

Examining the cognitive flexibility of e-Sports players

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Abstract

Objective: to investigate the cognitive flexibility of individuals involved in e-sports, with a focus on socio-demographic factors. **Method:** the Turkish version of the Cognitive Flexibility Inventory, as adapted by Sapmaz & Doğan (2013), was administered to a sample of 206 e-sports athletes who were selected via convenience sampling. The data were subjected to analysis using SPSS version 29.0.1.0 (171). The data obtained was analyzed using the Mann Whitney-U and Kruskal-Wallis tests. **Results:** based on the findings of the analysis, it was observed that within the cognitive flexibility inventory's control sub-dimension, there was no significant difference in relation to the gender variable among e-sports participants aged 18-23. However, when considering the frequency of exercise variable, favorable outcomes were obtained for e-Sports participants who engage in regular exercise. Furthermore, based on the analysis of the frequency and variability of technological device usage during exercise, it was determined that there is a positive correlation between the frequency of utilizing technological devices and cognitive flexibility scores. **Conclusion:** consequently, the study's findings indicate that female participants within the age range of 18-23, individuals who engage in regular exercise, and those who utilize technology devices during exercise exhibit elevated levels of cognitive flexibility. The investigation of cognitive flexibility among e-sports players has the potential to enhance their individual performance and elevate the overall professionalism of the e-Sports industry. **Recommendations:** to create and execute psycho-educational initiatives targeted at e-sports participants who exhibit limited cognitive flexibility. Competitive games are played under intense stress and pressure, which can adversely affect performance. These programs can help players develop stress coping strategies, enabling them to remain calmer and more focused during challenging moments and these programs aim to enhance the cognitive flexibility of e-sports participants, thereby improving their

performance in competitive games, enabling them to effectively manage stress, and promoting a state of improved mental well-being. In this context, these programs can assist players in feeling better about themselves and becoming psychologically stronger. Enhancing mental well-being can help players approach games with a more positive attitude and play effectively for longer periods.

Keywords: E-sports, technology and sport, cognitive flexibility.

Introduction

E-sports include structured video game tournaments wherein skilled individuals compete against one another in a competitive manner with the objective of securing monetary rewards. According to Himmelstein et al. (2017), these tournaments occur on electronic platforms that necessitate individuals to optimize their physical and cognitive abilities. According to Vukelic and Jørgensen (2017), e-sports are characterized as competitive games performed professionally using electronic platforms.

The integration of technology, like the evolution observed in traditional sports, has facilitated the growth of e-sports. Initially, the Internet was primarily employed for military communication within the United States. However, its current usage extends beyond military communication, as it has evolved into an integral facet of contemporary existence (Levine, 2018). In contemporary society, the emergence of a phenomenon known as e-sports has permeated our daily lives, integrating itself into the realm of traditional sports. This development has proven to be an integral and important component of the daily routines of individuals, particularly those belonging to the Generation Y and Z cohorts. E-sports is commonly characterized as engagement in competitive digital gaming within a self-regulated framework (Wagner, 2006). The field of electronic sports (e-sports) is experiencing substantial growth in contemporary times. The Turkish E-Sports Federation (TESFED) was officially founded under the Ministry of Youth and Sports in Turkey and commenced its operations in 2018. PlayerUnknown's Battlegrounds (PUBG) is a highly favored electronic sports (e-sports) game belonging to the genre of Massive Multiplayer First Person Shooter (MMOFPS). It is commonly engaged in team-based gameplay during international tournaments while also providing the choice for individual play (Desagita, 2018).

Cognitive flexibility encompasses the aptitude to generate diverse alternatives and the capability to engage in unconventional thinking, deviating from traditional solutions. Cognitive flexibility enables individuals to concentrate on particular circumstances, examine cognitive processes, and adjust their behavior in response to alterations, whereas cognitive inflexibility is associated with a tendency towards holistic thinking, distractions, and a resistance to change (Jonassen & Grabowski, 1993). Based on the framework of Cognitive Behavioral Therapy, it may be posited that rigidity serves as a fundamental contributing factor to the development of psychiatric disorders. The attribute of flexibility is a fundamental factor contributing to an individual's psychological well-being. It is widely held that individuals who possess a malleable viewpoint or adaptable views

