

SELECTED INTERNAL AND EXTERNAL FACTORS DETERMINING SUCCESSFUL SHOOTING OF FREE THROWS IN BASKETBALL AMONG YOUTH PLAYERS OF THE SLOVAK NATIONAL BASKETBALL TEAM

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Abstract

The importance of shooting free throws in relation to winning in basketball in current league games plays a crucial role, affecting various internal, as well as external factors. The aim of the study was to analyze selected internal and external factors determining successful shooting of free throws in basketball among youth players of the Slovak national basketball team. The monitored group consisted of four players of basketball team ŠKP Banská Bystrica, which plays in the Slovak Higher Cadet League, Slovak First Men League, as well as the Slovak Extraleague Eurovia SBL. In terms of data obtaining of monitored phenomena, we used direct observation, as well as an interrogative method of two standardized questionnaires by Gurský (2015) processed by casuistry and primary statistics. The results showed among players determinism of monitored internal and external factors that were reflected in successful shooting of free throws in basketball in association with elevation angle of shooting and angular velocity of a ball, as well as in relation to heart rate, as an expression of typology of players and management of stress during neutral, positive and negative impulses. Mental endurance of players and mastering of fundamentals "free throw shooting" are a prerequisite of high-quality performance of the players, as well as of the team itself. The stated findings point out the fact and importance of shooting free throws in relation to winning basketball games. Therefore, we urge for practice to put in use game load, as well as to intensify volume of free throw shooting in training processes during neutral, positive and negative impulses.

Key words: audience, basketball shooting, free throws, personality, stress

Introduction

Due to an enormous number of internal, as well as external stimuli with which we are confronted in everyday life situations, our lives would be without selective attention very complicated, even unimaginable (Butter et al., 1985; Nemček, Nemček, 2008; Holzweg et al., 2013; Labudová et al., 2015;). The above stated facts are not exceptions even in sport games, such as basketball. Excellent performance of each player of a team is a prerequisite of quality and successful performance throughout a whole match. Such is also shooting free throws, which is recently devoted considerable attention (Button et al., 2003). Navarro et al. (2009) state the importance of free throws in basketball as eventuality of easily acquired points without any defence activity, while shooting free throws is the only situation in basketball, which is known in advance, and therefore can be practiced in advance. Okubo (2006) adds that each time there is a high probability of shooting free throws during a game, players can improve in practices the already mentioned offensive fundamentals, and therefore free throw shooting should be considered a formality in terms of hundred percent mastery of performance. Csataljay et al. (2009) in this context outline importance, as well as influence of free throw shooting, but not during the whole match, but especially during the last minutes of the match. Kozar et al. (1994) identify with the above and state that a total number of points scored in a game of basketball, free throws consist of 35%,

during the last five minutes 48% and during the last minute of a regular time unbelievable 69% of the total points. The above stated facts are the result in that shooting of free throws that belongs to one of the key factors, which is involved in winning in basketball matches (Marko et al., 2015). It turns out that, in expected or unexpected victories of teams, their performance on free throw shooting are often determined by internal or external factors and mastery is the prerequisite for success. Such is also mastery of stressful situations, to which free throws belong in basketball. It is a modern phenomenon – "choking", which represents a situation, in which players face high-pressure situations that do not perform as well as could be expected under completely ordinary conditions (Worthy et al., 2006). Carr et al. (2005) report that a match and performance in basketball are contingent to pressure, which means to be mentally tough and ready to play, respectively shoot free throws in any stressful situation. During psychological pressure attention of a player shifts from important stimuli to irrelevant, such as anxiety about performance and likely negative outcome of a basketball game, states Gray (2004), whilst adding that assumption of unexpected results of players is directly proportional to the above types of ideas. Stress, anxiety and excitement are internal states that can improve or worsen performance in basketball (Mumford et al., 1976). Anxiety integrates a wide

