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The relationship between motivation level and visual reaction performance in volleyball players

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Abstract

Aim: The purpose of this study was to examine the relationship between motivation levels and visual reaction performance in volleyball players, and to determine the predictive power of motivational subscales on visual reaction time. **Method:** A correlational design was adopted within a quantitative research framework. The sample comprised 71 volleyball players (22 male, 49 female) recruited through convenience sampling. Visual reaction time was measured using the Moart Visual Reaction Time Measurement Device; raw scores recorded in seconds (s) by the device were converted to milliseconds (ms) by multiplying by 1,000 prior to analysis. Motivation levels were assessed with the Sport Motivation Scale-II (SMS-II). Data were analysed using Pearson correlation and multiple linear regression analyses. **Results:** Mean visual reaction time was 454.1 ms. Significant negative correlations were found between visual reaction time and intrinsic motivation, identified regulation, and integrated regulation, indicating that higher autonomous motivation was associated with faster responses. Amotivation showed a significant positive relationship with reaction time. The regression model explained a substantial proportion of the variance in visual reaction performance, with identified regulation and intrinsic motivation emerging as the strongest predictors. **Conclusion:** These findings suggest that autonomous motivational orientations may support cognitive-motor readiness, whereas amotivation corresponds to slower reaction times, underscoring the importance of integrating psychological support into athlete training contexts.

Introduction

Among the determinants of sport performance, psychological variables have steadily gained ground alongside physical capacity and technical skill. When athletes train under broadly comparable conditions yet still differ in performance, motivation is repeatedly invoked as one of the central explanations for that variation (Vallerand, 1997; Hagger & Chatzisarantis, 2007; Engür, 2002). Defined as an internal force that initiates, directs and sustains behaviour, motivation is by now well documented in its bearing on sport participation, effort intensity and ultimate performance outcomes (Ryan & Deci, 2000a; Güler, 2025).

Self-determination theory (SDT) places motivation along a continuum that runs from intrinsic motivation at one pole to amotivation at the other, and proposes that the satisfaction of three basic psychological needs, autonomy, competence and relatedness, lies behind the development of more autonomous motivational forms (Deci & Ryan, 2000; Ryan & Deci, 2000a). Within the autonomous range, intrinsic motivation and identified regulation reflect the degree to which an activity has been integrated into the person's own values and identity, whereas introjected and external regulation correspond to internalised obligations or responses to external pressure. At the far end of the continuum, amotivation refers to the absence of intentionality and of perceived competence (Deci & Ryan, 2000). The accumulated evidence ties autonomous motivational forms to greater effort, persistence and quality of performance; amotivation, conversely, is linked with reduced engagement, higher dropout and a measurable decline in performance (Calvo-Cervelló et al., 2010; Lourenço et al., 2022; Ntoumanis, 2001; Erdem & Çakmak Yıldızhan, 2024).

From an SDT vantage point, however, motivation in sport has received comparatively limited empirical attention; existing work, as Demir (2022) and Kazak (2004) note, has clustered mainly around achievement

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motivation and sport participation motives. Studies that explicitly link the qualitative dimensions of motivation to cognitive-motor outcomes remain sparse, and the gap is particularly visible in research drawing on national samples.

Reaction time stands out, in turn, as one of the more telling cognitive markers of sport performance. Operationally, reaction time refers to the interval between stimulus onset and the initiation of a motor response, and it is treated as a reliable index of how quickly the central nervous system processes incoming sensory information (Raczek et al., 2003); for that reason it is widely preferred as a measure of cognitive-motor readiness. Visual reaction time, in particular, is sensitive to attention, concentration and cognitive readiness (Reigal et al., 2019), and athletes consistently outperform non-athletes on it (Akarsu et al., 2009; Dane et al., 2008). Domestic findings are largely in agreement: in team sports, reaction time has emerged as a meaningful indicator of performance (Kaplan et al., 2018; Erdoğan et al., 2020).

Volleyball, a highly dynamic team sport, layers tactical intelligence, fast decision-making and a continuous perception-action cycle on top of physical demands. Piras et al. (2014) showed that expert players process visual information both more rapidly and more selectively than novices, an advantage that they attributed to refined cognitive-motor integration. Mroczek et al. (2014), tracking elite players across competitive play, demonstrated that reaction times follow a dynamic course during a match, which suggests that cognitive-motor performance cannot be reduced to physical variables alone.

