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GAMING, EXECUTIVE FUNCTIONING AND MINDFULNESS: A COMPARATIVE EXPLORATORY STUDY BETWEEN LEAGUE OF LEGENDS GAMERS AND NON-GAMERS

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Abstract

Previous studies have shown that playing League of Legends (LoL) improves certain abilities and trainable skills. The aim of this study was to analyze the relationship and predictive value of executive functioning in dispositional mindfulness in a sample composed of LoL gamers and non-gamers. The results revealed that the gamers had less ability to focus on present-moment activities in their daily lives, were more judgmental in their inner experience, and were less disposed to proceed with mindfulness than were the non-gamers. The gamers showed greater tendency toward presenting problems related to emotional control, executive control, and a possible development of prefrontal symptoms. We concluded that the video game LoL requires the use of many cognitive abilities, including a high demand on the user's executive functions, a factor that seems to interfere with one's capacity for mindfulness away from the screen. Gamers may therefore experience a possible vulnerability to presenting prefrontal symptoms, and greater likelihood of their development.
KEY WORDS: *videogames, gamer, eSports, mindfulness, prefrontal symptoms*.

Resumen

Estudios previos han evidenciado que jugar a *League of Legends* (LoL) mejora ciertas capacidades y habilidades que pueden ser entrenadas. El objetivo de este estudio fue analizar la relación y el carácter predictivo del funcionamiento ejecutivo en la atención plena (*mindfulness*) disposicional en una muestra compuesta de jugadores y no jugadores de LoL. Los resultados reflejan que los jugadores presentan una menor capacidad para focalizar actividades del momento presente en su vida diaria, una mayor ausencia de juicio y una menor predisposición que los no jugadores a proceder con atención plena. En este grupo se aprecia una tendencia mayor a presentar problemas relacionados con el control emocional, el control ejecutivo y el posible desarrollo de síntomas prefrontales. Se concluye que LoL es un videojuego que requiere de la utilización de muchas capacidades cognitivas, entre ellas la alta demanda sobre las funciones ejecutivas del usuario, factor que parece interferir con la capacidad de atención plena más allá de la

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pantalla. Esto indica una posible vulnerabilidad en los jugadores a presentar con mayor probabilidad síntomas prefrontales.
PALABRAS CLAVE: *videojuegos, jugador, deportes electrónicos, atención plena, síntomas prefrontales.*

Introduction

Video games are a means of personal entertainment, even though their increasing professionalization is now taking them beyond this. Today, *eSports* are pursued in structured gaming competitions with players, teams, leagues, publishers, organizers, broadcasters, sponsors and spectators -and are becoming more and more important in the day-to-day lives of many users (*Asociación Española de Videojuegos*, 2018). Within the broad repertory of electronic games in the *eSports* category we find the video game League of Legends (LoL), produced by RIOT Games, and belonging to the MOBA genre (Multiplayer Online Battle Arena). LoL is a team strategy game where cooperative work is a priority; the objective is to destroy the enemy's Nexus and avoid the destruction of one's own. LoL competitions have the greatest worldwide viewership of any eSport, a fact that is reflected in the growing number of active users in recent years. The video game launched its first season in 2009; by the end of 2021 there were already 180 million active monthly users (Richard et al., 2021).

Video games are not merely entertainment, because they allow the player to learn and develop abilities that can be extrapolated to daily life (Gómez-García et al., 2016), as well as to construct an entire system of values (Vaamonde et al., 2018). Gómez-Martín et al. (2012) emphasize the explicit relationship between video games and the usefulness of computer-based teaching systems, underscoring the benefit of this appealing tool for traditional teaching systems. This suggests the possible complementary use of video games, and evidence is given for their potential educational use in enhancing certain pedagogical components (Gómez-García et al., 2016). This view is far removed from the negative view of video games that was initially prevalent. According to behavior patterns observed by García-Lanzo and Chamarro (2018), video games need not be seen as harmful to the population, much less to adolescents, who are the main focus of attention. One assertion has been that video game users show near-violent behaviors, and little emotional control. Kou and Gui (2020) deny such popular affirmations when they define gamers as passionate youth who are very dedicated to what they do, and whoare interested in developing their psychological abilities through gaming. These authors study emotional regulation ability in LoL players, and based on their results they explicitly reject the notion that *eSports* users are more prone to inflict violence whether online or offline, in comparison to the average person. Non-problematic gaming, where users do not meet any condition in the parameters of a gaming addiction disorder, can have a positive impact on players' cognitive processes (Nuyens et al., 2019).

