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Examining the Relationship Between Gamification Profiles (HEXAD) and Mental Fatigue in Football Players: A Theoretical and Contextual Analysis

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Abstract

Background Human behavior in performance settings reflects the interplay of cognitive and psychological processes. This study examined the associations between gamification user types and mental fatigue scores in male football (soccer) players and investigated the interactive effects of playing position, competition level, and serious injury experience.

Method A total of 331 male football players actively competing in different cities across Turkey participated in this cross-sectional, correlational study. Data were collected via the Mental Fatigue Awareness Scale in Athletes (MFASA) and the Modified Gamification User Types Scale (MGUTS). Analyses included Pearson correlation and two-factor analysis of variance (ANOVA).

Results The MGUTS total score was negatively associated with mental fatigue ($r = -.17$, $p < .01$). Mental fatigue scores differed significantly as a function of the playing position × serious injury experience interaction ($F(3, 323) = 12.38$, $p < .001$, $\eta^2 = .103$) and the playing position × competition level interaction ($F(3, 323) = 20.69$, $p < .001$, $\eta^2 = .161$). The interaction effects were most pronounced particularly in the goalkeeper and defender positions.

Conclusion Mental fatigue in football players operates as a multidimensional construct shaped not only by physical loading but by the joint influence of motivational profiles, position-specific cognitive demands, and experience-level factors. The findings highlight the importance of differentiating mental fatigue assessment and intervention approaches on the basis of positional role and competition level.

Keywords Mental fatigue, gamification user types, football players, positional role, competition level, soccer

Introduction

Human behavior in both daily life and performance settings reflects not only physical capacities but also the interplay of cognitive and psychological processes. The degree to which such interplay shapes behavior depends on the nature of the demands individuals face in a given context. In daily life, people draw continuously on physical, cognitive, and emotional resources to meet competing demands; over time, this sustained resource expenditure affects adaptive functioning and performance. The accelerating pace of modern life has now intensified this burden: tasks requiring sustained attention, perceptual processing, decision-making, and self-regulation impose cognitive loads that accumulate across domains [1, 2, 3]. Sport is one setting where the multidimensional demands converge with particular intensity. Training loads, competitive pressure, time management, and performance expectations collectively tax athletes' mental and emotional resilience and add a cognitive burden that extends beyond the physical requirements of the activity itself [4].

Conceptualized as a consequence of prolonged or intensive cognitive engagement, mental fatigue is among the psychological processes most likely to affect sport performance [5]. Research has shown that it can impair technical execution, reduce decision-making accuracy, and alter psychophysiological responses in athletes [6, 7]. Recent work has extended such emphasis beyond performance outcomes alone [8], as mental fatigue also produces measurable shifts in athletes' subjective awareness and perceptual appraisal processes [9, 10, 11].

Multiple individual, environmental, and cognitive factors contribute to both the onset and severity of mental fatigue. Motivational tendencies occupy a central position among these factors because they shape an individual's capacity to meet cognitive and psychological demands during task engagement, willingness to persist, and responsiveness to intrinsic or extrinsic incentives [12]. Earlier studies had established that individuals could vary in their motivational profiles [13] and that the profiles influenced cognitive load, sustained attention, task persistence, and susceptibility to fatigue and burnout [14]. Approaches that classify motivational tendencies systematically therefore offer an explanatory framework for understanding mental fatigue in athletes. Gamification user types represent one such classification, grounded in motivation-based user profiling.

Gamification user types describe which motivational sources individuals gravitate toward when engaging with activities, tasks, or digital environments [14]. The framework enables researchers to identify what drives individuals during task engagement, which reward and feedback mechanisms they respond to, and how they allocate mental resources [14, 15]. The HEXAD model classifies users into six motivational types: Socializer, Free Spirit, Achiever, Philanthropist, Player, and Disruptor [15]. Socializers are motivated by social interaction, belonging, and cooperation. Free Spirits gravitate toward exploration, autonomy, and creativity. Achievers draw motivation from goal attainment, progression, and a sense of competence. Philanthropists sustain task engagement through contributing to others and perceiving meaning in their actions. Players respond primarily to extrinsic rewards such as points and tangible gains. Disruptors tend to challenge existing systems, modify rules, or subvert competitive structures [14, 15, 16]. Within sport science, motivational orientation during training, patterns of cognitive loading, and mental fatigue scores among young football players may vary as a function of these profiles. Although mental fatigue and motivational processes have each received separate attention in the sport science literature, studies examining motivation-based user profiles in relation to cognitive fatigue remain scarce. This gap calls for a more integrated investigation of the relationship between athletes' motivational tendencies and their experiences of mental fatigue.

