

The Iceberg Profile Does Not Influence the Performance of Elite League of Legends Players, but Changes With the Events of the Game

Adrián Mateo-Orcajada , Lucía Abenza-Cano , Juan Pablo Rey-López , and Raquel Vaquero-Cristóbal 

Abstract—Little is known about the interactions between the iceberg profile, which is characterized by high vigor scores, as opposed to low scores in tension, depression, anger, fatigue, and confusion, and performance in *League of Legends* (LOL). For these reasons, the objectives of the present research were to analyze whether the performance was influenced by the presence of the iceberg profile before the start of the game and to determine the changes produced in the iceberg profile of esports players as a function of the final outcome of the game, the players' performance during the game, and pregame anxiety and self-confidence. The participants were players in a professional LOL esports team during a SuperLiga Orange spring split. The profile of mood states and competitive state anxiety inventory-2 questionnaires were used. Performance was assessed using in-game variables, such as game result, favorable and unfavorable plays, and kills/deaths/assists ratio. The results showed that no changes were found in the performance of the players according to the pregame iceberg profile. Changes were found in the pre- and postgame iceberg profile, according to the final outcome of the game, and the favorable and unfavorable plays. Furthermore, the psychological variables cognitive and somatic anxiety, and self-confidence, had a relationship with the presence or absence of the iceberg profile. To conclude, the iceberg profile does not seem to influence the performance of esports players, although it is modified by events that occur during the game.

Index Terms—Esports, mood state, professional, self-confidence, videogames.

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I. INTRODUCTION

PERFORMANCE in esports is at an early stage and there is no exact definition of this concept, given the complexity of defining this concept in view of the large number of multi-dimensional variables that can affect performance [1], [2], [3]. In fact, there is no consensus on the performance indicators that can be the most decisive and that can affect success during the game [1], [4]. In this sense, previous research has shown that elements from different fields, such as engineering and computer science, ergonomics, physical and psychological aspects, technical-tactical skills of each esports, or healthy habits, can be relevant for achieving success during the games [3], [5]. Thus, specific game actions and technical-tactical skills have been studied in esports, such as *League of Legends* (LOL), where it has been shown that kills, deaths, kills-deaths-assistances ratio (KDA), neutral monsters, gold achieved, or structures destroyed are the most relevant factors [6] that can be favorable or unfavorable plays for the final result, depending on the team that executes each play [7]. The execution of these plays, hence performance, can be affected by multiple health-related factors. Previous studies have shown that factors, such as physical fitness, nutrition and hydration, sleep, motivation, as well as psychological factors before and during the competition, could influence the result of esports competitions [8], [9], [10], [11]. In particular, psychological factors have been one of the most explored areas of study in the field of esports [12], [13], [14]. However, no studies have analyzed changes in the specific performance in esports during the game, based on the psychological state of the players, although some scientific literature is available in the field of traditional sports, which can serve as a starting point. Previous research has shown that psychological models and psychology interventions designed and applied to traditional sport could be utilized to explain what occurs in the field of esports [15], [16], [17].

In this regard, one of the parameters that have been analyzed within traditional sports, due to its possible influence on sporting performance, is the state of mind of the athletes [18]. More specifically, the dimensions of tension, depression, anger, vigor, fatigue, and confusion have been analyzed due to their influence on sports performance [19], with the “profile of mood states” (POMS) questionnaire [20] being the most popular tool used for this purpose [21]. In fact, the POMS questionnaire [20] has been the most widely used instrument

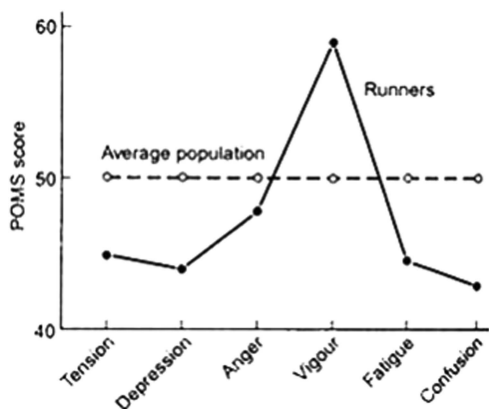


Fig. 1. Graphical representation of the iceberg profile with a sample of runners [19].

in sport psychology mainly because it is a valid and reliable questionnaire [20], which allows for the individual assessment of each of the six dimensions of mood states [22]. According to Terry et al. [23], anger is typified by feelings that vary in intensity, from mild annoyance or aggravation to fury and rage; confusion is characterized by bewilderment and uncertainty, associated with a failure to control attention and emotions; depression is a negative self-schema characterized by hopelessness, personal deficiency, worthlessness, and self-blame; fatigue is characterized by tiredness, mental and physical; tension is typified by nervousness, apprehension, worry, and anxiety; and vigor is related to excitement, alertness, and physical energy. The analysis of these dimensions from the individual standpoint provides information on the psychological state of athletes and allows for intra- and intersubject comparisons [19], which can predict sports performance [18], [19]. This is a decisive aspect, as this questionnaire is very useful for assessing the state of the players immediately before and after a competition, and has been successfully utilized in sports, such as jiu-jitsu, swimming, judo, or volleyball [8].

Likewise, from a global perspective, the state of mind of athletes has been proposed, as its six dimensions are interrelated and jointly affect sporting performance [24]. The joint analysis of the state of mind dimensions of athletes with a graphical approach has given rise to the concept of the iceberg profile [19]. An iceberg profile shows when, within the analysis of an athlete's state of mind, the vigor score outweighs the rest of the parameters, so this profile is characterized by low scores in the dimensions of tension, depression, anger, fatigue, and confusion, as opposed to a high score in the vigor dimension [19]. The name is given because when the analysis of the state of mind is represented graphically, the drawing is similar to that of an iceberg, as shown in the study with runners by Morgan [19] (see Fig. 1). The iceberg profile represents a theoretical pattern of optimal performance based on the scores obtained from the mood state of the players [19], which is related to an optimal psychological state that favors sporting success [25], [26], [27]. In fact, it has been found that, in climbing and karate, the presence of the iceberg profile prior to a competition favors performance [25], [28]. However, in other research carried out in soccer, swimming, or gymnastics, it does not seem to be

a determining factor [29], [30], [31], [32], which leads us to consider that the influence of the iceberg profile on performance depends on other aspects, such as the sport modality (individual or team), the competitive level, or the specific demands of the sport.