Previous studies have identified a variety of psychological, cognitive and personal factors that can be strengthened through the use of video games and

eSports. In the systematic review by Vaamonde et al. (2018), they conclude that video games and eSports can be a useful tool for mental training and assessment. Bediou et al. (2018) carried out a meta-analysis where results showed improved attention and improved spatial perception and cognition when users played regularly. In another meta-analysis, Sala et al. (2018) also demonstrated that regular practice benefitted visual processing, as well as the capacity for mobility, attention, and cognitive control.

Among all the factors that are enhanced through video games and eSports, we find cooperation, team work for planning strategies, creativity (Alarcón & Collazos, 2017; Cui et al., 2021; Gabbiadini & Greitemeyer, 2017; Gong et al., 2019; Pedraza-Ramírez, 2019; Rodríguez & Del Moral, 2018); communication and socialization skills (García-Lanzo & Chamarro, 2018; Kou & Gui, 2020; Mora-Cantallops & Sicilia, 2018; Pedraza-Ramírez, 2019); visual working memory, selective attention, shifting between visual-auditory attention, visuospatial processing, cognitive flexibility, visual perceptive learning, information processing speed, reaction time and inhibitory control over stimuli (Cui et al., 2021; Oei & Patterson, 2013; Rodríguez & Del Moral, 2018; Vaamonde et al., 2018); logical mathematical reasoning, deductive reasoning and fluid intelligence (Bonny & Castaneda, 2017; Kokkinakis et al., 2017); problem solving and decision making (Bányai et al., 2019; Rodríguez & Del Moral, 2018; Vaamonde et al., 2018); self-confidence, emotional self-regulation, self-control and self-care (Bányai et al., 2019; Carbonie et al., 2018; García-Lanzo & Chamarro, 2018; Gong et al., 2019; Kou & Gui, 2020; Vaamonde et al., 2018); harmonic passion (García-Lanzo & Chamarro, 2018) and skill in multi-tasking (Chang et al., 2017; Oei & Patterson, 2013).

In short, many of the abilities mentioned above correspond to the brain's executive functions (Chang et al., 2017; Gong et al., 2019). In effect, improvement in the abilities mentioned above is reflected in the brain (Vaamonde et al., 2018), where we find an increase in gray matter in the occipital cortex, the center of many complex operations mentioned (Cui et al., 2021). In a study with university students, Carbonie et al. (2018) confirmed benefits both in values and in psychological factors, including greater cooperation, engagement, personal growth, initiative, self-esteem, emotional self-regulation, hedonism and personal growth. In the Richard et al. (2018) study with LoL gamers, results indicated improved reflection, decision making, and elements of both individual and cooperative learning.

Other studies that focus on the complexities, specific occurrences, and mechanics of a LoL match explain how good teamwork is essential in order to reach consensual decisions, both individually and jointly, and lead the allied team to victory in gaming scenarios that recreate situations similar to real life (Alarcón & Collazos, 2017). Moreover, the presence of a coach or external instructor allows for logical-mathematical skills to be developed within the game scenario (Del Moral et al., 2018), and the best decisions to be made through cooperative play, for which purpose systematized intervention and ongoing coaching are carried out (Rodriguez & Del Moral, 2018). Oei and Patterson (2013) concluded that the evidence of positive cognitive effects from video games involves theorizing their practical application, such that in the future, it may even be possible to select the right type of video game to improve a particular cognitive ability; a therapeutic effect of video

games is possible in this new era, and even their use in cognitive interventions (Latham et al., 2013).

Nonetheless, we must consider another line of research that studies the negative impact and effect of video games and eSports. In this regard, harmful consequences, addictive potential and vulnerability to maladaptive behaviors are of particular concern (Bertran & Chamarro, 2016). An Disproportionate time spent on gaming may indicate irresponsible use, where a person is escaping from the problems and tasks of life, generating psychological dependence and even a certain psychopathological vulnerability due to excessive dedication (Bányai et al., 2019; Bediou et al., 2018; Sala et al., 2018). Loss of control can affect a person's daily life, and in relation to this, the prefrontal cortex is considered to be a determining factor in loss of higher-level behavior control. Deficits in executive functioning make behavior regulation more difficult and are manifest in functional and structural deficits typical of certain behavior addictions like excessive Internet use (Korponay et al., 2017) or obsessive passion for gaming (Bertran & Chamarro, 2016); such deficits are linked to prefrontal difficulties in daily life at any age (Pedrero et al., 2018). The relationship between problematic use of ICT and malfunction in prefrontal behavior has been studied in adolescents. The results can be extrapolated to other ages, where symptoms with incorrect executive control are found in people whose use of ICT is problematic (Pedrero-Pérez et al., 2019; Valiente-Barroso et al., 2021a).