range of experience, including memories, thoughts and evaluation (Hayes et al., 1996). Anxiety is related with a strong social assessment, as well as self-assessment, which during free throw shooting has resulted in consistent loss of performance. An individual has an ability to regulate levels of emotional arousal and often even small, insignificant thought can affect performance, respectively free throw shooting explains Udry (1994). One of the exogenous factors that have considerably participated on player's, as well as team's performance is an audience, which can be perceived in three primary groups. A separate group is consisted of so-called "Hooligans" who scatter opponents during free throw shootings in many different ways (McGowan, 1987). Strauss (2002) states that sections, which are designated for the above mentioned fans are strategically located in places, such as the end line of a basketball court, where the shooting players directly stare into the epicenter of noisy and irritating fans who create disruptive and loud

sounds, often accomplished by insults. Cheerleaders and mascots are often associated with basketball games as their activities, creations and encouraging lead to influence shooting players from the free throw line. Combining all disturbing elements that adversely affect players who shoot free throws from an opponent team, a home court helps to create a home advantage, so that fans become allowed and often highly desirable, as well as rare the sixth player. The aim of the study was to analyze selected internal and external factors determining successful shooting of free throws in basketball among youth players of the Slovak national basketball team.

Methods

The monitored group consisted of four players (tab. 1) of basketball team ŠKP Banská Bystrica, which performs in Slovak Higher Cadet League, Slovak First Men League, as well as Slovak Extraleague Eurovia SBL.

Table 1. Characteristics of monitored group (n = 4)

| Monitored group | | Basketball players of ŠKP Banská Bystrica | | | | |
|---------------------------------|------------------|---|-------------------------|-------------------------------|----------------------------|-------------------------------|
| Measured values | | Player no. 1 | Player no. 2 | Player no. 3 | Player no. 4 | |
| Nationality | | Slovak | Slovak | Slovak | Slovak | |
| Position | | Center | Point guard | Center | Point guard | |
| Date of birth | | 2000 | 2000 | 1994 | 1982 | |
| Decimal age | | 15,67 | 15,99 | 21,97 | 33,81 | |
| Length of practice | | 6 y. | 7 y. | 14 y. | 25 y. | |
| Height [cm] | | 204 | 181 | 198 | 178 | |
| Weight [kg] | | 84 | 72 | 96 | 64 | |
| Dominant limb of shooting | | Upper right | Upper right | Upper right | Upper right | |
| Shooting percentage in league | | 62 % | 67 % | 75 % | 90 % | |
| Shooting percentage in research | Neutral impulse | Successful shooting | 1, 3, 4, 5, 6, 7, 9, 10 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 | 1, 2, 3, 4, 5, 6, 9, 10 | 2, 3, 4, 5, 6, 7, 8, 9, 10 |
| | | Unsuccessful shooting | 2, 8 | ∅ | 7, 8 | 1 |
| | Positive impulse | Successful shooting | 1, 3, 4, 5, 6, 8, 9, 10 | 2, 3, 5, 6, 7, 8, 9, 10 | 1, 2, 4, 5, 6, 7, 8, 9 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 |
| | | Unsuccessful shooting | 2, 7 | 1, 4 | 3, 10 | ∅ |
| | Negative impulse | Successful shooting | 2, 3, 4, 5, 8, 10 | 1, 2, 3, 4, 6, 7, 8, 9, 10 | 1, 2, 4, 5, 6, 7, 8, 9, 10 | 2, 3, 4, 5, 6, 7, 8, 9, 10 |
| | | Unsuccessful shooting | 1, 6, 7, 9 | 5 | 3 | 1 |

Legend: y.- years, cm- centimeter, kg- kilogram, 1, 5- contact with a hoop, 3, 10- without contact with a hoop, ∅ - zero value