Football provides a suitable context for examining how motivation-based individual tendencies relate to mental fatigue. The sport requires continuous deployment of attention, perception, and decision-making under conditions of high cognitive and physical demand [17]. Its fast-paced structure, rapid decision-making requirements, intense competition, and constantly shifting environmental stimuli place sustained demands on attentional and cognitive control processes. The study was therefore designed to include male football players aged 12 to 35, an age range spanning active developmental and performance phases. The present study focused exclusively on male football players to reduce sample heterogeneity and allow a more controlled examination of the relationships among motivational profiles, positional demands, and mental fatigue within a relatively homogeneous competitive context [18]. Future research should examine whether these relationships differ across female athlete populations.

Playing position in football also generates differential cognitive demands. Positions vary in attentional requirements, decision-making frequency, and the scope of tactical responsibility, producing different patterns of cognitive loading [17]. Serious injury experience has been shown to increase athletes perceived psychological burden and to affect performance-related anxiety and mental resilience [19, 20]. Amateur and professional levels of competition differ in training intensity, competitive pressure, and performance expectations, further shaping the nature of the mental fatigue experience [21, 22]. The study was therefore designed to examine mental fatigue scores not only through the individual effects of these variables but also through their joint effects with playing position. Two-factor analyses of variance were conducted with mental fatigue scores as the dependent variable.

Since football players are sensitive to both cognitive loading and motivation-based individual tendencies, examining how gamification user types relate to mental fatigue constitutes a meaningful research problem. Because gamification user types capture athletes' motivational orientations and patterns of mental resource allocation during task engagement, these variables may be associated with mental fatigue. The purpose of this study was to examine the associations between gamification user types and mental fatigue in male football players aged 12 to 35, and to evaluate how these variables relate to each other within different contextual factors.

The following hypotheses were formulated to test the relationships among variables:

H1. Significant associations exist between HEXAD user types and mental fatigue, particularly for socializer and player profiles, with the direction and magnitude of these associations varying by user type.
H2. The interaction between playing position (goalkeeper, defender, midfielder, and forward) and serious injury experience (yes/no) on mental fatigue scores is significant.
H3. The interaction between playing position (goalkeeper, defender, midfielder, and forward) and competition level (amateur/professional) on mental fatigue scores is significant.

Method

Research Design

We employed a cross-sectional correlational design within a quantitative research framework. The primary focus was to examine the relationships between male football players' mental fatigue levels and gamification user types. Joint effects of mental fatigue with playing position, serious injury experience, and competition level (amateur/professional) were evaluated by two-factor analyses of variance. Data were collected from male football players competing at different league levels during the 2025–2026 season. Convenience sampling was adopted because field conditions and athlete accessibility vary considerably in sport science research [23, 24]. The study thus follows a cross-sectional correlational design that identifies the associations between player profiles and mental fatigue and examines how these variables vary across individual and contextual contexts.

Participants

The sample consisted of 331 male football players actively competing in different cities across Turkey who participated voluntarily. Age distribution was categorized into two groups: 63.1% were aged 12–18 (n = 209) and 36.9% were aged 19–35 (n = 122), indicating that the sample spanned both developmental and adult performance periods. Regarding sport experience, 34.1% of players had 1–3 years of experience (n = 113), 27.2% had 4–6 years (n = 90), and 38.7% had 7 years or more (n = 128). Positional distribution was as follows: 15.7% goalkeepers (n = 52), 37.8% defenders (n = 125), 25.4% midfielders (n = 84), and 21.1% forwards (n = 70). Competition level was split between amateur (66.5%; n = 220) and professional (33.5%; n = 111). Of the players, 41.1% (n = 136) reported a history of serious injury, defined in accordance with the consensus statement by Fuller et al. [25] as any football-related injury resulting in absence from training or competition for 28 days or more, while 58.9% (n = 195) reported no such experience. This distribution across various subgroups allows for the statistical assessment of the interaction effects between individual and contextual variables on mental fatigue.

Data Collection Tools

Mental Fatigue Awareness Scale in Athletes (MFASA)

The MFASA is a unidimensional, 25-item instrument developed for athlete samples [5]. Participants rate each item on a 5-point Likert scale ranging from 1 (Never) to 5 (Always). Confirmatory factor analysis (CFA) in the original validation study yielded acceptable fit indices (χ^2/df = 1307.60/287 = 4.55; RMSEA = .079; NFI = .96; NNFI = .96; CFI = .96). The single-factor structure accounted for 52.486% of total variance. Reliability indicators were strong: Cronbach's α = .96, composite reliability (CR) = .94, and average variance extracted (AVE) = .503 [5].