In addition, the state of mind of the athletes is a dynamic concept, so the result obtained during the competition modifies the postgame iceberg profile. In this sense, it has been shown that tennis players who win show a lower total mood disturbance than those who lose [26], and in athletics, when performance is poor and defeat occurs, a considerable decrease in the vigor score is favored, leading to the disappearance of the iceberg profile [33], whereas when athletes perform better during the competition, an increase in positive mood states (vigor) and a decrease in negative mood states (fatigue, depression, or anger) are observed [27].

In addition to the importance of performance during competition, the iceberg profile is related to other psychological variables. The importance of psychological variables in sports is well known, mainly in competition [34], due to its relationship with sports performance [35]. In particular, moderate levels of stress [36], a reduction in anxiety levels [37], and higher levels of self-confidence [38] have been widely studied in the field of sports, as they have been shown to be predictive variables of high sports performance during competition [26], [39]. Thus, the iceberg profile has been shown to be related to these psychological variables in tennis, where it has been observed that players who won their matches had a prematch iceberg profile and scored higher in self-confidence and lower in anxiety [26]. Therefore, the iceberg profile could, directly and indirectly, influence sport performance, through its relationship with other psychological variables.

II. BACKGROUND AND RELATED WORK

In the esports field, some research studies have tried to explain the relationship between psychological variables and their influence on players' performance. In one of our previous studies on LOL, significant differences were found between pre- and postgame mood states according to the game result [13]; another of our studies showed that consecutive matches influenced the mood state of the player, while the result of the game was also important [14]; Sanz-Matesanz et al. [3] showed that excessive playing time affected the physical and psychological level of the players, which reduced their subsequent performance; the results by Wang et al. [40] found that anxiety was negatively related with competition performance, while self-efficacy was indirectly and positively related; Hulaj et al. [41] found that perceived competence and autonomy were significant predictors of performance, but that motivational factors were not as important; Matuszewski et al. [42] showed that higher performing players were less extraverted and agreeable, but more open to experience; Bikas et al. [43], [44] showed that consecutive esports games had a negative influence on players' mood, mainly increasing fatigue, as well as on the probability of victory, decreasing it considerably during successive games; Sharpe et al. [45] indicated that esports performance might break down under pressure due to elevated anxiety, threat appraisals, and disrupted gaze behavior; Beres

et al. [46] showed that the propensity to clutch was negatively correlated with anxiety and positively correlated with private self-awareness and the player's experience with the competitive game; Behnke et al. [47] found that gaming performance was influenced by pleasant emotions with high-approach tendencies; Poulus et al. [48] conducted interviews with elite esports players and concluded that they used mental strategies to help regulate their emotions and remain mindful in the presence of "tilt," which was very important for maintaining high levels of self-confidence, uninterrupted focus, and flow states; another study by Poulus et al. [17] showed some overlap between mental toughness and stress coping process in competitive esports athletes; while the results obtained by Leis and Lautenbach [12] showed that physiological and psychological stress reactions occur in competitive games, influencing the performance of the players. Such is the importance of psychology in esports that previous research has shown the need for a psychologist and coach to work together to optimize player performance [49]. However, although previous scientific literature in the field of psychology and esports has shown significant advances, no study has yet to analyze whether the presence or absence of a specific psychological profile, such as the iceberg profile, influences players' performance during games.

Therefore, there is currently an open question of whether or not this iceberg profile may or may not be present prior to competition in professional esports players, and whether it influences their performance, and it is also not known whether this profile is modified as a consequence of the players' performance during the game. The absence of previous scientific research in the field of esports is relevant because, although previous research in traditional sports has analyzed differences in performance according to the presence of the iceberg profile, a common conclusion has not been reached [25], [29].

As no previous research has associated LOL performance (favorable plays, unfavorable plays, final outcome of the game, and KDA) to the iceberg profile of players pre- and postgame, or whether other psychological variables may be relevant in the iceberg profile of players, the aims of the present research were as follows:

- 1) to establish whether the presence or absence of the pregame iceberg profile was a determinant factor of performance (game result, favorable and unfavorable plays, favorable-unfavorable ratio, and KDA) during the game;
- 2) to analyze changes in the iceberg profile of esports players as a function of the final result of the game;
- 3) to determine the changes in the iceberg profile considering the number of favorable and unfavorable plays, and the KDA of LOL players during the game;
- 4) to characterize the modification in the iceberg profile as a function of the pregame anxiety and self-confidence scores.

Based on the previous research and the aims of the present investigation, the hypotheses proposed were as follows: the presence of the iceberg profile before competition will not affect the final result of the game, winning or losing, nor the number of favorable and unfavorable plays, the favorable-unfavorable ratio, and the KDA of the players (H1); the final result of the

game will affect the presence of the iceberg profile, making its appearance more difficult when the game is lost, and easier when the game is won (H2); when the number of unfavorable plays is greater than the number of favorable plays, and/or the KDA score is low, the iceberg profile will not be present postgame (H3); and the presence of negative psychological states pregame, such as a high somatic or cognitive anxiety, or poor self-confidence, will decrease the presence of the pregame iceberg profile in esports players (H4).

III. MATERIALS AND METHODS

A. Design

The present study was descriptive and longitudinal, and it assessed the psychological state of the players before and after each league game, as well as their performance in the game. The research design and protocol followed the STROBE statement (to improve reporting in observational studies) [50]. All participants signed the informed consent form prior to the start of the study, which informed them of the aims, procedures, and confidentiality of the data obtained. The ethics committee of the Catholic University of Murcia approved the research design (code: CE112002) following the guidelines of the Helsinki declaration (to meet satisfactory ethical standards during scientific research) and the code of the World Medical Association.