The observation was implemented in February 29, 2016 in the gymnasium of Grammar School Jozef Gregor Tajovský in Banská Bystrica, where basketball team ŠKP Banská Bystrica plays home games. The players realized thirty shot attempts from free throw line – 5,8 meters/ 19 feet far from end line and 4,6 meters/ 15 feet far from hoop, while acted neutral, positive and negative impulses. The players were using an officially approved basketball – Spalding TF-100 SBA Legacy (circumference ± 76,5 centimeters and weight ± 539 grams), basketball hoop (inner diameter ± 45 centimeters and vertical height 305 centimeters),

as well as rules and regulations appointed by International Basketball Federation (FIBA). During implementation of shooting free throws we were using high-speed cameras PCO 1200 hs (located on the right side of shooting players, at a distance of 7,5 meters and a height of 1,45 meters. The camera was set to capture 500 images per second, while exposure times were set to 0,005. The video record of shooting players took place at extension of 760 x 1024 with aperture of 2, which was adapted to a lack of light) and Canon Legria HF R706 (located at a distance of 9,25 meters and a height of 1,45 meters, which was located on the

right side of shooting players. The camera was set to identical values as the camera PCO 1200 hs, however differed in the number of frames per second – 270). The above stated cameras were instrumental in creating the video record. Beating heart (heart rate) was observed by sport testers Garmin Forerunner 405, which varied depending on factors affecting performance of the players. During neutral impulses, each player was shooting ten free throws, while they were not under any pressure, respectively was not exerted any highly stressful situation. Under the effect of positive, as well as negative factors, it was not so. The positive impulse was accompanied by three cheerleaders who continuously throughout the shooting performed various creations and choreography at the end line, as well as encouraged with different slogans. During negative impulses the players faced 18 unpleasant, noisy and irritating fans who created disruptive and loud noises, often accompanied by insults and slogans like – "Miss it!, One more! Repeat!" and so on.

The impulse was measured as a sound level at a height of 80 dB – 100 dB, which was created by fans. The recorded video, as well as data, such as heart rate were then embedded from – Verbatim Micro SDHC 32 into a computer, while were continuously using operating system – Microsoft Windows XP. Video files in the computer were later converted into audio video interleave (avi format), to be compatible with a program on biomechanical motion analysis – Kinovea 0.8.23, by which was then calculated the elevation angle of shooting, as well as angular velocity of a ball, by a method called – triangulation, in which we used coordinates of three points delimiting of circumference of a basketball. The monitored group were also submitted two standardized questionnaires (Gurský, 2015), which dealt with a typology of personality, while consisted of 50 closed, dichotomous questions from which we obtained typological personality information about players (level of openness/ closeness, balance/imbalance). The second questionnaire surveyed mastering of stress and stressful situations of players, which consisted of closed, dichotomous questions within a scope of 40. In terms of data processing of interpretation of results we used casuistry method with a use of induction and deduction, as well as logical analysis and synthesis, with usage of arithmetic mean (\pm) and percentage frequency analysis (%), by which we expressed data and facts in the form of tables and graphs.

Results

The study presents partial results in relation to aim, which are subject of additional exact monitoring and processing. The figure 1 presents personality types of temperament in relation to the monitored group (N = 4), in which players no. 1, 3 and 4 were qualified into sanguine type, because of increased values of extraversion (a measure of openness) and stability (a measure of balance). The only exception was player no. 2 who was qualified as a phlegmatic

type, because of the results from questionnaire, in which were the results in range of 48 % - 52 %.

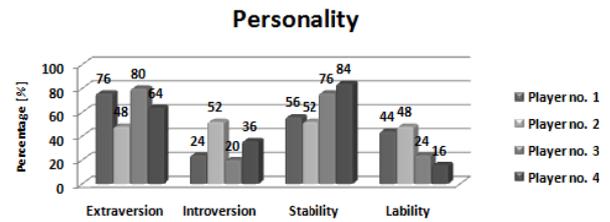


Figure 1. Evaluation of personality types of players (n=4)

