect of the daily lives of nearly all children and adolescents, with 97% engaging in gaming for at least an hour each day in the United States. While much of the research conducted by psychologists has focused on the negative impacts of gaming, such as violence, addiction, and depression, it is important to adopt a more balanced perspective (Granic et al., 2014). Today's games are characterized by increased complexity, diversity, realism, and social interaction. Therefore, it is imperative to consider not only the potential drawbacks but also the positive aspects that gaming can offer (Granic et al., 2014)

1.1. Conceptual Background

According to cognitive flexibility theory, cognitive flexibility comprises the capacity to represent information from various conceptual and case views. When the knowledge is subsequently needed, it also entails the capacity to create a knowledge ensemble from these various conceptual and case representations, that is suited to the comprehension or problem-solving scenario at hand (Gruber, 2001). A broad range of cognitive abilities can be developed through

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enhanced brain connectivity by indulging in selected gaming (Granic et al., 2014; Spanos, 2021). In this sense, video games can be a good aid to promote well-being, prevent and treat mental health issues (Granic et al., 2014). Yet, gaming has also been reported to have detrimental effects in case of excessive usage (Spanos et al., 2021). Excessive consumption can significantly lead to sleep disorders (Peracchia & Curcio, 2018) by altering brain biochemical and circadian rhythms (Breus, 2024). Eventually, poor quality of sleep can further deteriorate cognitive abilities (Honn et al., 2019; Spanos, 2021).

The conceptual analysis of sleep by (Nelson et al., 2022) talks about the degree to which a person is content with every facet of their sleep experience. This is the perceived sleep quality. The four components of sleep quality include wakefulness following sleep onset, sleep latency, length, and efficiency. Factors affecting sleep quality can be psychological (stress, anxiety, depression), physiological (age, circadian rhythm, body mass index) and environmental (room temperature, TV/device use, family/social obligations). Consequences of poor sleep quality include exhaustion, agitation, malfunction during the day, delayed reactions, etc. Sleep quality is a critical factor for overall health and well-being, influencing cognitive performance, mood regulation, and physical health (Spanos, 2021). According to Honn and colleagues (2019), sleep loss significantly results in deficiencies in cognitive flexibility.

1.2. Navigating Gaming Habits, Cognitive Flexibility, and Sleep Quality

Recent findings suggest that participation in digital pastimes contributes to the development and enhancement of a broad spectrum of cognitive abilities commonly labeled as "action" games within academic circles (Granic et al., 2014; Spanos, 2021). Most conceptual approaches aim to contextualize concepts within their historical and cultural settings and for historians, this means considering not only the spatial context but also the temporal context—the specific time period being studied (Spanos, 2021). It's essential to recognize that interpreting concepts from the past requires understanding their meaning within that historical period, not through the lens of present-day perspectives (Spanos, 2021). Digital games like Civilization or fantasy role-playing games—they each have unique characteristics that may not align with conventional terminology (Spanos, 2021). In essence, studying games from a conceptual standpoint involves unraveling the meanings behind the terms used to describe them and understanding how those meanings have evolved over time within specific historical contexts therefore it requires careful consideration of the nuances and complexities inherent in different types of games and the various perspectives from which they are studied (Spanos, 2021).

Video games can help youth promote well-being as well as prevent and treat mental health disorders (Granic et al., 2014). Video games may be utilized to mitigate Alzheimer's disease risk factors since gamers' brains contain more grey matter, which enhances brain connectivity. Playing active video games on a regular basis can enhance one's physical and mental well-being (Spanos et al., 2021). Video gaming through mobile devices for an extended number of hours automatically leads to a prolonged screen activity. Long-term VG exposure, especially in the evening, is a significant, frequent, and likely source of sleep disorders (Peracchia & Curcio, 2018). The severity of the link between problematic gaming and sleep issues has varied among studies, and the directionality/causality remains unknown hence given the importance of adequate sleep duration and quality for optimal functioning, subjective well-being, and good health, identifying potential drivers of sleep difficulties is of critical scientific and practical importance (Karna et al., 2023). Manero et al. (2016) looked into the ways in which age, gender, and gaming habits affect how effective an educational video game is at encouraging teens to watch classical theatre. According to the study, students' interest in theatre was highly influenced by their gaming habits, with casual and well-rounded gamers demonstrating greater interest than non-gamers and hardcore players. Similarly the primary goal of a different study by Ozcetin et al. (2019) evaluated the impact of video games on teenagers but on cognitive functions. The cross-sectional study revealed that the playing group's visual memory scores were somewhat higher. Furthermore, the total error value in the Stroop Test and the total interference value in the California Verbal Learning Test-Children's Version test both considerably rose in the group that plays video games on a daily basis. Liao et al. (2020) found that gaming behaviors were positively correlated with perceived price fairness and motivation to meet gaming objectives, both of which were associated with higher levels of online gamer loyalty. According to Feng et al. (2020) individuals who were classified as belonging to the high flexibility group demonstrated superior performance in acquiring the rules of the task compared to those classified as low flexibility they also exhibited significantly higher accuracy levels. Zaman et al. (2022) assess the prevalence of gaming addiction among a Pakistani sample it was found that gaming addiction among the Pakistani general population is significantly associated with poor sleep quality however according to Peracchia and his colleague (2018) intense video gamers reported significantly higher subjective sleep quality, habitual sleep efficiency, and positive daytime functioning. Interestingly, playing video games intensely turned out to be a stronger predictor of poor sleep quality than playing them for extended periods of time.