What has gone underexamined, in the sport sciences literature, is the relationship between motivational orientation and reaction time itself. Within SDT, autonomous motivational forms are theorised to support more efficient deployment of attentional resources and a more sustained cognitive readiness (Hagger & Chatzisarantis, 2007; Ryan & Deci, 2000a). Amotivation, by contrast, is expected to compromise reaction performance through attentional diffusion and a slowing of cognitive processing (Deci & Ryan, 2000; Ntoumanis, 2001). To our knowledge, no empirical study to date has tested this relationship directly in volleyball players.

On that basis, the present study examines the relationship between motivation levels and visual reaction performance in volleyball players, and tests which motivational subscales predict reaction time. The expected contribution is twofold: an empirical test of SDT in the volleyball context, and a set of practical implications for training. The following hypotheses, grounded in the theoretical framework and available empirical evidence, were therefore formulated:

H_1: Based on self-determination theory, it was hypothesized that higher levels of intrinsic motivation (H1) and identified regulation (H2) would correspond to shorter visual reaction times, while higher amotivation levels (H3) would correspond to longer reaction times in volleyball players. Additionally, it was hypothesized that motivational subscales would significantly predict visual reaction performance (H4).

Method

This study employed a correlational design within a quantitative research approach (Büyüköztürk et al., 2020; Karasar, 2023). A correlational design is suited to determining the direction and magnitude of relationships between variables and to identifying the predictive capacity of one or more variables on another (Büyüköztürk et al., 2020). In the present study, the independent variables were obtained through self-report measures and the dependent variable through an objective performance measurement; predictive relationships were tested using multiple linear regression analysis.

Participants

The sample consisted of 71 volleyball players recruited through convenience sampling based on voluntary participation. Of these, 22 were male (31.0%) and 49 were female (69.0%). Ages ranged from 18 to 20 years. A power analysis conducted using G*Power 3.1 (f^2 = 0.30, α = .05, $1-\beta$ = .80, number of predictors = 6) indicated a minimum required sample size of 55 participants; the present study's n = 71 exceeded this threshold (Faul et al., 2007). Demographic characteristics of the participants are presented in Table 1.

As shown in Table 1, the majority of participants were female (n = 49, 69.0%) and aged 18 years (n = 29, 40.8%). Athletes with 1–3 years of sport experience constituted the largest group (n = 48, 67.6%). Outside hitters (n = 25, 35.2%) and middle blockers (n = 21, 29.6%) were the most frequently represented playing positions.

Table 1
Demographic characteristics of participants.

Variables	Category	f	%
Gender	Male	22	31.0
	Female	49	69.0
Age	18 years	29	40.8
	19 years	20	28.2
	20 years	22	31.0
Sport Experience	1–3 years	48	67.6
	4–6 years	19	26.8
	7–9 years	4	5.6
Playing Position	Outside Hitter	25	35.2
	Middle Blocker	21	29.6
	Setter	12	16.9
	Opposite Setter	12	16.9
	Libero	10	14.1

Note. The sum of frequencies for playing position (*f* = 80) exceeds the sample size (*N* = 71), as some participants reported more than one position. Position data were collected in a multiple-response format.

Data Collection Instruments

Personal Information Form

A brief demographic form developed by the researchers was used to collect information on gender, age, sport experience, and playing position.

Visual Reaction Time Test

The Moart Visual Reaction Time Measurement Device (Lafayette Instruments, Sagamore, USA) was used to assess cognitive and motor speed. The device records raw scores in seconds (s); these were converted to milliseconds (ms) by multiplying by 1,000, and the resulting values entered the analysis as the "Performance" variable. All assessments were conducted in a quiet, adequately lit room free from distractions. Prior to testing, participants received a detailed explanation of the procedure and maintained a standardised seated position throughout. The index finger of the dominant hand was held approximately 3 cm above the response button, and light stimuli were delivered at randomised intervals to minimise anticipatory responding. Each participant completed three practice trials followed by five consecutive test trials. The fastest and slowest responses were excluded, and the mean of the remaining three trials was recorded as the performance score (Shelton & Kumar, 2010; Ratcliff, 1993; Cousineau & Chartier, 2010).

Sport Motivation Scale-II

Motivation levels were assessed using the Sport Motivation Scale-II (SMS-II), originally developed by Pelletier et al. (2013) and adapted into Turkish by Öcal and Sakallı (2018). The scale comprises 18 items across six subscales intrinsic motivation, integrated regulation, identified regulation, introjected regulation, external regulation, and amotivation rated on a seven-point Likert-type scale. In the Turkish adaptation study, Cronbach's alpha coefficients ranged from .55 to .81, and CFA fit indices (χ^2/df = 1.5; RMSEA = .05; CFI = .96; NNFI = .96) were reported at acceptable levels (Öcal & Sakallı, 2018). A subsequent study confirmed the six-factor structure of the SMS-II with a athlete sample (Yıldız et al., 2017). In this study, the Cronbach's alpha coefficients were as follows: internal motivation $\alpha = 0.81$, assimilation $\alpha = 0.71$, identification $\alpha = 0.74$, introjection $\alpha = 0.63$, external regulation $\alpha = 0.76$, and amotivation $\alpha = 0.73$; the scale total was found to be 0.80.