B. Participants

Five male professional LOL players (age: 19.4 ± 2.51 years; years of experience: 2.4 ± 1.14 years) from the same team were analyzed during all the games in the 2019/2020 season. The players were from Spain ($n = 1$), The Netherlands ($n = 1$), and Portugal ($n = 3$). All of them had previous competition experience, and all of them held the highest ranking ("challenger") in the EU West competitive server. The team's performance during the regular season was 11 victories and 7 defeats (61.11%-win rate), finishing 4 out of 10 and qualifying for the play-offs. The season was composed of 18 games, so a total of 90 individual games (18 games $\times$ 5 players) and 4638 plays were analyzed during the regular season. A play refers to an action carried out by a particular player, or several members of the team, in which they interact with the elements of the map and/or against opponents, by making use of their abilities, trying to benefit the team. The start and end of each play were different depending on the elements involved. Thus, when the play referred to a confrontation with rivals, the beginning of the play began with the first attack of a player on another player of the rival team, or vice-versa, and ended when they stopped attacking each other or the players died. Regarding the neutral monsters on the map, the start of the play began when they started attacking the monster and ended when they stopped attacking or they defeated it. And with map structures, the start was determined when the players attacked the structure and the end when they destroyed it. In the case of structures, it should be noted that when players attacked a structure but did not destroy it completely, it was also counted as a play, as it is an act that forces the opposing team to move toward the area to prevent the structure from being destroyed, thus

influencing the game. The participants participated voluntarily, with their selection being nonprobabilistic by convenience. The inclusion criteria were: being a professional player; and being a starting player on the team.

The sample was selected by convenience, as it was the only team of the LOL SuperLiga Orange that could be accessed at a reasonable distance (less than around 350 km of distance) to allow researchers to be face-to-face with players in the 18 games. Therefore, the five starting players of this team were a part of the research. The games were played online from the team's gaming house.

C. Instruments

The "competitive state anxiety inventory-2" (CSAI-2) instrument [51] was used to measure the players' cognitive anxiety, somatic anxiety, and self-confidence before games. This questionnaire has been previously validated in English [52]. The English version was completed by all the players as they all had a high level of English, which was their usual language of interaction. The Cronbach's alpha values for the three dimensions of the questionnaire were found in the 0.77 and 0.82 range. The CSAI-2 is composed of 27 items, 9 for each of the three dimensions.

The instrument used to obtain information about the players' mood states was the POMS questionnaire [20] in its 58-item version. This questionnaire provides information on six dimensions: tension, depression, anger, vigor, fatigue, and confusion. For its completion, a Likert scale from 0 (not at all) to 4 (very much) is used. To obtain the score for each dimension, the values of the items belonging to the dimension are added, except for items 19 (relaxed) and 48 (efficient), belonging to the dimensions tension and confusion, respectively, where the score was added inversely ($4 = 0$; $3 = 1$; $2 = 2$; $1 = 3$; and $0 = 4$). With the value obtained in each dimension, percentiles were calculated, following the scale for men by Balaguer et al. [53], and once obtained, it was determined that the players presented an "iceberg profile" when the value of the vigor dimension was above the 50th percentile, and those of the dimensions tension, depression, anger, fatigue, and confusion were below the 50th percentile [19]. This questionnaire was chosen because it was previously validated in English [22] and because it had a reliability between 0.76 and 0.91 in all of its dimensions. The English version was completed by all the players as they all had a high level of English, which was their usual language of interaction.

All the LOL games played were saved and subsequently analyzed using the spectator viewing platform available within the game (Riot Games, California, United States). Following the methodology from previous research [6], the most decisive plays for performance were selected, such as kills, deaths, destruction of structures, and neutral monsters, among others. In addition, each of the plays in which players participated was classified as either favorable plays for team performance, where players benefited the other players and/or the team, that brought them closer to victory (such as a kill, obtaining a neutral monster, killing an opponent, or destroying a structure of the opposing team), or

unfavorable plays for team performance, where the beneficiary was the opposing team (such as deaths, advantage in terms of gold or numerical superiority), following the methodology from our previous research [7]. Thus, the favorable and unfavorable plays in which each of the analyzed players was involved in each game were obtained [7]. After this, the ratio of favorable to unfavorable plays was calculated with the formula: Number of favorable plays – Number of unfavorable plays. This was performed following the methodology from previous research, in which the towers or gold obtained by one's own team minus those obtained by the rival team were subtracted to calculate the tower ratio or gold ratio, among others [6]. It should be noted that only those plays in which the beneficiary of the play was clearly distinguishable were included, while those in which the beneficiary could not be distinguished were excluded from the analysis [7]. In addition, the kills deaths assistances (KDA) ratio was calculated as an indicator of an individual player's performance throughout the game [6].

D. Procedure

To carry out the present research, a team of LOL professionals at a location close to the researchers' place of work was contacted via the email address on their website. After an initial meeting with the team's manager, a second meeting was held with the team's coaching staff and players to explain the aims and objectives of the project. All the team players gave their authorization to participate voluntarily in the present research, and both the manager and the members of the coaching staff authorized the taking of pre- and postgame measurements, as well as the presence of a member of the research team in the team's gaming house before, during, and after each game to ensure the correct taking of the data.

The present study was longitudinal, with data collected during the entire LOL spring split (three months). Players individually completed the POMS questionnaire and the CSAI-2 before the start of each game, specifically before warming up. Afterward, the players warmed up with their coach and technical staff, after which the competitive game immediately began. Once the game was over, the players filled out the POMS questionnaire again. A researcher was present during all the data collection sessions to ensure the correct completion of the questionnaires and to resolve any doubts that might arise.

Once it was known whether the players had the iceberg profile before and after the game, a variable with four categories was established: iceberg pre-iceberg post; iceberg pre-not iceberg post; not iceberg pre-not iceberg post; and not iceberg pre-iceberg post. In this way, it was determined whether players who had the iceberg profile before the game kept it or lost it at the end of the game, or whether players who did not have the iceberg profile before the start of the game had it or not at the end of the game.