On the other hand, dispositional mindfulness as a trait is understood to be a relatively intrinsic, basal capacity, generally stable, although one can be trained in the tendency to act, observe, accept and achieve better emotional adjustment (Garland, 2013; Hervás et al., 2016). One typical characteristic of mindfulness is the awareness and timely recognition of one's impulses (Katz & Toner, 2013), thus, people with high levels of mindfulness understand their own behaviors better, are less impulsive, more reflective and react in a more conscious manner (Gámez-Guadix et al., 2016). Continuing in this line, previous studies have found direct relationships between mindfulness and fewer psychological problems that indicate lack of personal well-being (Black et al., 2012; Calvete et al., 2014; Cortázar & Calvete, 2022). People with high levels of attention are less likely to have ruminative thoughts, they do not get involved in them nor do they judge them, they maintain states of calm and balance, which allows them to make better decisions, always avoiding impulsivity (Kabat-Zinn, 2003, 2009). Also verified is the relationship and impact of mindfulness in executive functioning, directly involved in coordination and control of a person's cognitive, emotional and behavioral conduct (Fiocco & Mallya, 2015; Gallant, 2016; Valiente-Barroso et al., 2021a, 2021b).

Due to the need for further inquiry into both the practical and therapeutic effects that LoL may be able to offer the average user, there is much scientific interest in whether there are differences in prefrontal symptomatology and dispositional mindfulness between regular gamers and the general population. As stated earlier, most prior research has focused on the evidence of improved executive functions, so it would be interesting to observe whether, in addition to these abilities, we might also attribute benefits of improved quality of life and mental health in the general population (Nuyens et al., 2017). This line of research is

therefore the object of growing interest in both its social and educational aspect. Based on all the above, the aim of present study is to analyze the relationship between executive functioning measured through self-reported prefrontal symptomatology (considering the problems of social, emotional, and executive control) and dispositional mindfulness in LoL gamers and non-gamers. In conjunction with this general aim, another specific objective is to check whether there are significant differences in the variables of prefrontal symptomatology and dispositional mindfulness in the LoL gamer group vs. the non-gamer group. Finally, we wish to analyze the explanatory and predictive ability of prefrontal symptomatology (problems of social, emotional and executive control) on dispositional mindfulness, in both the gamers group and the non-gamers group.

Method

Participants

Non-probabilistic convenience sampling yielded 198 participants for the study. Of these, 117 were gamers (59.1%) and 81 were non-gamers (40.9%). Male participants represented 63.1% of the sample, and females 36.9%. Age of the participants ranged from 26 to 35 years (46.5%), 60.1% were unmarried, 33.8% had university studies.

Regarding the gamers group, Table 1 shows that the gamers surveyed most often began their LoL activity 7 to 10 years ago (40.2%), and their most frequent time dedication was 5 to 10 hours weekly (41.9%). Regarding the number of players per game ranking, for this study we sought to recruit a sample with comparable proportions to the actual distribution. Thus, our most frequent category in game ranking was "Iron - Bronze - Silver - Gold" (Table 2).

Table 1
Sample characteristics with regard to gaming

Game related features	*n*	%
Started gaming		
Less than 1 year ago	7	6
From 1 to 3 years ago	23	19.7
From 4 to 6 years ago	21	17.9
From 7 to 10 years ago	47	40.2
More than 10 years ago	19	16.2
Weekly time spent gaming		
Less than 5 hours	35	29.9
From 5 to 10 hours	49	41.9
From 10 to 15 hours	23	19.7
More than 20 hours	10	8.5

Table 2
Comparison by game ranking distribution

Rank	%
Real distribution[1]	
Iron - Bronze - Silver - Gold	87.1
Platinum - Diamond	10.5
Master - Grand Master - Challenger	0.2
Study distribution	
Iron - Bronze - Silver - Gold	79.5
Platinum - Diamond	17.9
Master - Grand Master - Challenger	2.6