Procedure

Data were collected during the 2025–2026 academic year. Prior to data collection, ethical approval was obtained from the Alanya Alaaddin Keykubat University Faculty of Educational Sciences Publication Ethics Committee (Decision No: 2026/05; Date: 08.04.2026). Participants were informed about the study's purpose and procedures, and written informed consent was obtained from all individuals. All data were used exclusively for research purposes and participant confidentiality was maintained throughout.

Data Analyses

Normality was assessed by examining skewness and kurtosis values; all variables fell within the ±2.0 range, satisfying the assumption of normality for parametric analyses (Tabachnick & Fidell, 2013). Bivariate relationships between variables were examined using Pearson correlation analysis. To determine the predictive effect of motivational subscales on visual reaction performance, multiple linear regression analysis was conducted using the Enter method. Overall model significance was evaluated with ANOVA (*F*-test), and the relative contributions of predictors were assessed via standardised beta (β) coefficients and *t*-statistics. Multicollinearity was examined using tolerance and VIF values. All analyses were performed using SPSS 26.0, with α = .05 as the significance threshold.

Results

Normality was evaluated through skewness and kurtosis statistics prior to analysis. All variables yielded values within the ±2.0 boundaries, indicating that the distributional assumption for parametric testing was met (Tabachnick & Fidell, 2013). Descriptive statistics, correlation analysis, and multiple linear regression results are presented below.

Table 2
Descriptive statistics for study variables (n=71).

Variables	Mean	SD
Visual Reaction Time (ms)	454.1	45.3
Intrinsic Motivation	5.27	0.72
Integrated Regulation	4.93	0.85
Identified Regulation	5.47	0.82
Introjected Regulation	5.13	0.89
External Regulation	5.03	0.88
Amotivation	4.64	0.83

SD = Standard deviation; *n* = Number of participants.

Table 2 presents the descriptive statistics for all study variables. The mean visual reaction time was 454.1 ms (SD = 45.3). Among the motivational subscales, identified regulation yielded the highest mean score (M = 5.47, SD = 0.82), while amotivation produced the lowest (Mean = 4.64, SD = 0.83).

Table 3 presents the Pearson correlation coefficients between performance and the motivational subscales. Significant negative relationships were observed between visual reaction time and intrinsic motivation ($r = -.695$, $p < .01$), identified regulation ($r = -.707$, $p < .01$), and integrated regulation ($r = -.244$, $p < .05$), indicating that higher levels of these subscales were associated with shorter reaction times and thus better performance. Amotivation showed a significant positive relationship with reaction time ($r = .288$, $p < .01$), such that higher amotivation was linked to slower responses. Introjected regulation and external regulation did not demonstrate significant associations with performance ($p > .05$).

The regression model was statistically significant [$F(6, 64) = 19.254$, $p < .01$], with motivational variables accounting for 64.3% of the variance in visual reaction performance ($R^2 = .643$; adjusted $R^2 = .610$). Identified regulation ($\beta = -.447$, $p < .01$) and intrinsic motivation ($\beta = -.402$, $p < .01$) emerged as significant predictors. Integrated regulation, introjected regulation, external regulation, and amotivation did not make significant independent contributions to the model ($p > .05$). The scatter plots presented in Figure 1 illustrate the relationships between identified regulation and intrinsic motivation and visual reaction time.

Table 3
Pearson Correlation Analysis Results for Performance and Motivational Variables

Variables	1	2	3	4	5	6	7
1. Performance	1						
2. Intrinsic Motivation	−.695**	1					
3. Integrated Reg.	−.244*	.137	1				
4. Identified Reg.	−.707**	.572**	.186	1			
5. Introjected Reg.	−.154	.150	.009	.039	1		
6. External Reg.	.051	.000	−.257*	−.155	.178	1	
7. Amotivation	.288**	−.258*	−.120	−.266*	−.111	.078	1

*$p < .05$; **$p < .01$.

Table 4
Multiple linear regression analysis results for the prediction of performance.

