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Context is Key: Certain factors that inhibit the success of two- and three-point shots in basketball

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Abstract

The aim of this research was to examine whether there are significant differences in the succes rate of two-point and three-point both shooting, without and under the influences of inhibiting factors such as fatigue and psyhological stress, among basketball players with various levels of shooting accuracy within a team. The experiment involved two groups of participants (advanced and average), which included 18 senior players of the Basketball Club „Student" from Bajina Bašta, all male, aged 16 to 35 years. The players performed shooting from five characteristic positions (for both two- and three-points shoots) under three different conditions: without inhibiting factors, under fatigue, and with defending players present. The participants were divided into two subsamples based on their two- and three-point shooting percentages from the previous season. The results obtained using a *Mixed between-within subject ANOVA* indicated a decreasing trend in shooting percentage under the influence of inhibiting factors, with a statistically significant decline for three-point shooting (statistically significant main situation effect F=8.23, p=0.001, with important effect η^2=0.34). The study highlights the need for further research with a large sample, additional situational parameters and biomechanical analysis of shooting technique under influencing factors. The results suggest an optimization of the training process by integrating situational shooting drills that include elements of fatigue and psychological stress.

Keywords: *basketball, accuracy, fatigue, psychological stress*

Introduction

Basketball is a game in which the rules determine the winning team as the one that scores a greater number of points, which is why the shooting percentage (two-point, three-point, and free throw attempts) is considered as one of the leading factors in deciding the winner of the basketball competitions (Chen et al., 2018). The most common way of scoring in basketball is the jump shot, which is seen as the most important element of the game due to its high demands for execution in situational context (Struzik et al., 2014). The importance of shooting in modern basketball is further supported by the comparative study of Wang and Zeng (2022), which analyzed shooting tendencies based on official NBA statistics across the 2010/2011 and 2020/2021 seasons. Their results indicate that alongside the increasing trend in the number of three-point attempts (from 22% to 39%) and decrease in two-point attempts (from 20% to 10%), the success rate of three-point shooting has also improved over the examined period. Addressing free-throw shooting performance from 1969. to 2019. in NBA competitions (2.6 million attempts sample size), authors (Morgulev et al., 2022) concluded that shooting efficiency fluctuates around 75%, and that free throws represent one of the most influential factors affecting the final game outcome. The analysis of parameters that influence the shooting efficiency of young players (age 16, 18 and 20) in European Championships from 2017. to 2022, authors (Rajković et al., 2025) indicated that shooting performance from perimeter positions (three-point shooting) and internal positions (two-point shooting) significantly affects the overall shooting efficiency index of basketball players.

The search for offense strategies in the strongest basketball league (NBA) and analysis of 10 seasons (2009-2019), showed that higher efficiency in three-point shooting increases the likelihood of winning, while two-point shooting has lesser impact on the final outcome (Gou & Zhang, 2022). Same study demonstrates that teams with higher percentages

of three-point shot attempts secure play-off positions, whereas lower-ranked teams tend to have a better two-point shooting percentage, suggesting that higher-ranked teams heighten the perimeter play, while lower-ranked teams rely more on inside scoring. These findings are consistent with studies examining basketball performance parameters during the Tokyo 2021. Olympic Games (Simović et al., 2022). Their results indicated that winning teams attempted more three-point range and had higher percentage of two-point and three-point shots, compared to losing teams, which represents three out of five most important basketball game parameters. These results are supported by research aiming to show the change of standards for two- and three-point shots and determine their influence on match outcome (Zajac et al., 2023). The results have shown that during the analyzed period the number of three-point attempts increased and two-point attempts decreased, and the success rate of three-point shots improved while two-point shots did not differ significantly. Forecasting the game outcome in the NBA regular seasons over three seasons from 2020 to 2023, based on statistical performance indicators in half-time analysis (both individual and team-based), some researchers concluded that key predictors of success include two- and three-point shooting percentages, as well as free-throw shooting efficiency (Tsagris et al., 2024).