Modified Gamification User Types Scale (MGUTS)

The Gamification User Types Hexad Scale, originally developed by Tondello et al. [14] and revised by Tondello et al. [16], was adapted to Turkish culture [26]. The scale comprises 24 items across six subscales, with four items per subscale: Socializer, Philanthropist, Free Spirit, Disruptor, Player, and Achiever. No items are reverse scored. Responses are recorded on a 7-point Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree). Internal consistency in the present sample was $\alpha = .881$. Because scale items are framed in general terms rather than gaming-specific language, respondents need no prior gaming experience or familiarity with game preferences.

Data Analysis

Data were collected through face-to-face paper-based questionnaires and online data collection forms administered to male football players. Before the analysis phase, the raw dataset was screened for missing values, outliers, and compliance with fundamental statistical assumptions. Of the initial 403 responses, 10 contained missing data and were excluded. The remaining 393 observations were imported into statistical analysis software, and normality was assessed. Proximity among mode, median, and mean values indicated that the distribution approximated normality. In the first stage of outlier detection, 11 extreme observations were removed. A subsequent detailed evaluation based on Z-scores (criterion: ±3) and Mahalanobis distances (critical value: $\chi^2(49, .001) = 86.661$) led to the removal of 51 additional observations. The final dataset comprised 331 valid observations.

Multivariate outliers were identified using Mahalanobis distance based on all subscales of MFASA and MGUTS (critical value: $\chi^2(49, .001) = 86.661$). After removing 18% of the initial sample to ensure statistical robustness, results remained broadly consistent, and no systematic pattern was observed among removed outliers in terms of age, position, or competition level. To address potential Common Method Bias (CMB), Harman's single-factor test was conducted, indicating that a single factor accounted for only 32% of the variance (<50%), suggesting that CMB is not a major concern in this study. Homogeneity of variances was confirmed via Levene's test ($p > .05$). Following significant ANOVA effects, Tukey's HSD post-hoc tests were performed with a Bonferroni adjustment to control for Type I error across multiple comparisons. Age was included as a covariate (ANCOVA) to control for developmental differences. All assumption tests were conducted on Jamovi 2.6.2. Model fit was evaluated by χ^2/df, CFI, TLI, SRMR, and RMSEA indices [28, 29, 30].

Results

Confirmatory Factor Analysis and Measurement Model

Confirmatory factor analysis (CFA) results indicated that both instruments achieved acceptable model fit in the present sample, as shown in Table 1. For the MFASA, the χ^2/df ratio of 3.48 fell within acceptable limits, CFI and TLI values of .90 indicated adequate data-model fit, and SRMR (.080) and RMSEA (.073) values remained within recommended thresholds, supporting the single-factor structure. For the MGUTS, the χ^2/df ratio was 2.53, CFI (.91) and TLI (.92) exceeded .90, and SRMR (.079) and RMSEA (.076) fell within acceptable ranges. Evaluated against the fit criteria proposed by Hu and Bentler [33] and Kline [34], construct validity was supported for both instruments in the present sample. Furthermore, standardized factor loadings for all items ranged from .58 to .89, confirming the structural integrity of the measurement model. Notably, inter-factor correlations among the MGUTS subscales were high (r = .81–.96), indicating limited discriminant validity between HEXAD dimensions within this sample of football players. These findings may suggest that the HEXAD profiles function less as fully distinct motivational constructs and more as indicators of a broader global motivational tendency in highly competitive sport environments. Therefore, subscale-level findings should be interpreted cautiously. Future studies are encouraged to test second-order or bifactor models to clarify the dimensional structure of the MGUTS in athlete populations.

Table 1. Confirmatory Factor Analysis Results for Data Collection Instruments

	CMIN/DF (χ^2/df)	CFI	TLI	SRMR	RMSEA	Cronbach's α
MFASA	957/275 = 3.48	.90	.90	.080	.073	.91
MGUTS	896/237 = 2.53	.91	.92	.079	.076	.94

Normality Tests

Table 2 presents Kolmogorov–Smirnov test results for the MFASA and MGUTS subscale scores. All variables produced statistically significant K-S values, indicating departures from a normal distribution ($p < .001$). Normality tests, however, are highly sensitive in large samples ($n > 300$) and can flag even trivial deviations as statistically significant [27]. The evaluation therefore did not rely on K-S results alone; skewness and kurtosis values were examined to assess the structural characteristics of the distributions more reliably. All skewness and kurtosis values for the MFASA and MGUTS subscales fell within acceptable limits (±1), indicating that the distributions approximated normality in practice [31]. Although the Disruptor subscale showed relatively flatter distribution characteristics (kurtosis = −.919) and the Player subscale showed slight positive kurtosis (.259), both values remained within accepted thresholds for parametric testing. Despite the significant K-S results, the overall distributional properties were judged suitable for parametric analyses, and no contraindication was identified for the statistical methods employed in this study [29, 32].