Variables	B	SE	β	t	p
(Constant)	76.584	5.159	—	14.846	.000
Intrinsic Motivation	−2.521	0.586	−.402	−4.305	.000
Integrated Regulation	−0.584	0.420	−.109	−1.390	.170
Identified Regulation	−2.478	0.520	−.447	−4.762	.000
Introjected Regulation	−0.322	0.391	−.064	−0.823	.413
External Regulation	−0.200	0.411	−.039	−0.487	.628
Amotivation	0.265	0.430	0.048	0.616	.540

$R = .802$ $R^2 = .643$ Adjusted $R^2 = .610$ $F(6, 64) = 19.254$ $p < .01$

Note. Dependent variable: Visual Reaction Time (ms). Tolerance values ranged from .63 to .94; VIF values ranged from 1.07 to 1.58.

Figure 1

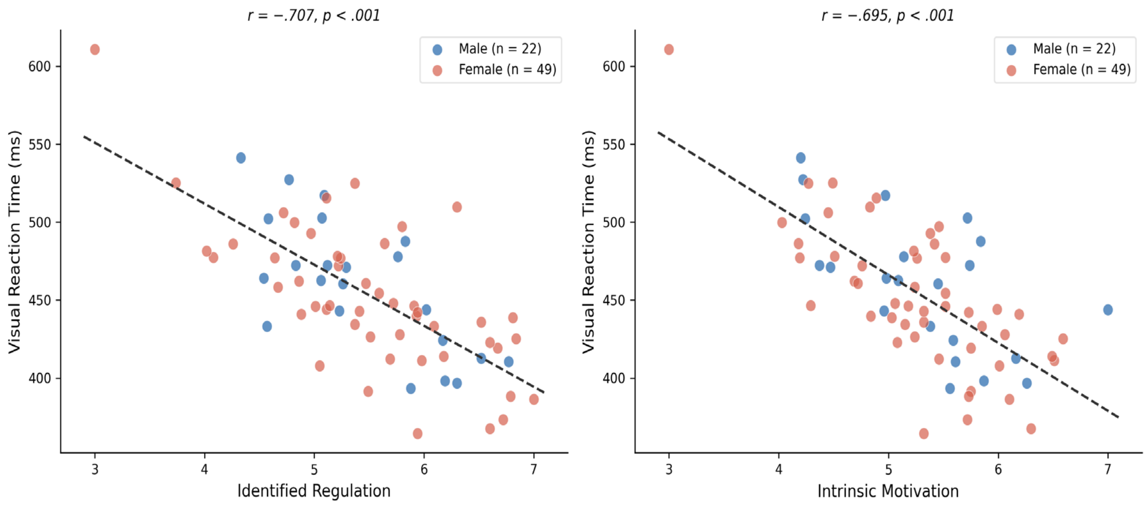

Figure 1. Scatter Plots of Motivational Subscales and Visual Reaction Time

Discussion

The findings of this study indicate that motivational orientation significantly predicts visual reaction performance in volleyball players and is broadly consistent with the core propositions of SDT. Hypotheses H1, H2, and H3 were supported, and H4 was confirmed through the regression analysis. That motivational variables explained 64.3% of the variance in visual reaction performance (adjusted R^2 = .610) warrants careful interpretation. While this proportion is notably high, it should be considered in the context of the sample characteristics: participants were relatively homogeneous in age (18–20 years) and experience level (67.6% with 1–3 years), which may have reduced variance in both motivational profiles and reaction performance, potentially inflating the proportion of explained variance. The remaining variance likely reflects variables not examined here, such as physical conditioning, sleep quality, cognitive anxiety, attentional capacity, and sport experience. When reaction time is understood as a multidimensional construct shaped by numerous interacting factors (Reigal et al., 2019; Kaplan et al., 2018), the motivational contribution observed here, though substantial, should be interpreted with appropriate caution pending replication in more diverse samples.

The strong negative relationship between intrinsic motivation and visual reaction time (r = −.695; H1 supported) indicates that athletes who genuinely enjoy and find meaning in their sport respond measurably faster to visual stimuli. Deci and Ryan (2000) and Ryan and Deci (2000a) proposed that intrinsic motivation is associated with high-quality cognitive engagement when the psychological needs for autonomy, competence, and relatedness are met. Altıntaş et al. (2013) found that intrinsic motivation (r = .27, p < .01) and identified regulation (r = .30, p < .01) were positively related to flow state in elite athletes, a finding the present study corroborates through an objective cognitive-motor criterion. When reaction time is considered a direct function of arousal, attention, and information-processing speed (Akarsu et al., 2009; Dane et al., 2008; Kaplan et al., 2018), it appears that athletes motivated by internally driven goals may allocate attentional resources more efficiently.