As the results of most studies show that the success of two-point, three-point and free throw shootings are the key factors of winning in basketball competitions, a certain number of authors have dealt with potential factors that influence shooting percentages in situational conditions. A study that examined the relationship between cardiorespiratory markers (maximum oxygen consumption – VO2 max and maximum heart rate per minute – HRmax), on the one hand, and shooting success for the three points, on the other hand, with 38 senior basketball players sample from three basketball levels in Greece (the shortest competitive experience of 6 years), showed that fatigue significantly affects the decrease in shooting efficiency due to changes in release angles, and the velocity increase of the shot (Bourdas et al., 2024). Pojskić et al. (2018), dealing with the influence of anaerobic capacity on shooting efficiency, as well as the relationship between field tests results and shooting performance in competitive situations with 38 senior basketball players sample from different levels from the territory Bosnia and Herzegovina, conclude that a higher level of anaerobic capacity impacts the success in dynamic shooting tests and that the test results show a high correlation with official competition statistics.

One of the inhibiting factors of performance in two-point shooting in situational conditions is psychological stress which most often arises due to the presence of a defensive player (opponent) in competitive situations. Numerous studies show that the presence of a defensive player affects changes in shooting technique (the player performing the jump shot hands the ball faster, release angles are reduced and the ball entry angles into the basket are changed), which reduces the execution performance (Kambič et al., 2022; Rojas et al., 2000). A study that examined the synergistic influence of fatigue and psychological stress on the kinematic structure of the jump shot on a sample of 14 participants members of university in China, showed that these factors affect jump height, shot velocity, changes in the ball release, and reduce the three-point shooting percentage (Li et al., 2024). Despite the fact that the result of certain studies show that the shooting percentages for two- and three-points are higher without the presence of a defensive player (compared to the results with their presence), and the percentages vary depending on their distance (Amaro et al., 2022), the study (Morgulev, 2025) conducted on a larger sample of participants (members of the NBA league) contradicts the previously mentioned findings.

Although the listed studies deal with the problem of inhibitory factors on shooting success for two- and three-points (which is a crucial parameter of victory in competitions according to studies) there are few comparative studies based on the exact influence of interfering factors (e.g., fatigue and psychological stress) while executing dynamical shot. The aim of this study is to determine whether there are differences, and to what extent, in the success rate of two- and three-point shooting, with and without the presence of inhibitory factors such as psychological stress and fatigue, among players of various levels of accuracy, determined on the basis of statistical data from the official statistics of their previous games, as well as expert evaluations.

Method

Study design

The research was conducted on basketball players of senior team Basketball Club "Student" from Bajina Bašta, Serbia, which competes in the Second Regional League – West Region. Each participant was evaluated for shooting success in two- and three-point shots in different situations. The first situation involved performing a dynamic shot without disturbing factors; the second implied its execution after physical fatigue (caused by a motor task of anaerobic type directly previous to the shot); while in the third situation a psychological stress factor was included (whose source is the defensive player's pressure shortening the time of performing a jump shot). Players were divided into two groups – advanced and average. This was based on the quality achieved in competitive matches during the previous season. The data recorded in different shooting situations were compared using appropriate statistical procedures, and conclusions were drawn on the basis of comparative analysis.

Sample

The sample consisted of 18 basketball players who regularly compete and train basketball for at least 6 years. Among them there were 10 juniors (17-18 years old), 4 cadets (15-16 years old) and 4 seniors (aged 30 (+/-4) years). All participants were included in regular training process and had a minimum of 8 training sessions per week. The minimum competitive experience was 4 years for each participant, while the seniors had at least 10 seasons of senior experience.

The participants were divided into two subgroups ("advanced" and "average") based on their shooting success for two- and three-point shots, recorded in official statistics during the previous competitive season. The shooting per-

centage of advanced players was at least 40% and 30% for two- and three-point shots respectively, while percentages of the average subgroup were lower than mentioned values.

Protocol and measuring instruments

The test applied in this research involved performing dynamic shots from five different positions for both two-point (distance greater than 4.5m and less than 6.75m) and three-point shots (outside 6.75m line). The shooting positions used in this test were determined based on the most frequently used shots in game – corners (parallel to the player shooting; on both sides of the backboard), 45-degree angles (on both sides of the backboard), and the central position in relation to the rim. The realization of the test was assisted by two passers (they pass the ball to the tested player who shoots), while in the third situation a defensive player was included. The players warmed up for 10 minutes before the test, after which the test protocol was explained to them.