Table 2. Normality Test Results for Data Collection Instruments and Subscales

		N	***M***	**Skewness**	**Kurtosis**	**K-S Statistic**	**df**	**p**
MGUTS	Socializer	331	5.93	−.929	−.115	.177	331	< .001

	Free Spirit	331	5.95	−.974	−.124	.182	331	< .001
	Philanthropist	331	5.99	−.774	−.389	.179	331	< .001
	Player	331	5.94	−.984	.259	.193	331	< .001
	Disruptor	331	5.00	.031	−.919	.134	331	< .001
	Achiever	331	5.96	−.941	−.162	.206	331	< .001
MFASA	Mental Fatigue	331	2.03	.307	−.366	.104	331	< .001

Correlation Analysis

The relationships between mental fatigue and gamification user types were examined using Pearson correlation analysis (Table 3). The correlation between mental fatigue and the MGUTS total score was negative and statistically significant (r = −.17, p < .01). Mental fatigue also showed small but significant negative correlations with the Socializer (r = −.19, p < .01), Philanthropist (r = −.15, p < .01), Player (r = −.18, p < .05), Disruptor (r = −.12, p < .05), and Achiever (r = −.17, p < .01) subscales. The Free Spirit subscale did not reach significance (r = −.10, p > .05). These findings indicate small negative associations between gamification user types and mental fatigue scores. The direction and magnitude of the observed correlations support H1.

Table 3. Correlation Analysis Results for Study Variables

***N* = 331**	***M***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Mental Fatigue	2.03	1	−.17**	−.19**	−.10	−.15**	−.18*	−.12*	−.17**
2. Gamification (Total)	6.39		1	.91**	.92**	.96**	.94**	.67**	.94**

3. Socializer	5.93			1	.81**	.83**	.90**	.41**	.91**
4. Free Spirit	5.95				1	.88**	.85**	.51**	.83**
5. Philanthropist	5.99					1	.91**	.59**	.89**
6. Player	5.94						1	.46**	.92**
7. Disruptor	5.00							1	.48**
8. Achiever	5.96								1

*p < .05; **p < .01 Note: All correlations were interpreted as small based on Cohen’s criteria. Confidence intervals for effect sizes ranged from modest to moderate.

Two-Factor ANOVA Results

Playing position exerted a statistically significant main effect on mental fatigue ($F(3, 323) = 5.281$, $p < .01$, $\eta^2 = .047$), indicating that mental fatigue scores differed across positions (Table 4). Injury experience alone did not produce a significant main effect ($F(1, 323) = 2.783$, $p > .05$, $\eta^2 = .009$). The interaction between playing position and injury experience, however, was statistically significant ($F(3, 323) = 12.375$, $p < .001$, $\eta^2 = .103$). Mental fatigue scores thus varied across positions differently depending on whether players had experienced a serious injury; the two variables combined produced a stronger effect on mental fatigue than either variable alone. These results support H2.

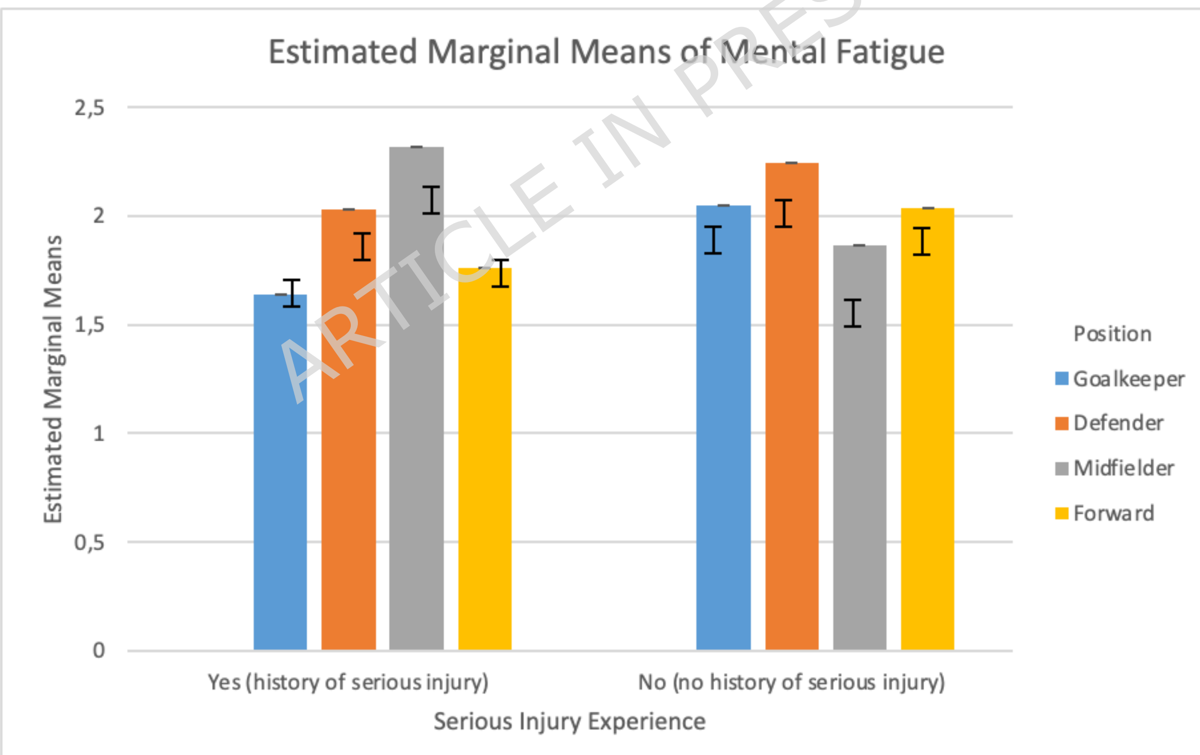
Table 4. Two-Factor ANOVA Results for Mental Fatigue Scores by Playing Position and Injury Experience

