

IMPACT OF SOUND ON THE PERFORMANCE OF BASKETBALL FREE THROW

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ABSTRACT

Various factors determine the quality of basketball and the overall result. The game consists of different situations – three-point shots, rebounds, and many more. In intense games, free throws play a decisive role in determining the winning team. The player has the opportunity to prepare for their performance. Due to the global Covid-19 pandemic, many basketball games occur without spectators and, therefore, without additional noise. The study's authors analyzed the statistics of free throws in Euroleague and National Basketball Association games – with and without spectators. The study's authors emphasize significant trends in exploring the world's strongest leagues. The accuracy of free throws is better in games when the presence of visitors is not allowed. The presented free throw statistics confirm that the players could take a free throw better without additional psychological stress.

A pilot study with ten respondents was also conducted. As part of this, the basketball players took free throw shots with and without an additional external sound effect. The presented results showed that it is possible to take a free throw more accurately without sound. The statistical data collection method and the performance of basketball free throw tests were used within the research framework. Data was compiled with the Microsoft Excel program.

Keywords: *basketball, free throws, sound effect, sports, sports coach*

Introduction

In the 21st century, there are approximately 400 million registered basketball players worldwide. Basketball is one of the largest sports in the world, with 214 countries joining the FIBA-International Basketball Federation. Basketball is a fast and dynamic sport, and the game's score changes every minute, making it exciting. Thanks to these features of play, basketball has become a modern time game.

Despite the country's relatively small population, Latvia has produced very high-achieving and top-level basketball players. Latvian basketball players play in the best leagues in Europe and the National Basketball Association. Active NBA players from Latvia are Kristaps Porziņģis and Dāvis Bertāns.

A free throw is the only basketball shot performed during the game without any defensive pressure. Therefore, the free throw is considered the easiest throw in basketball. But is that true? Growth and improvement can be seen in almost all aspects of basketball, but this development is stagnant. Since the 1970s, the average percentage of free throws in the NBA League has fluctuated between 75% without much change (McMahan, 2017).

Professional basketball players train every day and learn all the game elements until they reach the highest level. But still, when it comes to entering the penalty line, even the best athletes make mistakes. A player can throw with a very high percentage of sales throughout his career, but when, for example, performing a free throw in the title game, those free throws decide the game's outcome. The player exposes himself to a high-pressure situation, which makes the task much more difficult. In sports, the saying "choking under pressure" has emerged. Everyone knows that our ability to do something qualitatively decreases when we are exposed to stress. Therefore, this saying also applies outside the sports industry (Goldschmied et al., 2021). The most common signs of stress are a fast heartbeat, high blood pressure, fast breathing, and sweating. How can these factors be reduced, so they have the least possible impact on the athlete? Of course, the number of repetitions, execution techniques, and the ability to concentrate is essential. But how important are the psychological techniques that an athlete can use? Make the most of your performance. Previous research shows that "thinking too much" about body movements (free throw technique) can harm performance quality.

Literature analysis

Kinematics is any mechanism of body movement from the perspective of time and space, regardless of the forces that cause this movement. The biomechanics of basketball mainly consists of the throw trajectory and throw speed, throw angle and throw height (Robin et al., 2021). The throw's trajectory is never constant, and its height is directly related to the angle at which the ball falls into the basket. And is the angle at which the ball falls into the basket is the most influential factor for a successful throw (Aksović et al., 2020).

Thanks to the ball's rotation, it flies much more stable, and if the throw is not accurate and does not fall directly into the net, but hits the hoop or basket shield, then this rotation moves the ball down and inside the basket. A study was conducted in which it was found that the ball makes two to three complete rotations during a throw. Data shows that for guards under the age of 20, the ball makes 1.66 revolutions per second and 100.94 revolutions per minute (Okozaki & Rodacki 2018).

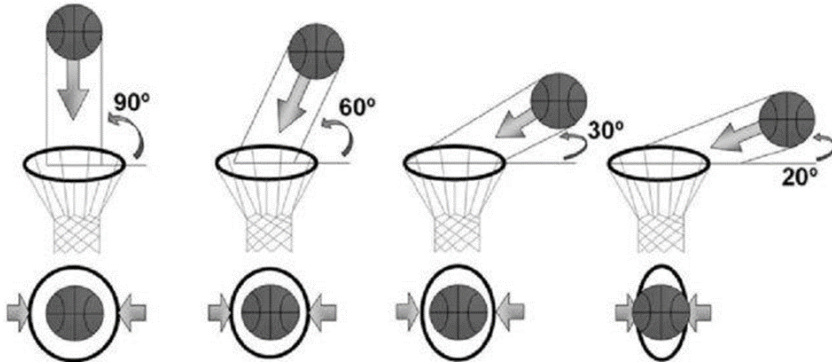


Figure 1. Basketball ball throwing angle and its effect on the throw (Akšović et al., 2020).