The analysis of the players' performance during the games was carried out, thanks to the spectator viewing platform available within the video game (Riot Games, California, United States). KDA, and the number of favorable and unfavorable plays were recorded. To establish which plays were favorable

TABLE I
INFLUENCE OF THE PREGAME ICEBERG PROFILE ON THE FAVORABLE AND UNFAVORABLE PLAYS, THE FAVORABLE–UNFAVORABLE RATIO, AND THE KDA OF THE PLAYERS

	Iceberg pre (n=40)	Not Iceberg pre (n=50)	t	p	95% CI
Favorable plays	16.45±9.22	17.44±8.48	-0.529	0.598	-4.71; 2.73
Unfavorable plays	11.68±7.02	12.18±6.36	-0.357	0.722	-3.31; 2.30
Ratio favorable-unfavorable	4.78±15.30	5.26±14.00	-0.157	0.876	-6.64; 5.66
KDA	6.27±5.39	6.47±5.24	-0.180	0.857	-2.44; 2.03

or unfavorable for the player, two researchers performed the analysis of the games individually (A.M-O and R.V.-C). A third researcher was in charge of deciding in cases where there was no consensus (L.A-C).

E. Data Analysis

The Kolmogorov–Smirnov test was used to evaluate the normality of the data, and kurtosis was also analyzed. All the variables included in the analysis followed a normal distribution, so a parametric statistics test was performed.

Two chi-square analyses (χ^2) were performed. The first one was performed to know if the pregame iceberg profile influenced the final result of the game (win or lose), and the second one to know if the variable “result of the game” (won or lost) modified or maintained the presence or absence of the iceberg profile between the beginning and the end of the game. For these analyses, frequencies and percentages were used. The contingency coefficient was used to estimate; first, the association between the variables “result of the game” and “iceberg pregame” and, second, between the “result of the game” and “iceberg profile modification,” indicating whether variables were independent or dependent on each other. The maximum expected value was 0.707; $r < 0.3$ indicated a low association; $r < 0.5$ indicated a moderate association; and $r > 0.5$ indicated a high association [54].

A student t-test was performed to determine the differences in favorable plays, unfavorable plays, the ratio of favorable–unfavorable plays, and the KDA of the players, according to whether or not they presented the iceberg profile before the start of the game. Descriptive statistics ($M \pm SD$) were used for all psychological (cognitive anxiety, somatic anxiety, and self-confidence) and performance variables (number of favorable plays, number of unfavorable plays, ratio favorable–unfavorable plays, and KDA), as a function of the iceberg profile status on which parametric tests were performed.

For the analysis of the modification of the iceberg profile during the game as a function of the number of favorable and unfavorable plays, the favorable–unfavorable plays ratio, somatic and cognitive anxiety score, self-confidence score, and players’ KDA during the game, a one-way analysis of variance was used, with the Bonferroni pairwise comparison applied to

the variables with statistical significance, adjusting for the value of $p < 0.0125$. Partial eta squared (η^2) was used to calculate the effect size (ES), defined as small: $ES \geq 0.10$; moderate: $ES \geq 0.30$; large: $ES \geq 1.2$; and very large: $ES \geq 2.0$ [55].

The $p < 0.05$ value was established to determine statistical significance. The statistical analyses were performed using the SPSS statistical package (v.25.0; SPSS Inc., IL).

IV. RESULTS

A. Influence of the Iceberg Profile Before the Game on the Final Result of the Game and the Favorable and Unfavorable Plays, the Favorable–Unfavorable Ratio, and the KDA of the Players

The analysis of the differences between the games won and lost by LOL players, depending on whether they presented the pregame iceberg profile or not, showed that the iceberg profile prior to the game did not have an influence on the final result of the game ($p = 0.266$). Table I presents the differences in the number of favorable and unfavorable plays, in the favorable–unfavorable ratio, and in the KDA of the players according to whether or not they presented the pregame iceberg profile. No significant differences were found in any of the variables analyzed, depending on whether or not the pregame iceberg profile was present ($p = 0.598–0.876$).

B. Evolution of the Iceberg Profile According to the Result of the Game

Table II presents the changes in the presence of the iceberg profile depending on the outcome of the game. The results show significant differences in the evolution of the iceberg profile when the game was won or lost ($p < 0.001$). More specifically, when players won the game, they were significantly more likely to maintain the iceberg profile, in case they already had it before the game (36.36% when winning versus 2.86% when losing); or even showed the iceberg profile after the game when they had not shown it before it (14.54% when winning versus 0.00% when losing). It should also be noted that, in case of defeat, a high percentage of the players who had the iceberg profile before the start did not show it after the game (34.29% when losing versus 12.73% when winning); or remained in a status of not showing an iceberg profile neither in the pregame nor in the postgame (62.86% when losing versus 36.36% when winning). The value of the contingency coefficient was moderate.

C. Changes in the Iceberg Profile According to the Favorable and Unfavorable Plays During the Game, the Favorable–Unfavorable Ratio, the KDA, and Pregame Anxiety and Self-Confidence

Tables III and IV present the changes in the iceberg profile of players as a function of the number of individual favorable and unfavorable plays, the favorable–unfavorable ratio, the KDA, somatic and cognitive anxiety score, and self-confidence score. The differences between groups were significant in all the variables analyzed (see Table III). The results of the Bonferroni posthoc analysis showed that when players maintained the iceberg profile from the beginning to the end of the game (iceberg

TABLE II
MODIFICATION OF THE ICEBERG PROFILE DURING THE GAME AS A FUNCTION OF THE OUTCOME OF THE GAME

Result	Iceberg profile modification				Group differences (χ^2 , p)	Contingency coefficient
	Iceberg pre & post	Iceberg pre but not post	Not Iceberg pre & not iceberg post	Not Iceberg pre but iceberg post		
Win	20 (36.36%)	7 (12.73%)	20 (36.36%)	8 (14.54%)	23.308; p<0.001	0.454
Lost	1 (2.86%)	12 (34.29%)	22 (62.86%)	0 (0.00%)		

TABLE III
MODIFICATION OF THE ICEBERG PROFILE DURING THE GAME AS A FUNCTION OF THE NUMBER OF FAVORABLE AND UNFAVORABLE PLAYS, SOMATIC AND COGNITIVE ANXIETY SCORE, SELF-CONFIDENCE SCORE, AND PLAYERS' PERFORMANCE DURING THE GAME