1.3. Need and significance of the study

Analyzing the effects of gaming on sleep quality and cognitive flexibility can help address potential issues with excessive gaming and provide insight into how gaming impacts these aspects of life. A study is necessary because there isn't enough research being done in this field right now (Peracchia & Curcio, 2018). Ultimately, this research is important for both designing legislation that supports responsible gaming practices and comprehending the broader effects of gaming on mental health

1.4. Research Gap

Examining how gaming affects cognitive flexibility and sleep quality can assist in addressing possible concerns related to excessive gaming. Furthermore, a study is required because there is currently a research deficit in this area (Alsaad et al., 2022). Numerous studies have established a link between gaming habits and poor sleep quality, and research has also been done based on gaming sports and gaming skills with cognitive flexibility but there haven't been much studies done based on gaming habits and cognitive flexibility and how they correlate (Imanian et al., 2024; Podlogar & Podlešek, 2022; Reynaldo et al., 2021). There is a paucity of prior research that is exclusively focused on the topic under study, particularly when considering India (Alsaad et al., 2022).

2. Material and methods

2.1. Aim

To assess the impact of gaming habits on cognitive flexibility and sleep quality among gamers and to understand the relationship between them

2.2. Statement of the Problem:

The frequency of gaming behaviors has significantly increased in the last few years. For people of all ages, it has grown to be a highly popular pastime. Therefore, it's unclear exactly how gaming habits, like playing frequency and kind, connect to cognitive flexibility (Hamre et al., 2022). Despite several research conducted based on sleep as a domain, there have been little studies on cognitive flexibility. A study concentrating on these subjects is necessary because there hasn't been much research done on cognitive flexibility and sleep together. Further information is required to determine whether a relationship exists between these variables and how they relate to one another (Cibdol 2023; Hamre et al., 2022)

2.3. Objectives of the study

To assess the relationship between gaming habits, cognitive flexibility and sleep quality

To assess the influence of gaming habits on cognitive flexibility and sleep quality

2.4. Hypotheses

- **H₁:** There is a significant relationship between gaming habits and cognitive flexibility
- **H₂:** There is a significant relationship between gaming habits and sleep quality
- **H₃:** There is an influence of gaming habits on cognitive flexibility
- **H₄:** There is an influence of gaming habits on sleep quality

2.5. Operational Definitions

2.5.1. Gaming Habits:

The term "gaming habits" pertains to the actions, trends, and regularities people establish when engaging in video games. These behaviors cover different elements of a person's gaming involvement, such as their frequency of play, preferred game genres, the time spent gaming (Mozelius et al., 2016). Gamers' performance suffers as a result of spending longer time gaming than intended and neglecting other crucial tasks (Demetrovics et al., 2012)

2.5.2. Cognitive Flexibility

Cognitive flexibility is the understanding that there are options and alternatives available in every given scenario, the willingness to be adaptable and flexible, and the self-efficacy in being adaptable in any given situation where an individual has a choice about how to behave (Martin & Rubin, 1995)

2.5.3. Sleep Quality

An individual's level of contentment with every facet of their sleep experience is referred to as their sleep quality (Harvey et al., 2008). Subjective happiness, optimal timing, sufficient duration, high efficiency, and prolonged attentiveness during waking hours are characteristics of good sleep health. (Buysse & Reynolds, 1989)

2.6. Variables

- **Independent Variable:** Gaming Habits
- **Dependent Variables:** Cognitive Flexibility and Sleep Quality