The test was carried out in three situations:

- Situation 1 – dynamic shot from 2 set cones. The starting position is under the basket (cone No.1), from where, on the mark, the player moves in the full sprint to the position of the corner (marked cone No.2) and performs a shot, then returns with a light jog to the starting position and repeats the activity 5 times. The player performs this test from all 5 most characteristic shooting positions in a game.
- Situation 2 – the structure of the test is identical to situation 1, but before performing the shot, the player performs a motor task of anaerobic type (involving static pushing of an opponent for a duration of about 5 seconds), and then runs to the shooting position. The opponent (the player who participated in the static pushing) does not disturb the shooter during the shot; after 5 consecutive shots from one position, the players exchange roles.
- Situation 3 – includes a defensive player, who after pushing for duration of 5 seconds, has the task to move approximately one meter away from the pushing spot and by running toward the tested player who is shooting, tries to prevent (or to interfere with as much as possible) the shooter; after 5 consecutive shots from one position, the player switch roles.

In all three mentioned situations tests were carried out with both three-point shots (beyond the 6.75m line) and two-point shots (distance greater than 4.5m, but inside the 6.75m).

Each successful attempt was awarded one point, while missed shots were recorded as zero (0), for each participant, the total number of points in two- and three-point shooting was recorded, as well as the individual scores for each shooting position.

Statistical analysis

The arithmetic mean (Mean) and standard deviation (SD) were calculated for each variable. The statistical significance of differences between the arithmetic means obtained in different groups of subjects and derived in different shooting situations was tested by combined analysis of variance – Mixed between-within subjects ANOVA (Tabachnick & Fidell, 2019). Two factors (two independent variables) were combined: the situation from which the shot is performed (between group variability) and the specificity of the groups (within group variability). A mixed 3x2 design (a matrix with three time points and two groups) was used for data comparison. The influence of independent variables (situations and groups), both combined (factor interaction) and separate, was estimated using Partial Eta Squared, η2, based on the criteria proposed by Cohen (1988). Combined variance analysis was conducted for the shooting percentage and for each position.

Before applying the variance analysis, the equality assumption of independent variables in different subgroups was checked using Levene's test (Levene test of Equality of Error Variances), as an important prerequisite for a valid interpretation of the variance analysis (Pallant, 2020). For a more detailed detection of the variability source between individual groups, a Post Hoc analysis was conducted using the Tukey HSD criterion.

The complete statistical analysis was performed using IBM SPSS 30.0., and all conclusions were conducted at a significant level of 0.05 ($p<0.05$).

This study was approved in advance by the Ethics Committee of the Faculty of Sport and Psychology, Novi Sad. Each participant gave written consent to participate in the study.

Results

Descriptive data (Table 1) show that in situation 1, the differences in two-point shooting success are almost non-existent, as both subsamples performed similarly (Mean1=53.50, Mean2=53.20). In situation 2, a clear difference between the groups was recorded (when it comes to the success of the two-point shot – Mean1=56.00, Mean2=44.40). In situation 3, the difference between the groups was more pronounced than in the previous situation (Mean1=51.00, Mean2=36.80).

Before conducting the main analysis, assumptions about normality and homogeneity of variance were checked. Levine's test showed that there were no significant differences in the variances between groups (Sig>0.05) in all two–point shooting (Sig1=0.153, Sig2=0.940, Sig3=0.707), which shows that groups are homogeneous and that conditions for the application of Mix ANOVA analysis were met (Table 2).

The results of the main analysis (Mix ANOVA) showed that the effect of situation was not statistically significant, suggesting that average two-point shooting percentage did not vary between the three situations. The interaction effect of the factor was not statistically significant (Sig=0.26), indicating that advanced and average did not show a different pattern of change in performance between situations (Table 3).

Table 1. Average values of two point shooting success in different groups and situations

	N	Group	Mean	Std. Deviation
	8	1 advanced	53.50	nov.89
Sit1.2p.percentage*	10	2 average	53.20	19.50
	18	Total	53.33	16.nov
	8	1 advanced	56.00	jul.40
Sit2.2p.percentage**	10	2 average	44.40	8.sept
	18	Total	49.55	sept.61
	8	1 advanced	51.00	sept.25
Sit3.2p.percentage***	10	2 average	36.80	13.43
	18	Total	43.11	13.55

*Note. *two-point shooting percentages without the effect of inhibiting factors; **two-point shooting percentages affected by fatigue; ***two-point shooting percentages under the influence of fatigue and psychological stress.*