Instruments

a) Ad hoc questionnaire for sociodemographic and gambling-related data. This section contained sociodemographic questions to collect information on age, sex, marital status, level of studies and the condition of LoL gamer or non-gamer. Additionally, for the gamers, there were questions to report the time spent weekly on playing LoL, game ranking, and when they began to play. To collect information on the study variables, two self-report instruments were included.
b) *Five Facet Mindfulness Questionnaire* (FFMQ; Baer et al., 2006) Spanish version (Cebolla et al., 2012; Loret de Mola, 2009). The FFMQ contains a total of 39 items on a Likert scale with five possible responses, from 1 (never) to 5 (very often). A higher score indicates greater levels of mindfulness and a general tendency to adopt mindfulness-related behaviors in day-to-day life. The questionnaire is made up of five scales that reflect five skills pertaining to mindfulness. The first scale is Observation, which is the ability to notice internal and external experiences such as bodily sensations, cognitions, emotions, perceptions, sounds and smells. The second is Description, which indicates the ability to name and describe the experiences perceived, without judging them positively or negatively. The third scale is Aware actions, which measures the subject's ability to consciously focus their attention on the activities they are doing at each moment, in contrast to mechanical behavior. The following scale, Non-judgmental inner experience, is the subject's ability to abstain from evaluating their experiences, in other words, to experience them with acceptance without trying to change anything about them. Finally, the fifth scale is Non-reactivity, which shows a tendency to let feelings and emotions flow, without entering a ruminative state or becoming lost in them completely, and so be able to evaluate them as an external agent. Instrument reliability was measured through internal consistency, calculated as Cronbach's alpha, which produced acceptable values (between .78 and .89) for the entire scale and for each of the factors. Specifically, the values obtained were .89 for the total scale;

[1] Source: https://www.leagueofgraphs.com/es/rankings/rank-distribution

Observation (.76), Description (.83), Aware actions (.85), Non-judgmental inner experience (.86) and Non-reactivity (.76).

c) *Short Inventory of Prefrontal Symptoms* (*Inventario de síntomas prefrontales abreviado*, ISP-20; Pedrero et al., 2015). The ISP-20 seeks to detect possible signs of inadequate functioning in activity of daily life. This self-report contains 20 items with five Likert-type responses from 1 (never or almost never) to 5 (always or almost always). Its three scales correspond to executive control, social control and emotional control, as well as a total "prefrontal symptomatology" score, expressed as the sum of the previous scales. In all scales, high scores indicate the presence of problems. This instrument presents adequate psychometric properties, both in validity and reliability, with convergent and divergent validity demonstrated previously through objective neuropsychological measures. In this study, internal consistency of the total scale was adequate (.84) as measured by the Cronbach alpha coefficient.

Procedure

Data was collected between the months of March and May 2022; an online link containing one questionnaire was disseminated through the social networks (Twitter and Instagram) in profiles often visited by the gamer community. Thus, any gamer had free access to the form during the period that it was kept open, having the option or participate and also to distribute it among others. In the same way, the same type of dissemination was made available among non-gamers, through social networks.

A questionnaire was prepared on the Google Forms platform. It´s made up of the instruments mentioned in the previous section. The first part of the questionnaire explained the research intent, adding the pertinent ethical considerations for this type of research, and requesting confirmation of having read and agreed to the terms, including the pertinent legislation, anonymity and voluntary nature of participation, the right to be informed of the research results if desired, and the exclusively academic purposes of the research study wherein the questionnaire and data collection are framed. Participants were also informed that these tests produce no harmful effect on the user, and that they had the right to refuse to participate or to withdraw at any time they wished. Confidentiality and anonymity of the data collected were guaranteed under Organic Law 3/2018, 5th December, on the Protection of Personal Data and guarantee of digital rights. Because all questions on the form were obligatory and had to be completed for the subject to be included, this was taken into account in creating the form, so as to avoid incomplete responses and maximize the percentage of valid responses.