Source	**SS**	**df**	**MS**	**F**	**p**	**Partial η^2**
Playing Position (PP)	3.000	3	1.000	5.281	.001**	.047
Injury Experience (IE)	.527	1	.527	2.783	.096	.009
PP × IE	7.029	3	2.343	12.375	< .001**	.103
Error	61.160	323	.189			

Total	1444.109	331

*Note. R^2 = .114, Adj. R^2 = .095. **$p < .01$; *$p < .05$. Playing position: goalkeeper, defender, midfielder, forward. Injury experience: yes/no (serious injury defined as ≥28 days of absence [25]).*

Among players with a history of serious injury, mental fatigue levels varied more widely across positions than among uninjured players (Figure 1). Injured midfielders recorded the highest cell mean of any subgroup, whereas injured goalkeepers and forwards reported the lowest values. Among players without injury experience, the pattern reversed: defenders and goalkeepers showed relatively higher scores, while midfielders scored lower. The crossing of these positional profiles between injury groups, rather than a uniform elevation of scores in one group, is what produces the significant interaction effect.



Error bars represent 95% confidence intervals

Figure 1. Mental Fatigue Levels by Playing Position and Injury Experience

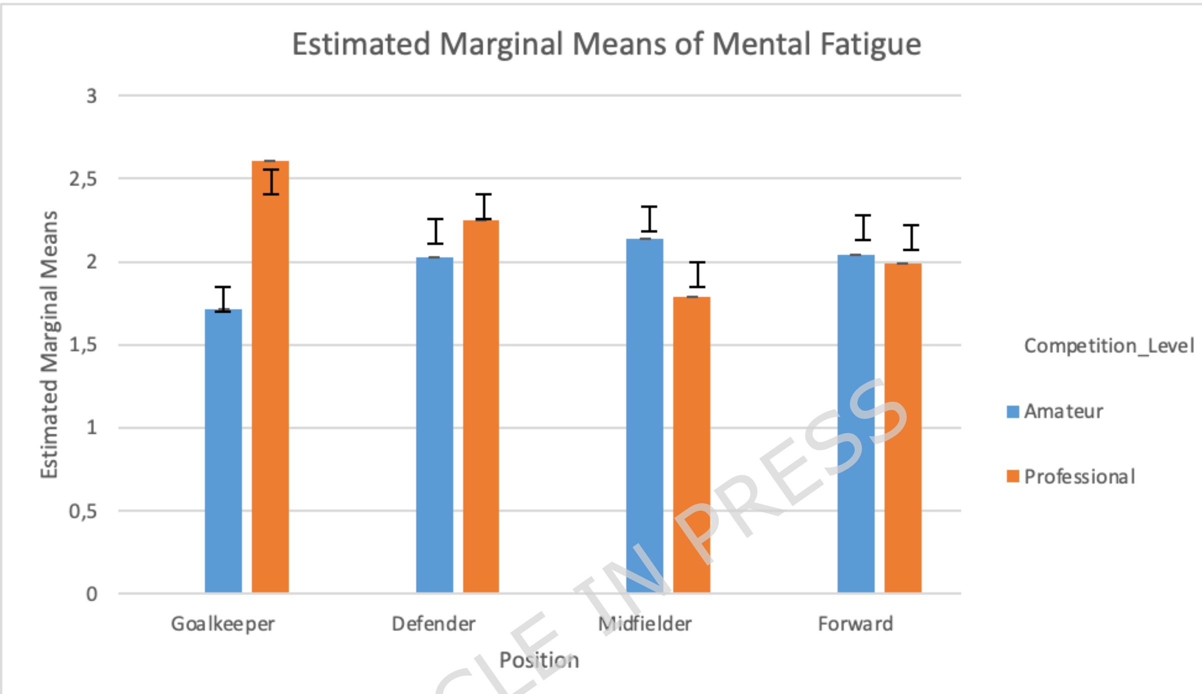
Competition level had a significant main effect on mental fatigue ($F(1, 323) = 11.893$, $p < .01$, $\eta^2 = .036$), confirming that amateur and professional players differed in mental fatigue levels (Table 5). Playing position also exerted a significant main effect ($F(3, 323) = 3.560$, $p < .05$, $\eta^2 = .032$). The interaction between playing position and competition level was statistically significant ($F(3, 323) = 20.690$, $p < .001$, $\eta^2 = .161$), indicating that the distribution of mental fatigue across positions followed different patterns for amateur and professional players. The goalkeeper position showed the most pronounced divergence: mental fatigue scores among professional goalkeepers were markedly higher than among their amateur counterparts. This pattern is consistent with the cognitive demands specific to goalkeeping, where error tolerance is minimal and mistakes translate directly into scoring outcomes, requiring sustained cognitive control and self-regulation. These results support H3.