2.7. Sample Distribution- Inclusion and Exclusion criteria

2.7.1. Inclusion Criteria

- Participants of both genders (Male and Female)
- College going students
- Individuals who go to frequent gaming lounges

2.7.2. Exclusion criteria

- Individuals who are employed

2.8. Sample Procedure

The study will focus on people aged 18 to 26 who often spend a minimum of three hours each day playing video games. The sampling technique used in this study is convenient sampling. convenient sampling is a non-probability sampling technique where subjects are selected based on their easy availability and proximity to the researcher. This method is often used due to its ease and speed in data collection, making it convenient for researchers

2.9. Description of the tools

2.9.1. Cognitive Flexibility Scale

Martin and Rubin (1995) developed the Cognitive Flexibility Scale. According to Dennis and Vander Wal (2010), the whole score ($r = .81$), the Alternatives subscale ($r = .75$), and the Control subscale ($r = .77$) of the 20-item CFI demonstrated strong test-retest reliability. For the Alternatives subscale ($\alpha = .91$), the Control subscale ($\alpha = .86$), and the total score ($\alpha = .90$), Cronbach's alpha ranged from good to outstanding (Martin et al., 1995).

2.9.2. Pittsburgh Sleep Quality Index

The most widely used self-report questionnaire for evaluating overall sleep quality was created by Daniel J. Buysse, and is called the Pittsburgh Sleep Quality Index (PSQI). The 18 separate components that make up the PSQI are used to evaluate daily impairments, sleep disruptions, and sleeping habits. The PSQI has strong internal consistency (Cronbach's α range= 0.70–0.83), known-group concept validity, convergent validity, and divergent validity, according to a recent comprehensive review and meta-analysis of 37 psychometric studies (Wang and others, 2022).

2.9.3. Problematic Online Gaming Questionnaire Short Form (POGQ-SF)

It is a 12-item version of the POGQ-SF was utilized to assess problematic online gaming. Demetrovics and colleagues developed the tool. The POGQ was initially created as an 18-item scale with good psychometric properties, drawing on a wide variety of empirical data. It examines six components of problematic use: withdrawal, social isolation, overuse, obsession, and interpersonal issues. Cronbach's alpha was 0.857 (Demetrovics et al., 2012; Pay et al., 2013).

2.10. Procedure

To collect data for the study, an online questionnaire consisting of the tools, required demographic details, informed consent and relevant details regarding the study was created using Google Forms. The link for the online questionnaire form was shared in Reddit and Discord gaming communities involved in gaming be it mobile device or PC so as to ensure widespread exposure to the population of the study. The links were also circulated through WhatsApp and Instagram to obtain data. Data was collected for a duration of eight weeks. After gathering the data, IBM SPSS Statistics Software was used for analysis.

2.11. Ethical Considerations

Throughout the whole study, the participant's confidentiality was maintained. The consent to take part in this investigation was given by the participants. No subject was forced to take part in this research. Consent was taken from the participant before the participation in the study

2.12. Statistical Techniques

Statistical tools employed in the study were Spearman's correlation to assess the relationship and Simple Linear Regression to assess the impact of the two variables. The data was interpreted in IBM SPSS

3. Results and discussion

3.1. H₁: There is a significant relationship between gaming habits and cognitive flexibility

Table 1 The non-parametric correlation between Gaming Habits and Cognitive Flexibility among gamers using Spearman correlation

Variables	Gaming Habits		
	N	ρ	Sig
Cognitive Flexibility	134	0.901**	0.000

**Correlation is significant at 0.05 level

Table 1 shows the relationship between gaming behaviors and cognitive flexibility is displayed in the following were the outcomes: N=134; ($\rho=0.901^{**}$, $p < 0.05$). At alpha 0.05, the association is significant. The obtained significance value or the p value is .000 which is lesser than the 0.05. The data in the table indicates that there is a strong positive correlation between gamers' gaming habits and cognitive flexibility.

The first hypothesis that we had set was that there exists a significant relationship between gaming habit and cognitive flexibility. According to the results obtained from the data, a significant strong positive correlation was found between gaming habit and cognitive flexibility. It can be interpreted as that as gaming habits increase, the cognitive flexibility also increases. When an individual is involved in games it increases or enhances their cognitive flexibility based upon how often they play and hone their skills. On the other hand when gaming habits decrease the cognitive flexibility of an individual decreases as well. Hence, from our results it can be concluded that our alternative hypothesis is accepted. A study conducted by Glass and colleagues (2013) on 'Real time strategy game training: Emergence of a cognitive flexibility trait' found that playing engaging video games that emphasize quick manipulation and maintenance of several information sources can fine-tune the distributed brain networks underlying cognitive flexibility. These findings could point to ways to improve cognitive function. According to Choi and his colleagues (2020) commercial video games, designed primarily for entertainment, have also shown a positive link with cognitive abilities such as attention and problem-solving skills, though findings across studies vary.