Table 2. Results of Levine's test of homogeneity of groups in the two point shot

Situation	Levene Statistic	df1	df2	Sig.
Sit1.2p.percentage*	2.251	1	16	0.153
Sit2.2p.percentage**	0.006	1	16	0.940
Sit3.2p.percentage***	1.146	1	16	0.707

*Note. *two-point shooting percentages without the effect of inhibiting factors;**two-point shooting percentages affected by fatigue;***two-point shooting percentages under the influence of fatigue and psychological stress.*

Table 3. Results of mixed analysis of variance (3x2) of two-point shooting success

Source of variation	F	df	Sig.	η2(partial)
Situation (within subjects)	2.37	1.37	0.013	0.13
Situation (between subjects)	7.82	1.16	0.01	0.33
Situation*group	1.40	1.37	0.26	0.08

The results of the Levine's test (Sig1=0.568, Sig2=0.923, Sig3=0.027), which refers to the data obtained during the three-point shot (Table 4), show that the assumption of homogeneity of variances of different groups is mostly fulfilled, and it is possible to analyze the results obtained with Mix ANOVA.

The results showed a statistically significant situation effect (shooting success varied, i.e. decreased as the situation became more complicated). The interaction effect of the factors was not statistically significant (Sig=0.151). The group effect was significant (Sig=0.026), meaning that advanced subjects achieved a higher overall percentage of three-point shooting success compared to average subjects (Table 5).

The average values of two- and three-point shooting of the two groups of subjects in three different situations are graphically presented in the figures (Figure 1 and Figure 2).

Table 4. Results of Levin's test of homogeneity of groups using three-point shooting

Situation	Leven statistic	df1	df2	Sig.
Sit1.3p.percentage*	0.340	1	16	0.568
Sit2.3p.percentage**	0.010	1	16	0.923
Sit3.3p.percentage***	5.943	1	16	0.027

three-point shooting percentages without the effect of inhibiting factors; **three-point shooting percentages affected by fatigue;*three-point shooting percentages under the influence of fatigue and psychological stress.*

Table 5. Results of mixed analysis of variance (3x2) of three-point shooting success

Source of variation	F	Sig.	η2(partial)
Situation	8.23	0.001	0.34
Linear trend	10.74	0.005	0.40
Situation*group	2.11	0.151	0.12
Group	6.01	0.026	0.27

three-point shooting percentages without the effect of inhibiting factors; **three-point shooting percentages affected by fatigue;*three-point shooting percentages under the influence of fatigue and psychological stress.*