Table 5. Two-Factor ANOVA Results for Mental Fatigue Scores by Playing Position and Competition Level

Source	**SS**	**df**	**MS**	**F**	**p**	**Partial η^2**
Competition Level	2.082	1	2.082	11.893	.001**	.036
Playing Position (PP)	1.870	3	.623	3.560	.015*	.032
PP × Competition Level	10.867	3	3.622	20.690	< .001**	.161
Error	56.548	323	.175			
Total	1444.109	331				

*Note. $R^2 = .181$, Adj. $R^2 = .163$. **$p < .01$; *$p < .05$. Playing position: goalkeeper, defender, midfielder, forward. Competition level: amateur/professional.*

Professional goalkeepers reported the highest cell mean of any subgroup, followed by professional defenders; both scored higher than their amateur counterparts (Figure 2). The pattern crossed at midfielder, where amateur players scored higher than professionals. At the forward position, amateur and professional players reported nearly identical levels. Post-hoc comparisons using Tukey’s HSD revealed that professional goalkeepers had significantly higher mental fatigue scores compared to amateur goalkeepers (p < .001) and professional forwards (p = .015). No significant differences were found between amateur midfielders and professional midfielders (p > .05). This crossing pattern across positions confirms that the distribution of mental fatigue varies by competition level, consistent with the significant interaction effect.



Error bars represent 95% confidence intervals

Figure 2. Mental Fatigue Levels by Playing Position and Competition Level

Discussion

We examined the relationships between mental fatigue and individual and contextual variables, including gamification user types, playing position, competition level, and serious injury experience, in male football players. Mental fatigue was found to be associated not only with individual motivational tendencies but also with task-related positional roles and prior serious injury experience.

Correlation analysis revealed negative, small-magnitude associations between mental fatigue and both the MGUTS total score and nearly all subscale scores, supporting H1. Small negative associations were observed between motivation-based profiles and reported mental fatigue levels. Self-

Determination Theory offers an interpretive framework for this pattern [12]. In profiles characterized by dominant intrinsic motivation (e.g., Socializer, Philanthropist, and Achiever), athletes' engagement with tasks tends to be more meaningful, autonomous, and sustainable, which may reduce cognitive loading [35]. Effective use of motivational resources may therefore lower cognitive exhaustion and contribute to reduced mental fatigue. Recent evidence further indicates that mental fatigue in soccer is not a static state; it fluctuates significantly from the regular season to play-offs [46] and can specifically impair sport-specific psychomotor performance and neuromuscular output [47, 48]. Existing research supports this interpretation. A study of amateur and professional football players found that athletes with higher intrinsic motivation reported fewer mental fatigue symptoms [36, 49]; elite basketball players with task-oriented motivational profiles experienced less cognitive exhaustion and attentional disruption [37]. Not all evidence aligns with these findings, however. Among university-level esports players, high extrinsic motivation improved short-term performance but increased cognitive fatigue over longer periods [38]. The discrepancy likely reflects the prolonged screen exposure and high-intensity cognitive arousal characteristic of esports, conditions that differ from the balanced physical and cognitive demands of football. While the results support H1, the small magnitude of the observed correlations ($r = -0.17$) indicates that motivation-based profiles explain less than 4% of the variance in mental fatigue, suggesting that other unmeasured factors likely play a more dominant role. Furthermore, the very high inter-correlations among HEXAD subscales ($r > .90$) suggest that these dimensions may not function as fully distinct constructs in this sample, potentially reflecting a global motivational factor or a response style bias within the competitive sport environment. Future research should test the HEXAD structure using second-order or bifactor models to clarify whether a global motivational factor underlies the observed high inter-correlations. Consequently, these findings should be interpreted with caution regarding their practical significance. The observed associations are statistically meaningful but practically modest, indicating that mental fatigue is likely influenced by multiple additional psychological, environmental, and performance-related factors not assessed in the present study.