3.2. H₂: There is a significant relationship between gaming habits and sleep quality

Table 2 Shows The non-parametric correlation between Gaming Habits and Sleep Quality among gamers using Spearman

Variables	Gaming Habits		
	N	ρ	Sig
Sleep Quality	134	0.419**.	0.000

**Correlation is significant at 0.05 level

Table 2 displays the relationship between gaming behaviors and sleep quality is displayed in Table 2. The following were the outcomes: N=134; ($\rho=0.419^{**}$, $p < 0.05$). The obtained significance value or p value is .000 which is lesser than the significant value of 0.05. The data in the table indicates that there is a significant moderate correlation between gamers' gaming habits and sleep quality.

The second hypothesis that we set was that there exists a significant relationship between gaming habits and sleep quality. According to the results obtained from the data from our research a significant positive correlation was found. Furthermore it was found that there exists a moderate significant correlation between gaming habits and sleep quality. To put it in other words it is thought that as gaming habits increase, the sleep quality also increases. An individual's gaming increases the quality of sleep of that individual. The sleep quality depends upon how long the individual is planning to play the games the more the gaming, more the sleep and better would be the quality of sleep. On the other hand when the gaming habits decrease the sleep quality decreases as well. Hence, from our results it can be concluded that our alternative hypothesis was accepted. A study on "Longer the Game, Better the Sleep: Intense Video Game Playing is Associated to Better Sleep Quality and Better Daytime Functioning" was carried out by Peracchia and colleague (2018). The results showed that the HG (Hard Gamer) group reported significantly better daytime functioning, habitual sleep efficiency, and subjective sleep quality than the CG (casual gamers) group. The results were examined in light of the possible relationship between the intensity of daily activities and overall sleep quality, taking into account the potential biases present in self-reported measures of sleep quality.

3.3. H₃: There is an influence of gaming habits on cognitive flexibility

Table 3 The influence of Gaming Habits on Cognitive Flexibility among gamers

Variables	Beta	R ²	F	P
Cognitive Flexibility	0.905	0.819	599.107	0.000

Table 3 shows the influence of gaming habits on cognitive flexibility among gamers. The table shows the dependent variable cognitive flexibility regressed on predicting the variable gaming habits to test the hypothesis. A significant regression equation was found $F(1,132) = 34.442$, ($p < 0.005$ level) with an R^2 of .819 and the beta value obtained was ($\beta = .905$) which indicates that gaming habits does influence cognitive flexibility among gamers and that gaming habits significantly did predict cognitive flexibility. The p value .000 is lesser than the significance value of 0.05 and can be concluded that the null hypothesis is rejected. The $R^2 = .819$ depicts that the model explains 81.9% of the variance in cognitive flexibility. Hence the alternate hypothesis that Gaming Habits have a significant influence on cognitive flexibility is accepted.

The third hypothesis that was set was that there is an influence of gaming habits on cognitive flexibility. Our findings showed that gaming habits had a significant influence on cognitive flexibility. Upon comparing and evaluating gaming habits with cognitive flexibility, the findings made it clear that gaming habits had a positive influence on cognitive flexibility and that gaming habits did predict cognitive flexibility. As a result, the alternative hypothesis regarding the influence of gaming habits on cognitive flexibility was accepted. According to a study conducted by Colzato and his colleagues (2010) their findings show that videogame experience is associated with cognitive flexibility as measured by a task-switching paradigm: VGP (video gaming players) showed smaller switching costs than NVGP (non-video gaming players) suggesting that they have better cognitive-control skills. Despite the drawbacks, online gaming has been shown to enhance cognitive performance (Ryu et al., 2021). Another study investigated how the degree of gaming addiction affects changes in event-related potentials (ERP) during task switching. A total of 45 middle school boys, ages 13 to 15, participated in the study. High-risk, potential-risk, and general groups were selected based on the results of the Internet Addiction Scale. The potential-risk group showed larger amplitudes in the P300 analyses when compared to the high-risk and general user groups at the F3 region and during the shape task, respectively. This suggests that the potential-risk group has greater cognitive flexibility to handle stimulus-related interference (Ryu et al., 2021).