Stress management of players is presented in figure 2, which determines four areas. Susceptibility to stress (A-type) is presented by three players (players no. 2, 3 and 4), who had increased their levels, which may lead at a later stage to self-harm. The second indicator was current level of stress, while only player no. 3 had increased value – 50 %, although the rate was still bearable. The third indicator was personal sensitivity, in which player no. 2 had a slightly higher value, but still within an ordinary range. The last and the most important examined factor was the level of mastering stress situations, to which could be also included shooting free throws, while all players achieved very good results, in range of 10 % – 30 %. After census and evaluation of individual factors of mastering stress, players no. 1 and 4 presented the strongest individuals, however player no. 3 among all four players (n = 4) the weakest, the most sensitive personality in dealing with stress and stressful situations, such as free throws in basketball.

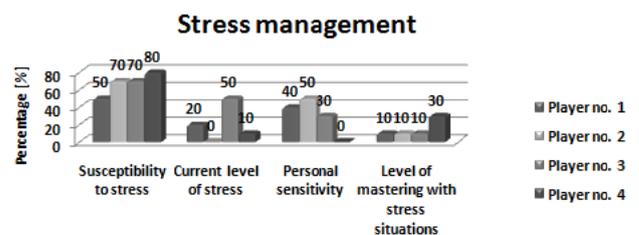


Figure 2. Evaluation of stress management of players (n = 4)

Another monitored indicator of the analysis of selected internal and external factors determining successful shooting of free throws in basketball was heart rate, which was monitored continuously during all shot attempts of the monitored group (n = 4) (tab. 2).

Free throw shooting was carried out during three impulses – neutral, positive and negative, while based on measurements and results, we found that the most noticeable difference occurred during the positive impulses during successful and unsuccessful shooting among players no. 1 and 2, in a ratio of 174 b/m : 194 b/m and 159 b/m : 178 b/m, which caused that listed players did not handle high pressure, highly stressful situation and

that the presence of three cheerleaders was not successful in influencing a throw from a free throw line. During neutral impulses we predictably found the smallest differences between successful and unsuccessful shooting, because players were not under any stress.

However, one of the shooting players, namely player no. 4 was measured with differences between successful and unsuccessful shooting, in an average of 19 b/m, while during positive impulses were not measured any differences and during negative impulses only 7 b/m. As expected,

18 unpleasant, noisy and irritating fans in the gym caused that after census and evaluation of all differences of successful and unsuccessful shooting of free throws, where the biggest differences were achieved during negative impulses, specifically 51 b/m. The above stated fans caused the fact that player no. 1 was not successful from the free throw line for 4 times, while performance of player no. 2 was outstanding as it needs to be stressed, because of hundred percent successful shooting during neutral impulses from already mentioned line, as well as player no. 4 who was hundred percent successful during positive impulses.

Table 2. Evaluation of heart rates of players (n = 4)

| | | Heart rate [b/m] | | | | |
|----------------------------------|-----------------------|------------------|--------------|--------------|--------------|--------------|
| Monitored group/ Measured values | | | Player no. 1 | Player no. 2 | Player no. 3 | Player no. 4 |
| Neutral impulse | Successful shooting | Before | 118 | 129 | 165 | 174 |
| | | During | 142 | 121 | 183 | 149 |
| | | After | 134 | 103 | 174 | 135 |
| | Unsuccessful shooting | Before | 118 | 129 | 165 | 174 |
| | | During | 154 | ∅ | 191 | 168 |
| | | After | 134 | 103 | 174 | 135 |
| Positive impulse | Successful shooting | Before | 152 | 148 | 172 | 164 |
| | | During | 174 | 159 | 162 | 122 |
| | | After | 143 | 119 | 158 | 109 |
| | Unsuccessful shooting | Before | 152 | 148 | 172 | 164 |
| | | During | 194 | 178 | 160 | ∅ |
| | | After | 143 | 119 | 158 | 109 |
| Negative impulse | Successful shooting | Before | 137 | 135 | 172 | 160 |
| | | During | 143 | 132 | 168 | 144 |
| | | After | 99 | 119 | 164 | 138 |
| | Unsuccessful shooting | Before | 137 | 135 | 172 | 160 |
| | | During | 156 | 149 | 181 | 152 |
| | | After | 99 | 119 | 164 | 138 |