Data analysis

A comparative exploratory study was designed using a quantitative, nonexperimental, cross-sectional methodology, which assumes that participants are assessed in more than one dependent variable at a given point of time (Ato et al., 2013). All calculations were performed using the statistical program SPSS version

29.0 for Windows. First, normality assumptions and homoscedasticity of the linear model were checked. Goodness of fit was calculated using the Kolmogórov-Smirnov test, and most variables met the normality principle, so we decided to use parametric tests. Pearson bivariate correlations were calculated to check for significant relationships between the variables of prefrontal symptomatology (social control, emotional control and executive control) and of mindfulness, in both the gamers group and the non-gamers group. Next, we carried out inferential analysis of means comparison using Student's *t,* in order to analyze whether there were significant differences between the gamers and non-gamers in the study variables. Cohen's *d* was also calculated to learn the magnitude of the differences (Sun et al., 2010), interpreting effect sizes to be small ($.20 \leq d \leq .50$), moderate ($.51 \leq d \leq .79$) or large ($d \geq .80$). A univariate covariance analysis (ANCOVA) was carried out to check for significant differences between the gamers and non-gamers in dispositional mindfulness, introducing prefrontal symptomatology as a covariable. Finally, two stepwise, multiple linear regression analyses were conducted in order to study the predictive nature of the variables of prefrontal symptomatology on mindfulness, considering two distinct groups, the gamers and the non-gamers, so as to compare the results from both groups.

Results

Relationships between prefrontal symptomatology and mindfulness in League of Legends gamers and non-gamers

Table 3 presents the results of the correlation analyses, differentiating between gamers and non-gamers. Statistically significant, negative relationships were observed between problems of social control and aware actions in the gamers group, while in the case of non-gamers, these significant, negative relationships with problems of social control were found with the non-judgmental variable. Problems of emotional control had a significant, negative correlation --in both gamers and non-gamers-- with aware actions, non-judgmental inner experience, non-reactivity, and total mindfulness, where the coefficient values in all of these was slightly higher in the gamers group. Additionally, in the gamers group, problems of emotional control correlated significantly and negatively with the Description variable. On the other hand, problems of executive control and prefrontal symptomatology were found to have statistically significant, negative relationships with the variables of Description, Aware actions, Non-judgmental inner experience, Non-reactivity and total mindfulness, in both groups, with stronger correlations in the LoL gamers group. Additionally, in the non-gamers group, the Observation variable was found to have statistically significant, negative relationships with problems of executive control and prefrontal symptomatology, respectively.

Table 3
Correlations between the variables of prefrontal symptomatology and of mindfulness

Facets of mindfulness	Social control		Emotional control		Executive control		Prefrontal symptomatology	
	Gamer	Non-Gamer	Gamer	Non-Gamer	Gamer	Non-Gamer	Gamer	Non-Gamer
Observation	-.11	.01	.14	-.09	.07	.33**	.07	-.26*
Description	.06	.12	-.23*	-.17	-.43**	-.39**	-.36**	-.29**
Aware actions	-.26**	-.16	-.42**	-.27*	.67**	-.57**	-.67**	-.53**
Non-judgmental inner experience	-.06	-.26*	-.43**	.38**	.51**	-.26*	-.51**	-.38**
Non-reactivity	-.07	.19	-.36**	-.32**	-.23*	-.30**	-.30**	-.25*
Total mindfulness	-.14	-.05	-.45**	-.40**	-.64**	.59**	-.63**	-.56**

Note: *p< .05; **p< .01.

Prefrontal symptomatology and mindfulness: differences between gamers and non-gamers

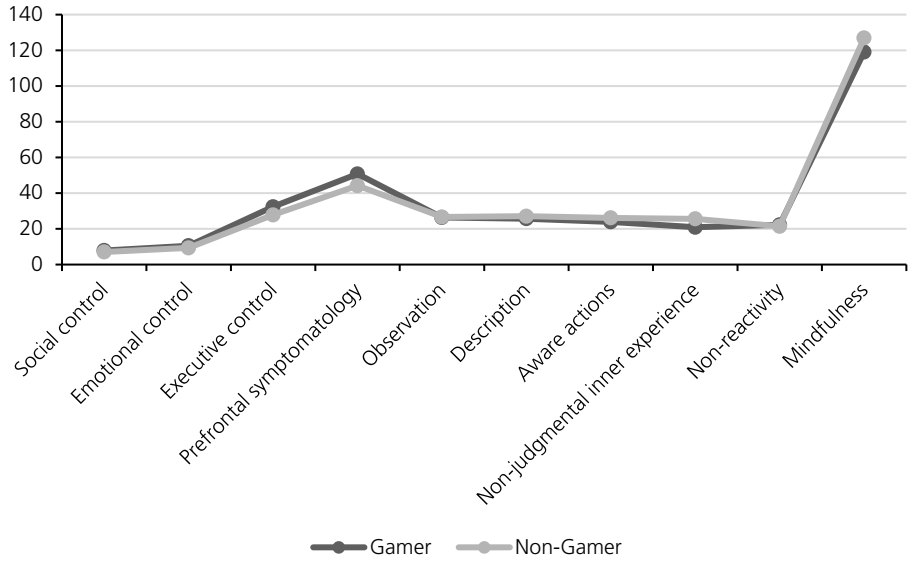
Differences in the means of the variables were studied according to whether the subject was a gamer or non-gamer by calculating Student's *t* test, applying Levene's test for equality of variances, with significance levels greater than .05 and a confidence interval of 95%. Results shown in Table 4 indicate significant differences in emotional control, executive control, prefrontal symptomatology, aware actions, non-judgmental inner experience, and total mindfulness, between gamers and non-gamers. In Figure 1, we find that the gamers report greater problems with social control, executive control and prefrontal symptomatology, as well as lower values in the variables of Aware actions, Non-judgmental inner experience, and Mindfulness in general.