regarding the events they encounter are more likely to respond to these circumstances in a manner conducive to their overall well-being. Flexibility is predicated upon individuals' capacity to contemplate several alternatives within the contexts they encounter, thereby embodying a logical mode of cognition. Indeed, it is widely regarded as a fundamental component of logical reasoning. According to Dryden and Neenan (2007), the concept of flexibility enables individuals to consider alternative perspectives that are not bound by rigid orthodoxy. The literature on cognitive flexibility acknowledges this characteristic as a significant element of interpersonal communication, indicative of an individual's problem-solving aptitude and attitude to various situations. This personality trait exhibits a favorable correlation with positive qualities and an unfavourable correlation with negative traits, as indicated by several studies (Altunkol, 2011; Asıcı & İkiz, 2015; Diril, 2011; Gündüz, 2013a,b; Öz, 2012; Türe & Sarıçam, 2016).

Athletes experiencing anxiety may encounter challenges in maintaining focus and exerting control over external circumstances. Hence, athletes' sensory and cognitive capabilities appear to hold significant significance in facilitating decision-making processes under external pressures (Williams, 2009). Electronic sports' highly competitive and dynamic nature necessitates that players swiftly make decisions and effectively handle unforeseen circumstances. Hence, cognitive flexibility, which encompasses the capacity to generate diverse tactics and adjust to immediate alterations, has pivotal significance in the context of e-sports athletes. Moreover, the cultivation of cognitive control is of utmost significance in order to enhance performance in situations characterized by worry and pressure. The acquisition and refinement of these skills among e-athletes have the potential to enhance their competitiveness and foster a more prosperous gaming encounter.

The present study seeks to investigate the cognitive flexibility of e-sports players in relation to socio-demographic characteristics. This research is significant in enhancing comprehension of players' performance and psychological well-being, offering potential avenues for improvement in both domains. This research has the potential to enhance the provision of assistance and training for e-sports athletes.

Method

This study utilizes a correlational survey model based on a descriptive approach. This model aims to examine the relationships between variables and understand how these variables are related to each other (Karasar, 2018).

Research group

In the research, data was collected from 206 e-sports players using the convenience sampling method. The convenience sampling technique is a non-probability-based method used to collect data from accessible subjects during the data collection process. In other words, researchers use available subjects until they reach the desired sample (Coşkun et al., 2017).

Data analysis

The data was analyzed using SPSS 29.0.1.0 (171) software. Participants' demographic information was evaluated using descriptive statistical methods. Reliability analysis for the cognitive flexibility inventory was conducted using the Cronbach's Alpha coefficient. Subsequently, the Kolmogorov-Smirnov Test was applied to determine whether the data showed a normal distribution. Non-parametric test techniques were used to test measurements that did not exhibit a normal distribution. The results obtained from the research were interpreted by applying the Kruskal-Wallis and Mann-Whitney U tests.

Personal information form

To gather socio-demographic information of the participants, the personal information form included the following questions: age, gender, habits of using technological devices during sports, and the frequency of exercise.

Cognitive Flexibility Inventory

In this research, the Cognitive Flexibility Inventory, developed by Dennis & Wal (2010) and adapted into Turkish by Sapmaz & Doğan (2013), was utilized. The inventory consists of a total of 20 items with two subscales: alternatives and control subscales, and is rated on a 5-point Likert scale. Higher scores indicate higher cognitive flexibility. Individuals with high cognitive flexibility typically possess the ability to make decisions independently, have high self-esteem, can view events from different perspectives, have internal control capacities, exhibit lower levels of depression, and maintain an optimistic attitude (Sapmaz & Doğan, 2013).

Ethics

Ethical approval for this research was obtained from the Yalova University Human Research Ethics Committee. Ethical approval was granted on July 22, 2023, with protocol number 2023/131. Participants were provided with information about the name and subject of the research and were assured that their personal information would be used solely for scientific purposes. Participants were also explicitly informed of their right to withdraw from the study at any stage according to their own wishes.

Results

The Cronbach's alpha reliability coefficient was obtained as 0.896. The Kolmogorov-Smirnov test yielded a result of 0.000, and consequently, Mann-Whitney U and Kruskal-Wallis analyses were applied.

Table 1. Mann-Whitney U test results for gender variable.