Figure 1. Average values of two-point shooting success in three situations

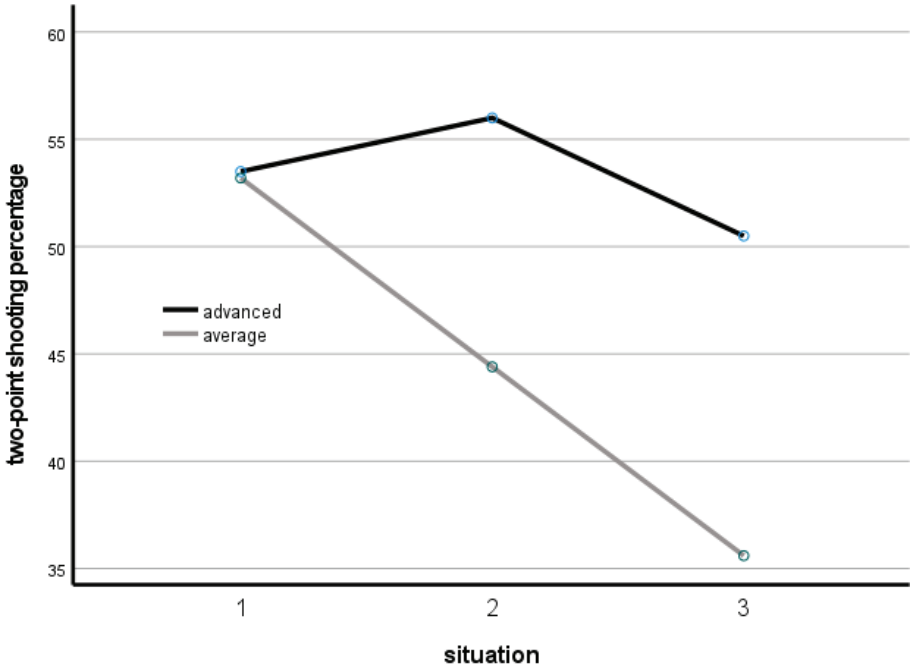
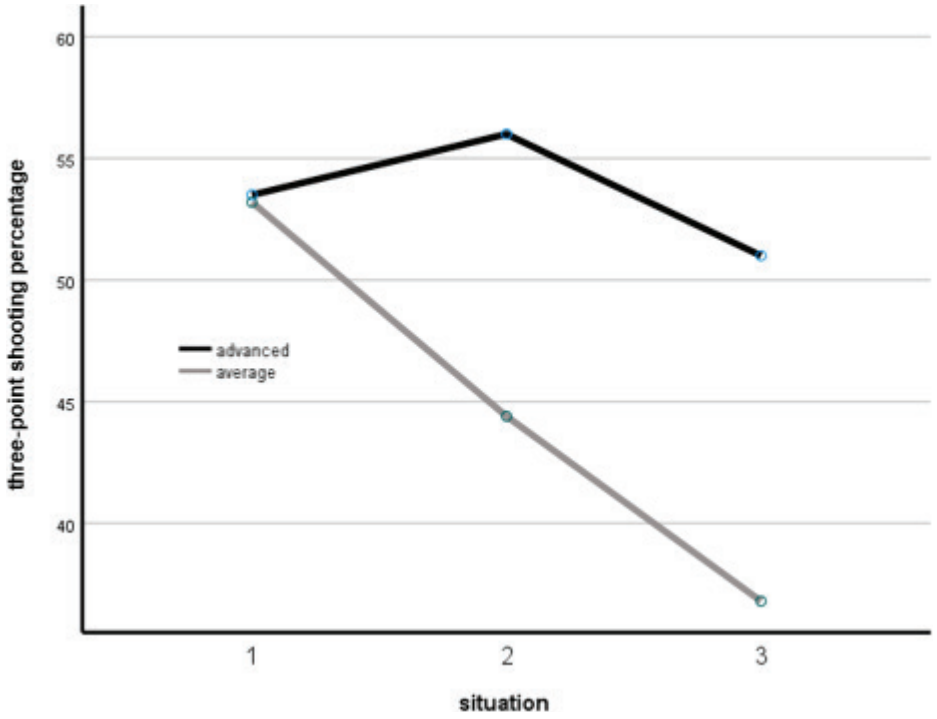


Figure 2. Average values of three-point shooting success in three situations



Discussion

In this study, differences in success levels of two- and three-point shots were analyzed, with and without the presence of inhibiting factors, as well as their influence on different groups of basketball players within a team (advanced and average). Inhibiting factors in this study were fatigue and psyhological stress, while shot percentages in the previous season were the determinant for dividing players into two groups. Traditional shooting trainings are realized in conditions without specific limitations (characteristic of competition conditions), despite a certain number of modern research studies, which show the negative impact of numerous factors (fatigue, psyhological stress) on success of two- and three-point shots competition conditions (Bourdas et al., 2024; Li et al., 2024; Pojskić et al., 2018). In this study, the effects of different situations (without and with the presence of inhibiting factors such as fatigue and psyhological stress), as well as the effect of groups (average and advenced players, according to shooting success percentage from the previous season), and the synergy of these factors on the success in two- and three-point shots were monitored, on sample of 18 basketball players competing in the senior rank of competition.

The results showed partial agreement with previous studies, and necessity for separate interpretation of the influence of the mentioned factors (group of situations and synergy of those two factors) on success in both two and three-point shots.

Analysis of the results, despite the decreasing trend of the percentage two-point shots under the influence of fatigue, shows that the effect of the situation (situation 2) does not significantly affect the performance. This research shows agreement with results of some previous studies (Bourdis et al., 2024; Pojskić, 2018) in which the influence of fatigue on the reduction of success in two-point shooting was confirmed, as well as that a higher level of anaerobic capacity increases the percentage of success in this shooting category. At the same time, such results are an indicator that the subjects who participated in this research have developed tolerance to loads in the anaerobic work regime, and that due to satisfactory physical preparedness fatigue does not affect the two-point shooting percentage. This study exhibited similar results in situation 3, when it comes to success in two-point shooting, where the inhibiting factor is psyhological stress (with the previously included fatigue factor), which is in agreement with the results of some previous research (Morgulev, 2025). As reports from several studies confirm that numerous psyhological factors influence shooting percentages in basketball (Bali, 2015; Lu & Li, 2022) and the results of this study confirm that one of them (psyhological stress) does not statistically significantly affect success in two-point shooting, it is concluded that the selected sample of basketball players shows resistance to the influence of this inhibiting factor in this shooting category. As the group effect showed statistical significance (two-point shooting percentages) because the percentage of success for two points of the advanced group is significantly higher than that of the average group, the study reveals that player's quality influences performance in this category more than the inhibiting factors included in the conducted study.