A univariate covariance analysis (ANCOVA) was carried out to check for significant differences between the gamers and non-gamers in dispositional mindfulness, eliminating the differences in prefrontal symptomatology. The results indicated that, in effect, prefrontal symptomatology was associated with dispositional mindfulness ($F_{(1.197)}$= 115.62, p< .001, η_p^2= .372), with a large effect size, but if we eliminate the effect of prefrontal symptomatology, gaming did not reveal any statistically significant effect in dispositional mindfulness ($F_{(1.197)}$= .287, p= .592, η_p^2= .001), and the effect size was low. The total explained variance was 38.9%, and once differences in prefrontal symptomatology were discounted, the gamers' mean in dispositional mindfulness (M= 121.75) was lower than that of the non-gamers (M= 123.02).

Table 4
Prefrontal symptomatology and mindfulness according to whether the subject plays LoL

Variables	Groups	*M*	*SD*	95% CI		*t*	*p*	*d*
				LL	UL			
Social control	Gamer	7.86	3.36	-.12	1.77	1.71	.087	.25
	Non-Gamer	7.04	3.26					
Emotional control	Gamer	10.54	4.20	.07	2.31	2.10	.037	.31
	Non-Gamer	9.35	3.47					
Executive control	Gamer	32.37	9.38	2.10	7.02	3.66	.000	.54
	Non-Gamer	27.80	7.39					
Prefrontal symptomatology	Gamer	50.77	13.17	3.10	10.06	3.72	.000	.55
	Non-Gamer	44.19	10.68					
Observation	Gamer	26.35	6.23	-2.01	1.43	-.33	.741	-.05
	Non-Gamer	26.64	5.78					
Description	Gamer	25.69	7.71	-3.51	.72	-1.29	.197	.19
	Non-Gamer	27.09	7.04					
Aware actions	Gamer	23.89	7.55	-4.19	-.30	-2.28	.024	-.39
	Non-Gamer	26.14	5.58					
Non-judgmental inner experience	Gamer	20.88	8.31	-6.90	-2.48	-4.15	.000	-.61
	Non-Gamer	25.62	7.24					
Non-reactivity	Gamer	22.26	4.79	-.48	2.15	1.25	.213	.18
	Non-Gamer	21.42	4.38					
Total mindfulness	Gamer	119.07	20.82	-3.52	-2.14	-2.71	.007	-.41
	Non-Gamer	126.90	16.83					

Figure 1
Differences of means between gamers and non-gamers in the study variables



Predicting level of mindfulness according to variables of prefrontal symptomatology

Multiple linear regression shows us the effect of prefrontal symptomatology on the level of mindfulness. In this analysis, the explanatory variables were taken to be social control, emotional control, executive control and the global dimension of prefrontal symptomatology. In this way we confirmed that the variables associated with prefrontal symptomatology predicted mindfulness, both in the gamers group and the non-gamers group, comparing the obtained results in each case. In the two analyses, the assumption of independence of errors was previously verified with the Durbin-Watson statistic, finding values between 1 and 3; as well as the principle of multicollinearity, where all the VIF (Variance Inflated Factor) of the explanatory variables showed a value of 1. The results are shown in Tables 5 and 6, respectively. In the case of the gamers group (Table 5), results from the regression analysis indicated that the level of mindfulness was predicted by two variables of the total. In the first model, emotional control predicted mindfulness, explaining 40.1% of the total variance, a statistically significant predictive capacity (β= -.407, *t*= -8.875, *p*< .001). Model 2 included the variables of executive control (β= -.544, *t*= -6.988, *p*< .001) and emotional control (β= -.211, *t*= -2.714, *p*< .01), together accounting for 43.3% of the variance and contributing significantly to the explanation of its influence in mindfulness. The rest of the variables were excluded from the model (social control and prefrontal symptomatology).