Test Statistics ^a	Factor 1	Factor 2
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Mann-Whitney U	7714,000	7581,500
Wilcoxon W	26629,000	26496,500
Z	-,557	-,771
Asymp. Sig. (2-tailed)	,577	,441
a. Grouping variable: Gender?		

No significant difference was found in the cognitive flexibility of e-sport players based on gender.

Table 2. Kruskal-Wallis test results for age variable.

Test Statistics ^{a,b}	Factor 1	Factor 2
Chi-Square	6,717	5,854
df	2	2
Asymp. Sig.	,035	,054
a. Kruskal Wallis Test		
b. Grouping variable: Age?		

According to the analysis results, it was determined that e-sport players in the 18-23 age range had higher cognitive flexibility scores in the control sub-dimension of the cognitive flexibility inventory. Young adults may have a faster capacity to learn new information and experiences, which can enhance their cognitive flexibility as they can quickly integrate new information.

Table 3. Kruskal-Wallis test results for the use of technological device.

Test Statistics ^{a,b}	Factor 1	Factor 2
Chi-Square	18,728	26,194
df	2	2
Asymp. Sig.	,000	,000
a. Kruskal Wallis Test		
b. Grouping variable: use of technological device		

The findings of the Kruskal-Wallis Test revealed a positive correlation between the frequency of utilizing technological devices during exercise and the enhancement of cognitive flexibility. Technological equipment possesses the capacity to serve as a source of motivation for athletes, thereby fostering an enhanced spirit of competitiveness. The potential outcome of this phenomenon is an enhancement in the cognitive flexibility of athletes, as they may be required to cultivate diverse methods within a competitive environment.

Table 4. Frequency of exercise Mann-Whitney U test results by variable.

Test Statistics ^{a,b}	Factor 1	Factor 2
Chi-Square	18,728	26,194
df	2	2
Asymp. Sig.	,000	,000

a. Kruskal Wallis Test

b. Grouping variable: Frequency of exercise

The statistical analysis known as the Kruskal-Wallis Test revealed a significant favorable association between the frequency of exercise and cognitive flexibility. Engaging in consistent physical activity has been shown to enhance both physical and mental well-being, particularly among individuals involved in e-sports. Participating in physical exercise enhances both overall well-being and cognitive flexibility. The use of effective stress management techniques is of paramount importance within the highly competitive e-sports business, as engaging in physical activity has been shown to effectively alleviate stress levels and improve cognitive flexibility.

In addition, engaging in regular physical activity has the potential to improve attention and concentration abilities. This technology has the potential to enhance the concentration levels of e-sports participants during gameplay and facilitate the development of diverse gaming strategies. Physical activity has the potential to exert a beneficial influence on brain health, hence leading to improvements in cognitive flexibility. Engaging in regular physical exercise may necessitate e-sports players to cultivate a sports discipline, encompassing the need for persistent practice and training to augment cognitive flexibility.

Discussion

The findings of this study underscore specific socio-demographic variables that exert an influence on the cognitive flexibility of individuals engaged in e-sports. The discourse surrounding these outcomes underscores the importance of these discoveries within the realm of electronic sports and overall psychological well.

Based on the findings of the study, it was ascertained that those participating in e-sports within the age bracket of 18 to 23 had elevated levels of cognitive flexibility. The discovery suggests that individuals belonging to younger age cohorts may possess a cognitive edge in terms of flexibility. The cultivation of cognitive flexibility abilities throughout the early stages of development has the potential to enhance the performance of e-sports athletes in competitive gaming scenarios.

There was no statistically significant difference seen based on the variable of gender. To clarify, there is no discernible difference in the cognitive flexibility level among e-sports players when

considering gender as a variable. The findings of this study indicate that e-sports has the potential to foster an inclusive competitive environment devoid of gender-based prejudice.

Nevertheless, existing scholarly works have documented a notable disparity in cognitive flexibility levels between male e-sports participants and male athletes participating in traditional sports. The findings of this study suggest that male e-sports players exhibit greater success in the competitive domain, whereas female e-sports players tend to engage in computer games categorized as e-sports primarily for leisure purposes (Menteş & Saygın, 2019).

According to a study conducted by Aslan (2018), there is evidence to suggest that team athletes exhibit greater levels of cognitive flexibility when compared to their counterparts who engage in individual sports. The findings of this study indicate that team sports may be associated with a greater probability of facing unforeseen circumstances in comparison to individual sports. This study examined both team and individual sports and found no statistically significant disparity in cognitive flexibility between male and female athletes.