The emergence of identified regulation as the strongest predictor in the regression model (β = −.447; H2 supported) is theoretically meaningful. Identified regulation reflects a relatively autonomous form of extrinsic motivation in which the individual integrates an activity with personal values and self-concept (Vallerand, 1997; Pelletier et al., 2013). Piras et al. (2014) interpreted the superiority of expert volleyball players in visual search strategies as a product of cognitive-motor integration. İlhan et al. (2021) similarly reported meaningful associations between motivation and flow state in tennis players. Erdem and Çakmak Yıldızhan (2024) demonstrated that satisfaction of basic psychological needs significantly predicted achievement motivation in team sport athletes, a finding that aligns with the identified regulation result of the present study.

The positive relationship between amotivation and visual reaction time (r = .288; H3 supported) suggests that motivational absence may have measurable consequences for moment-to-moment cognitive-motor performance. The comparatively weaker correlation coefficient for amotivation relative to intrinsic motivation is consistent with the SDT continuum model. The relatively low mean score for amotivation in this sample (M = 4.64) also suggests that most participants maintained an active engagement with sport, which may have constrained its effect. Altıntaş et al. (2013) found amotivation to be negatively related to flow state, and Engür (2002) reported that motivational profiles significantly influenced performance in elite athletes findings that collectively support the view that the adverse effects of amotivation extend beyond physical performance to cognitive-motor readiness.

The absence of significant associations between introjected and external regulation and visual reaction time suggests that controlled motivational forms exert a more limited influence on cognitive readiness. Deci and Ryan (2000) and Hagger and Chatzisarantis (2007) have argued that these forms direct attentional resources toward reward, punishment, or social approval rather than toward the task itself, thereby constraining the cognitive capacity available for performance. The failure of integrated regulation to produce an independent contribution in the regression model despite its significant bivariate correlation is likely a reflection of the high shared variance it shares with intrinsic motivation and identified regulation (r = .572). Nuri et al. (2013), comparing volleyball players with sprint athletes, found that volleyball players were superior in anticipatory skill but did not differ in simple visual reaction time a finding that points to the primacy of anticipatory capacity over raw reaction speed in volleyball.

The gender composition of the sample also warrants consideration. With 69.0% of participants being female, it is plausible that the comparatively high levels of intrinsic motivation and identified regulation observed in this sample partly reflect this distribution. Research suggests that female athletes may tend to show stronger identification with their sport and internal goal alignment than male athletes (Ntoumanis, 2001; Calvo-Cervelló et al., 2010). Furthermore, the predominance of athletes with 1–3 years of experience (67.6%) signals a sample at an early stage of sport identity formation.

Several limitations should be acknowledged. The cross-sectional design does not permit causal inference, and the restriction of the sample to a single sport branch limits the generalisability of the findings to other disciplines. The narrow age range of participants (18–20 years) further constrains the extent to which findings can be generalised to volleyball players across different developmental stages or age groups. The use of simple visual reaction time, moreover, may not fully capture the demands of actual game situations requiring the simultaneous evaluation of multiple stimuli. Future studies would benefit from longitudinal designs encompassing diverse sport branches and performance levels, from the inclusion of multidimensional cognitive measures such as choice reaction time and decision-making speed, and from treating gender and experience level as potential moderators.

Conclusion

The findings of this study suggest that motivational orientation may serve as a meaningful predictor of cognitive-motor performance in volleyball players, with identified regulation and intrinsic motivation emerging as the strongest determinants of visual reaction speed. The finding that autonomous motivational forms are associated with faster cognitive-motor responses, while amotivation corresponds to slower reaction times, suggests that motivational climate may carry meaningful cognitive implications on the court. These results draw attention to the importance of investing not only in physical conditioning but also in the motivational environment of athletes during training. Autonomy-supportive training contexts, individualised feedback, and psychological interventions designed to strengthen sport-identity integration are among the strategies that merit priority.

Author Contributions

Conceptualization: ŞÖ, BK, YT, ÖSU; Data Collection: ŞÖ, YT; Data Curation: ŞÖ, YT; Formal Analysis: YT; Investigation: ŞÖ, BK, YT, ÖSU; Writing – Original Draft: ŞÖ, BK; Writing – Review & Editing: ŞÖ, ÖSU; Visualization: ŞÖ, BK; Supervision: ÖSU.

Ethical Approval

The study was approved by the Alanya Alaaddin Keykubat University Faculty of Educational Sciences Publication Ethics Committee (Decision No: 2026/05, Date: 08.04.2026) and was carried out in accordance with the ethical principles outlined in the Declaration of Helsinki.

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Conflict of Interest

The authors hereby declare that there was no conflict of interest in conducting this research.

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