Variables	Iceberg profile modification				F	p	η^2
	Iceberg pre & post	Iceberg pre but not post	Not Iceberg pre & not iceberg post	Not Iceberg pre but iceberg post			
Number of favorable plays	20.90 $\pm$ 6.63	11.53 $\pm$ 9.32	16.19 $\pm$ 8.62	24.00 $\pm$ 2.98	6.760	<0.001	0.191
Number of unfavorable plays	7.29 $\pm$ 3.15	16.53 $\pm$ 6.96	12.95 $\pm$ 6.24	8.13 $\pm$ 5.72	10.045	<0.001	0.259
Favorable-unfavorable ratio	13.62 $\pm$ 8.75	-5.00 $\pm$ 15.17	3.24 $\pm$ 14.00	15.88 $\pm$ 8.41	9.154	<0.001	0.242
KDA	8.81 $\pm$ 5.24	3.45 $\pm$ 4.05	5.80 $\pm$ 5.11	10.00 $\pm$ 4.68	5.635	0.001	0.164
Cognitive anxiety	13.81 $\pm$ 4.88	11.79 $\pm$ 3.58	18.67 $\pm$ 8.38	13.13 $\pm$ 2.70	6.209	0.001	0.178
Somatic anxiety	5.71 $\pm$ 2.70	5.11 $\pm$ 1.15	10.79 $\pm$ 5.34	6.00 $\pm$ 1.07	13.318	<0.001	0.317
Self-confidence	30.71 $\pm$ 3.23	29.74 $\pm$ 3.28	24.40 $\pm$ 4.03	28.25 $\pm$ 4.83	16.710	<0.001	0.368

TABLE IV
DIFFERENCES IN PERFORMANCE AND PSYCHOLOGICAL VARIABLES AS A FUNCTION OF THE PRE- AND POSTGAME ICEBERG PROFILE PRESENTED BY THE PLAYERS

Group	Test	Mean differences	95% Confidence Interval	p
Number of favorable plays	Iceberg pre – not iceberg post; Iceberg pre – iceberg post	-9.38	[-16.25; -2.51]	0.002
	Iceberg pre – not iceberg post; Not iceberg pre – iceberg post	-12.47	[-21.62; -3.33]	0.002
Number of unfavorable plays	Iceberg pre – iceberg post; Iceberg pre – not iceberg post	-9.24	[-14.20; -4.28]	<0.001
	Iceberg pre – iceberg post; Not iceberg pre – not iceberg post	-5.67	[-9.85; -1.48]	0.003
	Iceberg pre – not iceberg post; Not iceberg pre – iceberg post	8.40	[1.80; 15.00]	0.005
Favorable-unfavorable ratio	Iceberg pre – not iceberg post; Iceberg pre – iceberg post	-18.62	[-29.61; -7.63]	<0.001
	Iceberg pre – not iceberg post; Not iceberg pre – iceberg post	-20.88	[-35.50; -6.25]	0.001
	Iceberg pre – iceberg post; Not iceberg pre – not iceberg post	10.38	[1.10; 19.66]	0.020
KDA	Iceberg pre – not iceberg post; Iceberg pre – iceberg post	-5.37	[-9.56; -1.17]	0.005
	Iceberg pre – not iceberg post; Not iceberg pre – iceberg post	-6.55	[-12.14; -0.97]	0.013
Cognitive anxiety	Not iceberg pre – not iceberg post; Iceberg pre – iceberg post	4.86	[0.16; 9.55]	0.038
	Not iceberg pre – not iceberg post; Iceberg pre – not iceberg post	6.88	[2.02; 11.73]	0.001
Somatic anxiety	Not iceberg pre – not iceberg post; Iceberg pre – iceberg post	5.07	[2.21; 7.93]	<0.001
	Not iceberg pre – not iceberg post; Iceberg pre – not iceberg post	5.68	[2.72; 8.64]	<0.001
	Not iceberg pre – not iceberg post; Not iceberg pre – iceberg post	4.79	[0.66; 8.91]	0.014
Self-confidence	Not iceberg pre – not iceberg post; Iceberg pre – iceberg post	-6.31	[-9.04; -3.58]	<0.001
	Not iceberg pre – not iceberg post; Iceberg pre – not iceberg post	-5.33	[-8.16; -2.51]	<0.001

pre-iceberg post) ($p = 0.002$), and when they did not present it at the beginning but at the end of the game (not iceberg pre-iceberg post) ($p = 0.002$), the number of favorable plays was higher during the game as compared with games in which players presented the iceberg profile before the beginning of the game but not at the end (iceberg pre-not iceberg post), with a small effect size (see Table IV).

Regarding the number of unfavorable plays, it was observed that when players presented the iceberg profile before starting the game but not at the end of the game (iceberg pre-not iceberg

post) ($p < 0.001$), and when they did not present the iceberg profile neither at the beginning nor at the end of the game (not iceberg pre-not iceberg post) ($p = 0.003$), the number of unfavorable plays was higher than when players presented the iceberg profile at the beginning and at the end of the game (iceberg pre-iceberg post). In addition, when players did not present the iceberg profile before the start of the game but presented it at the end of the game (not iceberg pre-iceberg post), the number of unfavorable plays was lower than when players presented the iceberg profile before the start of the game but not

at the end of the game (iceberg pre–not iceberg post) ($p = 0.005$). The effect size was small in both cases (see Table IV).

According to the favorable–unfavorable ratio, the results showed that when players presented the iceberg profile both at the beginning and at the end of the game (iceberg pre–iceberg post) ($p < 0.001$), and when they did not present it before the start of the game but did so at the end of the game (not iceberg pre–iceberg post) ($p = 0.001$), the favorable–unfavorable ratio was higher than when players presented the iceberg profile at the beginning but not at the end of the game (iceberg pre–not iceberg post). Moreover, when players presented the iceberg profile before and after the game (iceberg pre–iceberg post) ($p = 0.020$), the ratio of favorable–unfavorable plays was higher than when they did not present the iceberg profile before nor after the game (not iceberg pre–not iceberg post). The effect size in both cases was small (see Table IV).

With respect to the individual performance according to KDA, for the players who showed the iceberg profile at the beginning of the game but not at the end (iceberg pre–not iceberg post), the individual performance during the game was lower than the players who started and ended the game with the iceberg profile (iceberg pre–iceberg post) ($p = 0.005$), as well as for players who did not show the iceberg profile at the beginning but did show it at the end of the game (not iceberg pre–iceberg post) ($p = 0.013$). The effect size in this case was small (see Table IV).