Except of two-point shooting success, the aim of the research was to record how different three-point shooting situations impact the success of basketball players of different skill levels (advanced-average). The findings of numerous studies (Gou & Zhang, 2022; Simović et al., 2022; Zajac et al., 2023), which show that three-point shooting success influences competition outcomes to a greater extent than two-point shooting, multiply the importance of analyzing the influence of inhibiting factors on performance in this category. The obtained results show that situational conditions affect the three-point shooting percentage and that there is a difference between the established groups which is statistically significant, as a consequence of the fatigue effect on technical demands (increase in the wrist and shoulder flexion, angle of ball entry, as well as the reduction of strength and velocity).

The results of this research confirm a significant effect of the situation, meaning that success in this category changes depending on the execution conditions. Obtained data are consistent with previous research (Kambič et al., 2022; Li et al., 2024; Rojas et al., 2000), which showed that more demanding situations decrease the technical stability of the execution (change of launch angle, higher launch speed, reduced angle of passage of the prop through the target) and the possibility of unwanted increases.

A significant linear trend indicates that performance in a three-point shot gradually changes through three situations, and those changes are not accidental, but the result of inhibition factors impact. The most prominent trend is seen in siutation 3, when, besides the synergy of afforementioned factors, perceptual-cognitive factors may have role, such as visual attention and decision making speedd (which were not the subject of this analysis).

The results also show a significant effect of the group, i.e., that the advanced basketball players of the team chosen for the research were more successful in all three-point shooting situations. These outcomes confirm expectations that more experienced basketball players with a higher level of basketball competence adapt more quickly to more complex execution conditions (prompt adaptation to psychological stress).

Due to the interaction of factors not showing statistical significance, it can be stated that the pattern of change in three-point shooting success across different situations did not fluctuate depending on the groups (advanced and average) reacted analogously to the increase in demands through three situations (both groups show a drop in success, but th advenced maintain a higher level of absolute effectiveness). This finding suggests that a more complex situation has a universal effect on outcomes, regardless of skill level.

Study limitation

One of the main limitations of the study stems from its realization on a very small sample. Increasing the sample in some future studies, as well as introducing top players of the opposite sex, would certainly contribute to the reliability of concluding. Another limitation stems from the small number and nature of instruments for assessing success in two and three-point shooting. Yet another limitation is expressed, and is a consequence of the absence of a more precise biomechanical analysis (the research showed a statistically significant

influence of the group on the success of two and three-point shooting, which suggests that quality of technique is of extreme importance).

In order to overcome the stated limitations, it is advisable to conduct research with an expanded sample (preferably of opposite sex), increase the number of measurement instruments, along with biomechanical analysis of the shooting technique, which would undoubtedly contribute to a more reliable generalization of the results.

Practical aplications

Despite the limitations of the study, the results undoubtedly confirm that success in two-point and three-point shooting depends on both individual abilities and situational factors, whereby the effects of skill is reflected in a higher level of average success, not in the way subjects adapt to changing conditions. The results of this research are practically applicable to the training process (especially shooting trainings), because they indicate the importance of introducing situational elements during shooting training in order to influence the level of ability in real competition conditions.

The optimization of the training process is suggested through the integration of situational shooting training with various inhibiting factors (such as fatigue and psyhological stress). As the results of the study show that fatigue and psyhological stress can be a trainable component, their monitoring contribute to the long-term effectiveness of the training process.

The suggestions relate primarily to shooting training, in which the three-point shot is emphasized, because the inhibitory factors involved have shown a statistically significant impact on performance. Such suggestions do not bypass shooting training, in which the emphasis is placed on the two-point shot, because despite the fact that inhibitory factors have not shown a statistically significant impact on performance in this category, a decreasing trend in the percentage of shots under their influence has been registered.

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Conflicts of interest
The author declares that there is no conflict of interest regarding the publication of this paper.

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