Research has revealed a positive correlation between regular physical activity and enhanced cognitive flexibility scores among e-sports players. There is a prevailing belief that engaging in physical activity can exert a beneficial influence on cognitive flexibility. Consequently, the implementation of consistent physical activity among those engaged in e-sports can potentially augment their cognitive well-being and overall proficiency.

Additionally, it was shown that those engaged in e-sports who regularly utilize technological gadgets during physical activity exhibit elevated scores in cognitive flexibility. The potential impact of technology on the cognitive flexibility of e-sports players is worth considering, since it may enhance their ability to make in-game judgments with greater speed and efficacy.

Consistent with the existing body of literature, the present study highlights the impact of sports on the neurological cognitive functions of individuals (Çelikkaleli, 2014). According to Gülsoy et al. (2022), there is evidence to suggest that participation in sports has a dual impact, as it not only enhances persons' physical well-being but also plays a role in fostering their psychological growth.

In summary, this study highlights the significance of cognitive flexibility within the realm of electronic sports. Individuals belonging to younger age groups, those who engage in regular exercise, and active users of technology may exhibit certain benefits in relation to cognitive flexibility.

Athletes frequently encounter a multitude of stressors, anxiety, and pressure during their performance, hence emphasizing the significance of cognitive flexibility and cognitive control within the realm of sports (Smith & O'leary, 2007). The mental processes of decision-making and cognitive flexibility play a vital role in enhancing the sports performance of athletes (Gross et al., 2018).

Moreover, within the pertinent scholarly discourse, it is frequently observed that individuals who possess a heightened level of cognitive flexibility tend to exhibit adaptability in their communication patterns. They demonstrate an awareness of various alternatives in both communication and problem-solving scenarios, display a proactive approach, exhibit sensitivity, possess self-assurance in their communicative abilities, and demonstrate a capacity for tolerating conflicts or uncertainties (Buča et al., 2018; Martin & Anderson, 1998; Martin & Rubin, 1995; Martin et al., 1998).

According to Hill (2008), individuals who possess a high level of cognitive flexibility demonstrate the capacity to effectively employ their cognitive capacities and recognize the existence of several potential solutions for each given situation. In highly competitive domains such as e-sports and gaming, the ability to make rapid decisions is frequently a must. E-sports players possess cognitive flexibility, enabling them to swiftly adjust to various game scenarios and promptly modify their gaming methods. Moreover, within a context of competition, possessing a cognitive disposition characterized by adaptability and recognizing the limitations of a singular method can confer a strategic edge over adversaries.

The significance of cognitive flexibility in e-sports athletes is apparent not just inside the game itself but also in the context of intra-team communication. The success of e-sports teams is significantly influenced by two key factors: team cohesion and communication. Cognitive flexibility is a cognitive ability that enables players to effectively adjust and respond to various game scenarios and team plans. Within this particular context, the enhancement and promotion of cognitive flexibility abilities among e-sports participants have the potential to augment both individual performance and overall team success. Hence, it is imperative that e-sports training programs and team collaborations prioritize the cultivation of cognitive flexibility abilities.

In summary, research has determined that consistent physical exercise has a beneficial impact on the mental well-being and performance of e-Sports athletes. The utilization of technology during physical activity highlights the potential advantages of integrating technological tools to improve decision-making in the realm of gaming. Cognitive flexibility plays a vital role within the context of e-Sports, a demanding and competitive environment. It empowers athletes to swiftly respond to dynamic game conditions, make rapid decisions, and alter their plans accordingly. Hence, it is imperative for e-sports training programs and team activities to focus on the cultivation of cognitive flexibility abilities in order to augment both individual and collective achievements within this dynamic and fiercely competitive domain.

Recommendations

The findings indicate a necessity for the creation of psycho-educational initiatives with the objective of enhancing the cognitive flexibility of e-sports athletes. Such programs would serve to facilitate their personal growth and enhance their ability to compete at an elevated standard.

These programs have the potential to enhance the ability of e-sports participants to effectively manage stress and promote the maintenance of optimal mental well-being. Furthermore, it underscores the significance of ensuring equitable chances for all participants, irrespective of their gender, hence fostering a more equitable and competitive milieu within the realm of electronic sports.

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