Table 5
Results from the regression analysis in the gamers group, with mindfulness as criterion variable and the variables of prefrontal symptomatology as predictive variables

Model	*R*	R^2	Adjusted R^2	Durbin-Watson	*F* (*df*)	*p*
Model 1a	.638	.407	.401		78.775 (1,116)	<.001
Model 1b	.665	.443	.433	1.780	45.253 (2,116)	<.001

Note: [a]executive control; [b]executive control, emotional control.

In the case of non-gamers, the results shown in Table 6 indicate that the variables predicting level of mindfulness were the same as those in the gamers group. Thus, two explanatory models were observed where the predictive variables were executive control and emotional control, although their explanatory power was less than in the gamers group. In the first model, the predictive capacity of emotional control on mindfulness was statistically significant (β= -.599, *t*= -6.649, *p*< .001) and explained 35.1% of the total variance. Model 2 included the variables of executive control (β= -.521, *t*= -5.493, *p*<.001) and emotional control (β= -.208, *t*= -2.189, *p*< .05), together accounting for 38% of the total variance. The variables of social control and prefrontal symptomatology also were excluded from this model.

Table 6

Results from the regression analysis in the non-gamers group, with mindfulness as criterion variable and the variables of prefrontal symptomatology as predictive variables

Model	*R*	R^2	Adjusted R^2	Durbin-Watson	*F* (*df*)	*p*
Model 1a	.599	.359	.351		44.203 (1,80)	<.001
Model 1b	.629	.396	.380	1.987	25.560 (2,80)	<.001

Note: [a]executive control; [b]executive control, emotional control.

Discussion

Taking into account previous studies that support the positive personal effects of video games or eSports, this study proposed to analyze the relationship between prefrontal symptomatology and dispositional mindfulness and test whether a group with experience in LoL would obtain significantly higher measures in the application of mindfulness in their daily life, as well as fewer problems associated with prefrontal symptomatology, when compared to a group of non-gamers. We mentioned previously that LoL is a video game that requires the use of many cognitive abilities, such as executive functions, and this led us to theorize possible interference among these functions, and the extrapolation of mindfulness into daily life, away from the video game. In other words, for a gamer to be able to experience states of absolute concentration where they make use of other skills and abilities while acting within the video game, seems *a priori* to imply basic components that are fundamental to mindfulness in the here and now. The obtained results, however, have reflected tendencies contrary to this initial expectation. LoL gamers reported greater problems of emotional control, executive control and prefrontal symptomatology in comparison to non-gamers in both cases these problems demonstrated a negative association with mindfulness. The relationships were weaker in the case of non-gamers, which indicated better levels of mindfulness in this group. However, in both cases, we concluded that a better ability to consciously focus attention, without making judgments, accepting reality and allowing emotions and feelings to flow without entering into ruminative states, is associated with fewer emotional and executive problems, in which case this would confirm that an executive dysfunction may limit or interfere with the capacities or abilities of curiosity, openness and acceptance of reality (Kabat-Zinn, 2009). In this line of thinking, previous results that demonstrated executive involvement through emotional and behavioral control are corroborated or consolidated, as well as its inverse relationship to mindfulness (Fiocco & Mallya, 2015; Valiente-Barroso et al., 2021a, 2021b).

In response to the second objective, significant differences between the LoL gamers and the non-gamers have been verified in the aspects of not judging one's personal experiences, evaluating one's emotions and feelings externally, and in mindfulness, where these abilities are greater in non-gamers. This would contradict in part the arguments presented initially regarding the benefits of the game, although, on the other hand, it would speak highly of the attention skills or mindfulness exercised during the game. These same differences between the two