Legend: ∅ - zero value

The higher the curve – parabola of shooting among monitored group (n = 4) was, the greater was likelihood of success. However, haven't always witnessed parabolas with enough elevation angles of shooting, in which would a ball went through the basket, without any contact with a hoop (tab. 1). While shooting free throws, the expected elevation angle of shooting was decreasing depending on the success of shooting, on an average of ± 5°, however among all players, player no. 3 was measured with upward tendency, specifically 2° during negative impulse.

As expected, the biggest elevation angles of shooting were recorded during positive impulses, resulting in precise, respectively successful shooting of free throws. Among monitored group (n = 4) were during free throw shooting recorded diverse, respectively variety of elevation angles of shooting, in a range of 46°- 63°, while already mentioned elevation angles of shooting were did not change and player no. 2 was shooting constantly at an angle of 60°. The most noticeable differences between successful and unsuccessful shooting of monitored group (n = 4) were measured among player no. 1 whose the difference of the highest and the lowest elevation angle of shooting was 13°, on the other hand, the smallest visible differences were measured among player no. 2 (5°).

Table 3. Evaluation of elevation angle of shooting of players (n = 4)

| | | Elevation angle of shooting [°] | | | |
|----------------------------------|-----------------------|---------------------------------|--------------|--------------|--------------|
| Monitored group/ Measured values | | Player no. 1 | Player no. 2 | Player no. 3 | Player no. 4 |
| Neutral impulse | Successful shooting | 55 | 60 | 61 | 55 |
| | Unsuccessful shooting | 50 | ∅ | 58 | 52 |
| Positive impulse | Successful shooting | 63 | 60 | 63 | 57 |
| | Unsuccessful shooting | 55 | 55 | 57 | ∅ |
| Negative impulse | Successful shooting | 56 | 60 | 61 | 56 |
| | Unsuccessful shooting | 53 | 56 | 63 | 46 |

Legend: ∅ - zero value

The angular velocity of a ball, or in other words, speed of rotation of a ball in space is ranked, as well as elevation angle of shooting as the most important, if not critical biomechanical factor determining successful shooting of free throws. With adequate and sufficient angular velocity of the ball – ± 720 °/s, upon contact of the ball with the hoop is still a high percentage probability of success, as mentioned, ball changes rotation after a bump and subsequently goes through the hoop. The importance of the above mentioned angular velocity of the ball is also reflected in our monitored

group (n = 4), as up to 58,25 % the ball went into a contact with the hoop, although up to 43,25% were players successful from the free throw line.

The above findings show diversity of the results of the angular velocity of the ball, while the highest, as well as the lowest velocities were recorded among player no. 1 – 907,2 °/s and 496,8 °/s. During neutral impulses, player no. 2 scored all free

throws, with a help of contact with the hoop, while the angular velocity was recorded at 766,8°/s, as well as another player who was hundred percent successful (positive impulse), while accurately shot at angular velocity of the ball – 824,4 °/s. But sometimes, too high angular velocity of the ball in conjunction with high elevation angle of shooting led to unsuccessful shooting, as among player no. 3 whose measured data were – 655,3 °/s a 57°.