The interaction between playing position and serious injury experience also affected mental fatigue scores, supporting H2. The interaction took the form of a crossing pattern: injury experience was associated with higher mental fatigue among midfielders but with lower scores at the goalkeeper, defender, and forward positions relative to their uninjured counterparts. Cognitive Load Theory may provide a theoretical lens here [39]. Decision-making frequency, error tolerance, and attentional demands inherent in specific positional roles are primary determinants of cognitive load. Midfielders participate actively in both phases of play, engage in continuous environmental scanning, must sustain attention over prolonged periods, and carry high decision-making responsibility; injury experience may compound these demands, elevating cognitive fatigue. At other positions, the lower scores among injured players could reflect adaptive coping, altered role expectations during return-to-play, or reduced exposure to the demands that characterize full competitive engagement. Research on elite football players provides partial support for this pattern. A study of young players in English academy leagues found that players with injury histories reported higher mental fatigue levels, with positional variation in the magnitude of this effect [40]. Position-dependent psychological loading has also been reported to intensify during the post-injury period, strengthening perceived cognitive fatigue [41]. By contrast, a study of individual-sport athletes found that the effect of injury experience on mental fatigue was limited [42], a difference that may reflect the more complex cognitive demands created by role and responsibility sharing in team sports. The present findings indicate that injury experience interacts with positional role in a non-uniform manner, producing divergent effects across positions rather than a uniform elevation.

Playing position and competition level also interacted to affect mental fatigue scores, supporting H3. Professional goalkeepers reported markedly higher scores than players at other positions and amateur goalkeepers. Responsibility and error tolerance offer an explanatory framework: the goalkeeper role is defined by minimal error tolerance, where mistakes translate directly into scoring outcomes. At the professional level, spectator pressure, performance expectations, and career-related anxiety add further psychological demands. These combined factors increase the need for sustained cognitive control, attentional continuity, and self-regulation, elevating mental fatigue. Professional goalkeepers have been shown to report higher mental workload and performance anxiety than outfield players [43], and to experience more intense cognitive stress during decision-making [44]. Among amateur players, by contrast, positional differences in mental fatigue have been reported as more limited [45], attributable to comparatively lower performance pressure and external expectations at that level. Support for H3 confirms that mental fatigue levels are closely tied not only to position-specific demands but also to the competition level at which those demands are experienced.

Overall, mental fatigue in football players appears to be shaped by the interaction of motivational profiles, positional roles, and competition level. Confirmation of all three hypotheses underscores the need to consider both contextual and individual dimensions of cognitive loading jointly. The findings support the view that mental fatigue in performance contexts operates as a multidimensional construct rather than a unidimensional outcome variable. Findings should be interpreted with caution given the cross-sectional design, reliance on self-report measures, and small effect sizes.

Conclusion

Mental fatigue in male football players cannot be fully explained by physical loading or performance demands alone; it is a multidimensional construct that must be evaluated alongside motivational tendencies and individual psychological characteristics. The findings indicate that athletes' cognitive loading experiences are associated with positional roles and motivational profiles, showing variations based on competition level and injury history. Although statistically significant, these associations are small in magnitude, suggesting that mental fatigue is influenced by a broader array of contextual factors.

Negative associations between mental fatigue and gamification user type scores confirmed H1. Stronger motivation-based profiles were associated with lower fatigue. Profiles linked to intrinsic motivation (e.g., Socializer, Philanthropist, and Achiever) foster more meaningful and autonomous task engagement, promoting balanced cognitive resource use. This finding is consistent with Self-Determination Theory and related evidence on the fatigue-buffering role of intrinsic motivation [14, 35, 37].

Mental fatigue scores differed across playing positions, and the pattern of these differences changed depending on injury history, confirming H2. Among injured players, midfielders reported the highest cognitive fatigue, consistent with the sustained attentional, scanning, and decision-making demands of that position [17]. At other positions, however, injured players reported lower scores than their uninjured counterparts, suggesting that the relationship between injury experience and mental fatigue is position-dependent rather than uniformly additive. Injury experience may add performance anxiety and re-injury apprehension to existing cognitive demands at some positions [19, 20] while producing different adaptive responses at others. The crossing pattern underscores that mental fatigue is better explained by the joint contextual effect of position and injury than by either variable alone [40].