3.4. H₄: There is an influence of gaming habits on sleep quality

Table 4 Shows the influence of Gaming Habits on Sleep Quality among gamers

Variables	Beta	R ²	F	P
Sleep Quality	0.455	0.207	34.442	0.000

Table 4 shows the influence of gaming habits on sleep quality among gamers. The table shows the dependent variable cognitive flexibility was regressed on predicting the variable gaming habits to test the hypothesis H4. A significant regression equation was found that the $F(1,132) = 599.107$ ($p < 0.05$ level) with an R^2 of .207 and the beta value obtained was ($\beta = .455$) which indicates that gaming habits influence cognitive flexibility among gamers and which

indicates that gaming habits significantly predicted cognitive flexibility. The p value .000 is lesser than the significant value of 0.05 level and can be concluded that the results being significant and having an influence on the variable. These results clearly indicate the positive effect of gaming habits. Moreover the $R^2 = .207$ depicts that the model explains 20.7% of the variance in cognitive flexibility. Hence the alternate hypothesis that Gaming Habits have a significant influence on Sleep Quality is accepted.

The fourth hypothesis that was set was that there is an influence of gaming habits on sleep quality. Our findings showed that gaming habits being an independent variable had a significant effect on sleep quality that is the dependent variable. Upon comparing and evaluating gaming habits with sleep quality, the findings made it clear that gaming habits had a positive influence on sleep quality and that gaming habits did predict sleep quality. As a result, the alternative hypothesis regarding the influence of gaming habits on sleep quality was accepted. A study conducted by De Rosa and colleagues (2023) reported that playing video games does not always lower the quality of sleep and may even improve daytime performance. This highlights the need to re-evaluate the links between video game use and health, taking into account potential moderating factors such frequent VG (video game) exposure. Yet according to many contrasting studies still exist which states that playing video games for extended amounts of time, is a substantial, frequent, and likely cause of sleep disorders (Perrachia & Curcio, 2018; Silvi et al., 2024). Exposure to VGs (video gaming) in the evening can actually result in inadequate and poor quality sleep, which may have an impact on cognition during the waking days that follow (Perrachia & Curcio, 2018). Hence, it may be of utmost significance to evaluate the relationship behind game exposure and sleep quality in a nuanced manner (De Rosa et al., 2023).

4. Conclusion

The subject of video gaming is worth examining from the standpoint of human psychology and behavior because of its enormous popularity, cognitive flexibility, and sleep quality. The primary aim of the research was to evaluate the correlation between gaming habits, cognitive flexibility, and sleep quality, as well as the impact of gaming habits on these dimensions. The results of the study showed that there is a substantial correlation between gaming habits and both cognitive flexibility and the quality of sleep. The study also showed that playing video games has a significant correlation and an influence on sleep quality and cognitive flexibility. All these findings suggest that gaming habits, cognitive flexibility and sleep quality are correlated and that sleep quality and cognitive flexibility are influenced by the gaming habits one adapts to. In conclusion, we can state that their gaming habits both affect them and have a substantial association with cognitive flexibility and sleep quality.

4.1. Implications

The individual well-being, understanding the impact of gaming habits on cognitive flexibility and sleep quality empowers individuals to make informed decisions about their gaming behaviors and prioritize healthy sleep patterns. The Public health initiatives can utilize these insights to raise awareness about balanced gaming practices and educate individuals on strategies to manage gaming habits and optimize sleep hygiene. Thirdly, the gaming industry can leverage the findings to inform game design practices and promote responsible gaming behaviors, potentially incorporating features that encourage breaks and monitor gaming habits. Future researches can build upon these insights to explore the underlying mechanisms driving the relationships between gaming habits, cognitive flexibility, and sleep quality, informing interventions and strategies aimed at promoting overall well-being in gaming enthusiasts.

4.2. Limitations and suggestions

The current study had a number of restrictions.. Second, the study's sample size was limited to a small age range of 18 to 26 years, which would have left out important perspectives from younger and older gamers. Furthermore, because the study concentrated on night-time gamers, people who mostly play video games in the afternoon or during the day were not included. Finally, the study's findings may have been limited in their depth and scope and maybe using a different statistical technique might have helped to give a better insight. It is suggested that further extensive research should be done focusing more on a larger population, across larger age groups and considering gender as a factor too. This could give rise to a further explanation with better insights even at a cross cultural level.

Compliance with ethical standards

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The author(s) declared no conflict of interest

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