As for somatic and cognitive anxiety, the results showed that players who did not present the iceberg profile neither at the beginning nor at the end of the game (not iceberg pre–not iceberg post) had higher scores of anxiety as compared with players who had the iceberg profile both at the beginning and at the end of the game (iceberg pre–iceberg post) (cognitive anxiety: $p = 0.038$; somatic anxiety: $p < 0.001$), to those who had it at the beginning but did not have it at the end (iceberg pre–not iceberg post) (cognitive anxiety: $p = 0.001$; somatic anxiety: $p < 0.001$), and to those who did not have it at the beginning of the game but did present it at the end (not iceberg pre–iceberg post) (somatic anxiety: $p = 0.014$), with a small effect size for cognitive anxiety, and moderate for somatic anxiety (see Table IV).

Regarding self-confidence, players, who did not present the iceberg profile neither at the beginning nor at the end of the game (not iceberg pre–not iceberg post), showed a lower self-confidence score than those who showed the iceberg profile at the beginning and at the end of the game (iceberg pre–iceberg post) ($p < 0.001$), and players who showed the iceberg profile at the beginning but not at the end of the game (iceberg pre–not iceberg post) ($p < 0.001$), with the effect size being moderate (see Table IV).

V. DISCUSSION

The first objective of the present study was to establish whether the presence or absence of the pregame iceberg profile was a determinant factor of performance (game result, favorable and unfavorable plays, favorable–unfavorable ratio, and KDA) during the game. The results showed that no significant differences were found in the result of the game (victory or defeat), neither in the favorable, unfavorable plays, the favorable–unfavorable ratio nor in the KDA, when comparing the games in

which the players had the iceberg profile before the game and the games in which they did not. These results lead us to consider that the pregame iceberg profile was not a true determinant factor for sports performance.

Previous scientific literature on the influence of the iceberg profile on subsequent performance does not provide a consistent conclusion. However, it seems that, in some sports, such as climbing or karate, the presence of the iceberg profile benefits subsequent performance [25], [28], whereas in other sports, such as soccer, swimming, or gymnastics, the performance is not affected [29], [30], [31], [32]. This difference between sports is found in other psychological variables as well, such as agreeableness, sociotropy, or depression [56], [57]. This could be due to differences in the idiosyncrasy of the different sports. Thus, in many sports, as in war, there is no relationship between what occurs on the battlefield and the eventual results [58]. Therefore, the winner may be decided on a particular play at the end of the game, downplaying the importance of what occurred during the course of the game, so that the previous psychological state, in this case, the iceberg profile, would not be a predictor of performance or victory.

In this line, the idiosyncrasies of videogames, and more specifically LOL, make it a highly variable sport in which each game can take a completely different course [59], as the champions chosen at the start of the game, the objectives achieved, the structures destroyed, or the number of kills or deaths, are completely variable and unpredictable before the start, making it difficult for the pregame iceberg profile to predict the players' behavior during the game. Therefore, the fact that players have the iceberg profile before starting the game does not seem to be a predictor of performance or victory. Furthermore, LOL is a collective sport, and this could also provide an explanation for the lack of influence of the iceberg profile on performance, as in collective competitions, although personal performance is relevant, everything depends on the team as a whole and the poor performance of one player can be compensated for by the rest of the team [60], [61]. Also, in LOL, a bad individual performance may not be a determinant factor in the final stages of the game, where all players are equalized in terms of gold, items, and skills, so a bad individual start may not be so determinant in the final performance, as observed in recent research, where first blood or first tower destroyed, were not a part of the model that predicted victory or defeat, downplaying the importance of the pregame mood [7].

These results lead us to accept the first research hypothesis (H1), which stated that the presence of the iceberg profile before the competition will not affect the final result of the game, winning or losing, nor the number of favorable and unfavorable plays, the favorable–unfavorable ratio, and the KDA of the players, as no differences were observed in these variables when the iceberg profile was present or not, before the start of the game.

The second objective of the present research was to analyze the changes produced in the iceberg profile of esports players as a function of the final result of the game. The results showed that when players who had the iceberg profile before the game lost the game, and they also lost the presence of the iceberg profile in the postgame (iceberg pre–not iceberg post). These results are

similar to those found in previous studies, in which basketball or rugby athletes who were defeated showed significant decreases in vigor and increases in tension and depression [62], [63], [64]. Unfavorable plays that take place in esports games and lead the team to defeat could provoke a mental state characterized by negative emotions, such as frustration, known as “tilt” [65], [66]. Previous research has shown that tilt is caused by both external and internal factors of the game (opponents, teammates, and own performance) [67], which creates changes in moods, and may explain why the iceberg profile disappears from the beginning to the end of the game in esports players when the game ends in defeat. Thus, future interventions are necessary that allow players to suppress the negative thoughts that can appear after a bad start of the game, allowing them to optimize their performance during games in which numerous negative plays occur, and to implement self-control techniques in these players for games that end with adverse results. However, this issue should be addressed in future research, as it is not easy to eradicate, given that one of the main causes of tilt are toxic behaviors, such as bullying, which are perceived as normal by players, who include them as a part of the competitive culture of the game, interfering with team dynamics, players’ performance, their moods, and enjoyment [68].

On the contrary, when players won the game, players were more likely to keep the iceberg profile postgame if they already had it pregame (iceberg pre–iceberg post), or it was more likely to appear postgame if they had not had it pregame (not iceberg pre–iceberg post). Therefore, both in victory and defeat, changes were observed when comparing the iceberg profile before and after the game, with a common finding that when the players had the iceberg profile before starting the game, it was maintained after a victory until the end, but with defeat, the iceberg profile disappeared; meanwhile, when the iceberg profile was not present at the beginning of the game, but instead at the end, the game had been usually won. These results follow the line of previous research, in which football players and swimmers showed changes in mood states after the competition [33], [69], [70], regardless of the result obtained, perhaps produced by the stressful environment, characterized by the relevance and uncertainty of the event [69]. Similarly, previous research on esports showed that, after several consecutive games, players showed increases in mental fatigue, regardless of the result obtained in the games [43], [44], which suggests that the changes in mood observed are due to other factors unrelated to the final result, as could be the high demands of the game with hardly any rest between games. These findings point to the importance of recovery in esports players, as victory and defeat produce significant modifications to the iceberg profile, which should be further considered when knowing that previous research in this area has found a relationship between mood states and the quality of players’ sleep, with those who had higher levels of depression waking up a greater number of times and staying awake for longer periods during the night [71]. Correct rest is a determining factor in esports performance due to the need to make decisions and execute them in a short period of time [11]. Thus, future research needs to address the possible influence of the iceberg profile on sleep and other health-related and performance-related markers in esports players.