The interaction of playing position and competition level also differentiated mental fatigue scores, confirming H3. Professional goalkeepers reported higher fatigue than players at other positions and amateur goalkeepers. The goalkeeper position demands sustained cognitive control and attentional continuity because error tolerance is minimal and mistakes can directly affect match outcomes [43]. At the professional level, performance expectations, competitive pressure, and career anxiety further increase cognitive loading [21, 22]. Among amateur players, scores across defender, midfielder, and forward positions clustered within a narrow range, while amateur goalkeepers reported the lowest values in that group; this compressed distribution may reflect comparatively lower performance pressure. Mental fatigue must therefore be evaluated not only through positional demands but also through the competition level at which those demands are experienced.

Recommendations and Limitations

Assessment and intervention approaches to mental fatigue in football should account for athletes' motivational profiles and position-specific cognitive demands jointly, rather than relying solely on physiological load or training intensity. Profiles associated with intrinsic motivation may serve a buffering function against cognitive loading, while fatigue risk becomes more pronounced in positions defined by high responsibility and low error tolerance, particularly goalkeeping. Differentiating interventions on the basis of positional role and motivational tendencies is therefore warranted.

Mental fatigue in football players should be evaluated by considering motivational tendencies and position-specific cognitive demands alongside physical loading indicators. Coaches and sport psychologists can develop training and feedback strategies that support profiles associated with intrinsic motivation (e.g., Socializer, Philanthropist, Achiever), with the aim of helping players regulate cognitive loading more effectively. Professional goalkeepers, defenders, and midfielders, whose roles require sustained cognitive control and high decision-making responsibility, warrant closer monitoring for cognitive fatigue. Greater emphasis on psychological support during post-injury rehabilitation is also recommended. Future research could strengthen applied contributions by examining the effects of gamification-based motivational interventions on mental fatigue through experimental designs.

Several limitations must be addressed. First, the cross-sectional design precludes any causal inferences, and findings should be interpreted with caution given the small effect sizes observed. Second, the sample consisted exclusively of male Turkish players, limiting generalizability to female athletes and other cultures. Third, the study relied solely on self-report measures; future research should incorporate objective neurophysiological indicators such as reaction time or alertness tasks. Fourth, although age was statistically controlled as a covariate, combining adolescent and adult athletes within the same analytical framework may still have introduced developmental heterogeneity related to cognitive maturity, competitive experience, and psychosocial demands. Fifth, the very high inter-correlations among MGUTS subscales ($r > .90$) indicate limited discriminant validity. Sixth, important clinical details regarding serious injury, such as time elapsed since the injury and current recovery status, were not assessed. Finally, the exclusion of 18% of the initial sample as outliers was necessary for statistical robustness, and our sensitivity analysis confirmed that results remained consistent with and without these participants.

Abbreviations

MFASA: Mental Fatigue Awareness Scale in Athletes

MGUTS: Modified Gamification User Types Scale

CFA: Confirmatory Factor Analysis

ANOVA: Analysis of Variance

MF: Mental Fatigue

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Authors Contributions

Conceptualisation, M.K., F.C., M.G., H.G., M.C.K., D.W.M. and B.Y.; methodology, M.K., F.C., M.G., H.G., M.C.K., D.W.M. and B.Y.; formal analysis, M.K., F.C., M.G., H.G., M.C.K., D.W.M. and B.Y.; validation, M.K., F.C., M.G., H.G., M.C.K., D.W.M. and B.Y.; investigation, M.K., F.C., M.G., H.G., M.C.K., D.W.M. and B.Y.; resources, M.K., F.C., M.G., H.G., M.C.K., D.W.M. and B.Y.; writing—original draft preparation, M.K., F.C., M.G., H.G., M.C.K., D.W.M. and B.Y; writing—review and editing, M.K., F.C., M.G., H.G., M.C.K., D.W.M. and B.Y.; supervision, M M.K., F.C., M.G., H.G., M.C.K., D.W.M. and B.Y. All authors have read and agreed to the published version of the manuscript.

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Data availability

The study data can be obtained by contacting the corresponding authors, Dr. Dessalegn Wase Mola and Dr. Mustafa Can Koc, at dessalegn.wasie@gmail.com and cankoc_01@hotmail.com

Declaration

Ethics approval and consent to participate

All procedures performed in this study involving human participants were conducted in accordance with the ethical standards of the institutional research committee and with the 2008 Declaration of Helsinki and its later amendments. Ethical approval for the study was obtained from the Mersin University Sport Sciences Ethics Committee (Decision No. 2025-076, dated February 20, 2025).

Written informed consent was obtained from all participants prior to data collection. For participants under the age of 16, written informed consent was obtained from their parents or legal guardians. Participation was voluntary, and all participants were informed about the purpose of the study and their right to withdraw at any time without any negative consequences. All data were collected anonymously and treated confidentially.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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