Table 4. Evaluation of angular velocity of a ball of players (n = 4)

| Angular velocity of a ball [°/s] | | | | | |
|----------------------------------|-----------------------|--------------|--------------|--------------|--------------|
| Monitored group/ Measured values | | Player no. 1 | Player no. 2 | Player no. 3 | Player no. 4 |
| Neutral impulse | Successful shooting | 907,2 | 766,8 | 698,4 | 867,6 |
| | | 2,52 | 2,13 | 1,94 | 2,41 |
| | Unsuccessful shooting | 590,4 | ∅ | 738,0 | 604,8 |
| | | 1,64 | ∅ | 2,05 | 1,68 |
| Positive impulse | Successful shooting | 694,8 | 752,4 | 770,4 | 842,4 |
| | | 1,93 | 2,09 | 2,14 | 2,34 |
| | Unsuccessful shooting | 496,8 | 601,2 | 655,2 | ∅ |
| | | 1,38 | 1,67 | 1,82 | ∅ |
| Negative impulse | Successful shooting | 723,6 | 774,0 | 806,4 | 856,8 |
| | | 2,01 | 2,15 | 2,24 | 2,38 |
| | Unsuccessful shooting | 655,2 | 622,8 | 525,6 | 655,2 |
| | | 1,82 | 1,73 | 1,46 | 1,82 |

Legend: ∅ - zero value

Conclusion

The results of observation document mental, as well as technical readiness of the players at shooting free throws during neutral, positive and negative impulses. The importance of personality types of players and stress management was transferred on heart rate, elevation angle of shooting and angular velocity of the ball, in which we measured the most visible changes. We recorded heart rate during unsuccessful shooting elevated values, while during successful shooting decreased values.

Changes were also visible at elevation angle of shooting, as well as angular velocity of the ball, while in these cases the values had decreased tendency and biomechanical factors, such as angular velocity of the ball caused that fact that at 58.25% the ball was in contact with the hoop, whilst at 43.25% at players were successful from the free throw line, as it was done by providing adequate rotation of the ball in the space ($\pm 720^\circ / s$) in combination with adequate elevation angle of shooting ($\pm 55^\circ$).

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ODABRANI UNUTARNJI I VANJSKI FAKTORI KOJI ODREĐUJU USPJEŠNA SLOBODNA BACANJA U KOŠARCI MEĐU MLADIM IGRAČIMA SLOVAČKOG DRŽAVNOG KOŠARKAŠKOG TIMA

Sažetak

Važnost slobodnih bacanja u vezi s košarkom u trenutnim ligama igra krucijalnu ulogu, utječući na razne unutarnje, kao i vanjske faktore. Cilj ovog istraživanja bio je analizirati odabrane unutarnje i vanjske faktore koji određuju uspješna slobodna bacanja u košarci među mladim igračima slovačkog državnog košarkaškog tima. Nadzirana grupa sastojala se od četiri igrača košarkaškog tima ŠKP Banská Bystrica, koji igra u Višoj slovačkoj kadetskoj ligi, Slovačkoj prvoj muškoj ligi, kao i u Slovačkoj Ekstra ligi "EUrovia SBL". Po pitanju prikupljanja podataka nadziranih pojava, koristili smo izravno opažanje, kao i upitnu metodu dvaju standardiziranih upitnika Gurskýja (2015.) obrađenu kazuistikom i primarnom statistikom. Rezultati među igračima pokazali su predanost nadziranih unutarnjih i vanjskih faktora koji su se odrazili u uspješnim slobodnim bacanjima u košarci u vezi s kutom povišenja bacanja i kutnom brzinom lopte, kao i u povezanosti s brzinom otkucaja srca kao izrazom tipologije igrača i upravljanja stresom tijekom neutralnih, pozitivnih i negativnih impulsa. Mentalna izdržljivost igrača i savladavanje temeljnih "slobodnih bacanja" preduvjeti su za visokokvalitetnu izvedbu igrača, kao i samog tima. Navedeni zaključci ističu činjenicu i važnost slobodnih bacanja u vezi s pobjeđivanjem košarkaških utakmica. Stoga, apeliramo da vježba postane dio opterećenja igre, kao i da se pojača obujam slobodnog bacanja u procesima treninga tijekom neutralnih, pozitivnih i negativnih impulsa.

Ključne riječi: publika, bacanje u košarci, slobodno bacanje, osobnost, stres

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