However, it is surprising that players who started the game without the iceberg profile, in most cases, finished the game without it, regardless of the game result (not iceberg pre–not iceberg post). This is curious because, in a high number of games, when the player did not present the pregame iceberg profile, the victory did not cause the postgame profile to appear. This occurred on more occasions than the change from not having the pregame iceberg profile to having it postgame, which begs the question of whether the game results will have an effect on this change when players do not have the pregame profile. A possible explanation could be that, although players are able to regulate their pregame mood, this factor is not so determinant in predicting performance in certain modalities [72], [73], mainly in those of long duration, in which emotions fluctuate during the competition, with the evaluation of emotions during the competition being a better predictor in these cases [74]. Therefore, research is needed to monitor esports players during the course of the games, as it would provide more information about the changes in mood states and the iceberg profile during the competition.

Based on the results obtained, the second research hypothesis (H2), which posited that the final result of the game will affect the presence of the iceberg profile, making its appearance more difficult when the game is lost and easier when the game is won, can be partially accepted, as the iceberg profile was more likely to be present at the end of the game when the game ended in victory and more likely not to be present when the game ended in defeat. However, when players did not have the iceberg profile pregame, victory, and defeat did not exert a significant change, as on most occasions, they still did not have the iceberg profile at the end, regardless of the game result. This calls for future research to elucidate and analyze the most determinant in-game factors that may explain the changes in the iceberg profile of esports players, as the game result alone does not seem to explain all the possibilities.

The third objective of the present research was to determine the changes in the iceberg profile, considering the number of favorable and unfavorable plays, favorable/unfavorable plays ratio, and the KDA of esports players during the game. Regarding the number of favorable and unfavorable plays, and the favorable–unfavorable ratio, it is worth noting that when players maintained the iceberg profile from the beginning to the end of the game (iceberg pre–iceberg post), the number of favorable plays was higher, while the number of unfavorable plays was lower than the players who presented the iceberg profile before the beginning of the game but not at the end (iceberg pre–not iceberg post). In addition, the players who did not have the iceberg profile at the beginning, but at the end of the game (not iceberg pre–iceberg post), had a higher number of favorable plays during the game as compared with games in which players had the iceberg profile before the beginning of the game but not at the end (iceberg pre–not iceberg post). On the contrary, when players did not have the iceberg profile neither at the beginning nor at the end of the game (not iceberg pre–not iceberg post), the number of unfavorable plays was higher as compared with games in which players had the iceberg profile both at the beginning and at the end (iceberg pre–iceberg post). These differences are supported by the favorable–unfavorable

ratio. When having the iceberg profile before and after the game (iceberg pre–iceberg post), or when not having the iceberg profile before starting, but after finishing (not iceberg pre–iceberg post), the favorable–unfavorable ratio was higher than in games in which the players had the iceberg profile pregame, but not postgame (iceberg pre–not iceberg post) and in games in which they did not have the iceberg profile neither before nor after the game (not iceberg pre–not iceberg post). Similar results were found in previous research, in which different types of tasks activated different mood states [64]. In this case, favorable plays seemed to positively influence the mood states of esports players, which may be because these plays create an advantage over the opposing team, bringing players closer to victory, which is linked to joy and satisfaction, favoring mood states that shape the postgame iceberg profile. Nevertheless, even with these promising results, some questions remain. For example, one could analyze which types of plays, specifically within the set of favorable or unfavorable ones, could better explain the observed change or nonchange in the moods of LOL players.

With respect to the KDA, it was lower when the players had the iceberg profile at the beginning of the game but did not have it at the end (iceberg pre–not iceberg post) than in those players who started and ended the game with the iceberg profile (iceberg pre–iceberg post), and in players who did not have the iceberg profile at the beginning, but did so the end of the game (not iceberg pre–iceberg post). These results follow the line of previous research, in which the KDA and other psychological variables were related, with significant differences found between this performance parameter and the motivational profiles of the players [75]. Moreover, it should be considered that the KDA score is calculated based on favorable and unfavorable plays that occur when fighting against opposing players, more specifically kills, deaths, and assists [6], [7], and it is, therefore, logical to think that when a certain pre–postgame iceberg profile leads to favorable plays, it also leads to a higher KDA score.

Regarding the third research hypothesis (H3), which stated that when the number of unfavorable plays is greater than the number of favorable plays, and/or the KDA score is low, the iceberg profile will not be present postgame, it can be accepted. The results showed that a higher ratio of favorable plays and a higher KDA score were directly related to the maintenance of the iceberg profile from start to finish and to the appearance of the iceberg profile at the end of the games when it was not present at the beginning.

The fourth objective of the present investigation was to determine the modification in the iceberg profile as a function of pregame anxiety and self-confidence. The results showed that players who did not have the iceberg profile, both at the beginning and at the end of the game (not iceberg pre–not iceberg post), had higher scores in anxiety and lower scores in self-confidence as compared with players who had the iceberg profile at the beginning and at the end of the game (iceberg pre–iceberg post); and compared with those who had it at the beginning but not at the end (iceberg pre–not iceberg post). Previous research found significant correlations among athletes' mood states, anxiety, and self-confidence [76], [77], [78], with those showing the pregame iceberg profile having higher self-confidence scores and a greater ability to remain calm and

relaxed under the pressure of negative events [26]. These results become particularly relevant when considering that similar to other sports' modalities, esports players suffer competitive stress that can influence their performance [79]. Previous research has shown that self-confidence decreases uncertainty and favors self-perception [80], [81], being a fundamental element for decreasing competitive anxiety. Thus, it seems to be one of the most decisive aspects on which future interventions should focus to help esports players successfully face the most decisive situations of the games and to decrease the probability of anxiety having a negative influence.