groups have been found in regard to problems of emotional control, executive control and prefrontal symptomatology, thus confirming results from previous studies that indicate certain problems in the use and frequency of gaming, and that have even associated pathologies and addictions to these technologies. When the effect of prefrontal symptomatology is eliminated, the game has proven to have no significant effect on dispositional mindfulness, so these results would reinforce the influence of possible deficits of executive functioning in the mindfulness of gamers and non-gamers. Consequently, problematic use of gaming may be associated with executive deficits where the prefrontal cortex is a determining factor, and with the appearance of maladaptive behaviors and loss of behavioral control (Pedrero-Pérez et al., 2019; Valiente et al., 2021a). We must note, however, that whether a brain dysfunction is the cause or the consequence of problematic use cannot be asserted, even though there is a link to this behavioral deficit (Pedrero-Pérez et al., 2018). In this regard, it is especially important to distinguish between professional gamers and gamers with problematic use; the latter may really show an addictive behavioral tendency, and present certain psychological vulnerability. Consequently, we must not neglect the optimistic stance that considers the positive cognitive and executive impact attributed to non-problematic gaming (Chang et al., 2017; Nuyens et al., 2019).

Finally, the predictive ability of emotional control and executive control problems on level of dispositional mindfulness has been demonstrated. This holds true in both the gamers group and the non-gamers group, even though the differences are less significant in the non-gamers. We therefore confirm results from previous research that point to higher levels of dispositional mindfulness when no prefrontal symptomatology problems associated with executive functioning are detected, or they are less present; and how this implies better personal health and well-being (Fiocco & Mallya, 2015; Valiente et al., 2021b). Based on this, we must keep in mind that there is influence from mindfulness, with its conscious awareness, on certain problems that involve a loss of control sometimes attributed to excessive or inappropriate use of the Internet or video games (Gámez-Guadix & Calvete, 2016). These disturbances may be due to emotional and behavioral errors that provoke executive dysfunction or cognitive impairment (Pedrero-Pérez & Ruiz-Sánchez, 2013; Pedrero-Pérez et al., 2013).

In short, we concluded that LoL is a video game that requires the use of many cognitive abilities, an example of which is the high demand placed on the gamer's executive functions. According to results obtained in this study, this demand seems to interfere with the capacity for mindfulness away from the screen, giving way to the possibility of gamers experiencing executive problems. Therefore, these results reinforce the importance of one's mental state and mindfulness in daily activities, which may include video games or eSports. Executive functioning is crucial in all of these, as it is involved in decision making and problem solving, as well as in proper emotional and behavioral regulation.

This study is not free of limitations. As indicated, it was conducted online to allow access to a greater number of participants. However, this procedure excludes the possibility of applying other assessment tests that require physical presence, and it also limits control over external variables. Additionally, the number of non-gamers

in our sample was lower than the number of gamers; this disproportion limits the representativeness and generalization of results. It would be appropriate to increase the sample size, for example, by including the adolescent population, given their particular vulnerability and characteristics. Another limitation is the cross-sectional aspect of the study, which keeps us from establishing inferences or causality relations or from speaking strongly of effects. Given their correlational nature, the results can only be interpreted as tendencies. Consequently, we cannot affirm whether it is dispositional mindfulness that encourages executive performance, or the opposite, that (prefrontal) brain executive symptomatology is what generates greater or lesser mindfulness. We must mention that the variables of when gaming was started and one's weekly dedication to gaming were not considered in the analysis and its corresponding results, even though we initially collected this data from the sample.

For future lines of research, it would be interesting to conduct longitudinal studies that begin with an initially non-gamer sample, in order to evaluate the flows of mindfulness that are gradually produced when exposing them to LoL. A longitudinal study on a sample belonging to a population with mental disorders, namely mood problems and prolonged stress, would also be useful to observe whether being a gamer is a protective factor in the long term. We would propose, then, that future research consider the psychological vulnerability of e-gamers, in order to determine the problematic potential of gaming, in which mental problems would be mediators.

As a final conclusion, we must underscore the utility of video games in bringing out different skills and opportunities, some of which can undoubtedly be used and enhanced within an educational context (Rodríguez & Del Moral, 2018). Early training in the responsible, practical, effective use of gaming can result in healthy personal development, taking into view cognitive diversity (Tejada et al., 2017). This is endorsed by research studies that have shown the usefulness of coaches and sports psychology specialists for continuously improved performance in eSports competitions (Pedraza-Ramírez, 2019).

Integration of gaming in the classroom should therefore take place in a guided and systematic way, through active methodologies, such as cooperative learning, gamification or online cooperative games, in order to create environments that favor interaction among participants, a climate of trust, and relationships based on consensual decision making.

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