These results lead us to accept the fourth research hypothesis (H4), which posited that the presence of pregame negative psychological states, such as high somatic or cognitive anxiety, or poor self-confidence, will decrease the presence of the pregame iceberg profile in esports players. The present research also showed that pregame cognitive and somatic anxiety were presented to a greater extent when esports players did not have the pregame iceberg profile, whereas self-confidence scores were higher when the iceberg profile was present pregame. However, future research is needed to determine whether the iceberg profile and moods have an influence on the other psychological variables, or vice-versa. For the time being, and based on the results obtained, it can only be stated that the maintenance of an adequate mood that is as close as possible to the presence of the iceberg profile may be relevant for esports performance due to its relationship with low anxiety and high self-confidence. In fact, the iceberg profile alone does not seem to directly influence the performance of esports players (game results, plays, and KDA), as opposed to anxiety and self-confidence [40]. Therefore, future interventions should follow the line of previous research, in which techniques, such as imagery, were used to maintain the players' confidence high [82]. This high confidence can have a positive impact on the maintenance of an adequate mood, which would be relevant to keep players in a state of well-being [83]. However, future research is needed to analyze the relationship of the iceberg profile with other variables, such as expectations of success or autonomy support, which have been shown to be relevant in esports performance [84].

Therefore, the following relevant aspects are derived from the present investigation. Performance during the games, mainly game result, number of favorable and unfavorable plays, and KDA, produces changes in the presence of the iceberg profile; however, performance during the game is not affected by the pregame iceberg profile. These results are in line with previous research [85], which showed that postgame mood states were strongly influenced by performance than performance by changes in pregame mood states. Although this may seem irrelevant at the competitive level, where successive games are played, and the presence or absence of the iceberg profile would be of no importance for performance, the fact that this profile is related to other psychological variables makes it very relevant. Thus, when players do not have the iceberg profile, they are more likely to have high scores of somatic and/or cognitive anxiety, as well as a low self-confidence. Therefore, the study of this profile could indirectly provide relevant information for performance, given its relationship with other psychological variables.

Although this is the first study to analyze the relationship between changes in the iceberg profile and esports performance, it should be noted that only five male professional players were included in the study, which is an aspect to consider when wanting to generalize the data obtained to other populations, such as amateur players, players of other esports, or female esports players. The fact that there are individual differences in terms of psychological aspects that affect performance [86] should be assessed in esports, and future research should expand the results obtained in this study with a larger sample of players, or even try to analyze whether the iceberg profile follows a trend within the same team, as would be followed in other teams. Therefore, the results found in the present investigation are important, but they should be considered with caution due to the following limitations.

- 1) The sample of professional players corresponded to a small part of the total population of esports players. This is because the teams who participated in the SuperLiga Orange were geographically distant, and the need for a researcher to be present during the measurements limited the sample size. However, because access to the sample of professional players is difficult during the competition season, these studies could be replicated at other times of the season when teams are more likely to collaborate, such as preseason games;
- 2) Only males were evaluated because, at the time of measurement, the national and international competition teams were composed only of males, making a sample of females inaccessible. Previous research has shown that gamers perceive gender bias in esports because of stereotypical gender roles in the world of video games, thus decreasing the participation of females [87]. However, at this time, new professional teams composed exclusively of females have emerged, which could become the subject of future lines of research.
- 3) In a small sample, as in the present investigation, despite the fact that a psychological intervention was not carried out during the season, the way in which the players faced the stressful events of the competition, as well as their personality characteristics, could be relevant in the results found. Considering the limitations of this research, the results obtained can be considered an initial approach to the use of a psychological model, such as the iceberg profile, in the field of esports, which allows us to discover the modifications to which this profile may be subjected during competitive esports games.

However, it would be interesting for future research to psychologically monitor players during games, as this would provide more information on the changes in mood produced by a given play, or to go beyond the multiplayer online battle arena genre, as the psychological demands can be completely different. In addition, the analysis of other psychological variables that provide relevant information on the personality of the players, or on how they cope with the stressful situations of competition, would allow the construction of an optimal psychological profile for esports players. Furthermore, the expansion of this line of research to amateur players who play competitive games (ranked games) would greatly increase the sample

size. However, aspects, such as physical presence, a familiarization period to play competitive games in the presence of other people, among others, should be previously considered. Moreover, given the importance of high competition on the health of athletes, the possible influence of the iceberg profile on physiological markers, such as sleep, needs to be investigated. These results can help esports professionals implement self-control techniques in players to reduce the emotional impact generated by failure and to recover the emotional balance for their future participation in competitions, which is especially relevant in the final stages of championships when consecutive games are played.

VI. CONCLUSION

The first and most important conclusion of the study is that the presence or absence of the pregame iceberg profile in LOL players does not affect their performance during games (game result, number of favorable or unfavorable plays, and KDA). However, the presence of the iceberg profile was affected by the final outcome of the game (victory or defeat). The study shows that, when players had the iceberg profile before the start of the game, they were more likely to continue to have this profile after the game if they won. In addition, when they did not have the iceberg profile before the start of the game, they were also more likely to have the iceberg profile after the game if they won it. Therefore, the second important conclusion is that the result of the game influences the appearance or loss of the iceberg profile after the game. The third conclusion is that the number of favorable and unfavorable plays is also relevant, as players had the postgame iceberg profile to a greater extent when the number of favorable plays during the game was higher than the number of unfavorable ones, regardless of whether they had the iceberg profile before the start of the game. Regarding anxiety, it was observed that when the score was high (both somatic and cognitive), players tended not to have the iceberg profile, neither at the beginning nor at the end of the game; while when having a high self-confidence score, players tended to have the iceberg profile before and after the games, with this being the fourth relevant conclusion of the study. These results provide evidence of the importance of psychology in the field of esports, and although the pregame iceberg profile did not modify the subsequent performance (game result, plays, and KDA), modifications were observed in the postgame iceberg profile, according to the performance during the game and other psychological variables, such as anxiety and self-confidence.

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