Body position. A lot of basketball literature assumes that a player must place his entire body directly in front of the basket before throwing (Jang, 2014). The position of the legs is slightly narrower than the shoulders, the feet are parallel to each other, and the toes are straight at the basket. One portion (respectively for the throwing arm) is slightly protruding. The shoulders and chest are straight opposite the basket. Therefore maximizing stability during the throw and minimizing any body movement that could prevent the ball from heading straight to the basket. Take the throw from a moderate squat (Sevrez & Bourdin, 2015).

In youth basketball, jumping over the penalty line in the minor groups of children is allowed, but this would be a rule break even in later age groups. Situations like these are allowed because younger students do not have enough strength to take a free throw from the right penalty line. It is, therefore, necessary to gradually eliminate horizontal movement during the jump. Later, when the physical fitness is high enough, the free throws are already taken without jumping and provide excellent stability during the litter. The height at which the ball is released during a throw affects the angle of entry of the ball, and it is statically proven that the ball's angle of fall affects the weld's accuracy.

Ball release speed. In the case of an inaccurate throw, in 65% to 80% of cases, the force or speed of releasing the ball is the fault. Studies have shown that the speed of the ball during a free throw varies between 6 and 7.2 m/s. The force with which one throws the ball also affects the angle of entry and the trajectory of the throw (Robin et al., 2020).

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The best possible balance needs to be struck between these two parameters. To use as little force as possible, optimize the throw trajectory and the angle of entry of the ball. It has several advantages, such as improved litter accuracy, energy savings, and less chance of making mistakes during the little.

Noise can adversely affect a person's cognitive function—damage mental and physical health. Noise causes anxiety, irritation, cardiovascular disorders, and oxidative stress in the brain. Studies have shown that mental stress and visual/auditory attention are significantly reduced when subjects are exposed to noise levels of 95 dBA (Jafari et al., 2019).

Attention is the active cognitive selection process. This is a crucial feature responsible for physical movements and a person's emotional state. Noise can negatively affect information processing and strategic decision-making. But noise also causes anxiety in the body, which improves alertness and exacerbates its concentration without affecting the speed or strength of physical activity—this noise increases players' motivation during the game. In the current situation, when the arenas are empty, and games are without spectators, players need to get used to the new rule – silence. The Los Angeles Times interviewed NBA players who reported a lack of fan support. Those players are used to performing in front of spectators, which takes extra energy and motivation. *“In this environment, we need to be able to motivate ourselves,”* said the Portland Trail Blazers player Carmelo Anthony (Uggetti, 2021).

In 2015, a study showed that the advantages of home games between two teams provide a crowd effect. Which supports and motivates players. And also affects judges making decisions more in favor of the team supported by the spectators.

Research

Analysis of penalty shootout implementation in European basketball clubs and National Basketball Association (NBA) during the pandemic. Examination of the penalty shootout statistics of TURKISH AIRLINES EUROLEAGUE teams revealed that the absence of spectators in the stands is probably why the teams take penalty shots with a much higher percentage this season than in previous seasons.

They analyzed the top five European teams with the best penalty shots in the last five years. The overall development and growth of the free throw are visible. Slowly but gradually, the accuracy of penalty shots has increased. 2016-17 during the season, the game was attended by an average of 8,472 fans. This season's most significant number of spectators was Crvena Zvezda in the match against CSKA Moscow – 18487 spectators.

This number of spectators provides a loud and charged atmosphere during the game. They were reaching a noise level comparable to a rock music concert. 2017-18 During the season, the game was attended by an average of 8,864 fans (Euroleague statistic).

This number of people can generate noise well above 95 dBA if it is assumed that a single human cry can exceed 100 dBA. The entire last season, with spectators in the stands, was the 2018-19 season. A year before the Covid-19 global pandemic, restrictions and security measures were introduced afterward. The game was attended by an average of 8282 fans and spectators.

Looking at the best top 5 teams of the 2016-17 season after the free throw, only one couple with an accuracy higher than 80% (CSKA Moscow – 82.15%). But at the top5 of the 2020–21 season, the percentage of free throws sold by all five teams is over 80%. The best team is Zalgiris Kaunas, with 83.96%. It would rank fourth by taking the best free throw sales team of the 2016-17 season and comparing it with this year’s best teams.

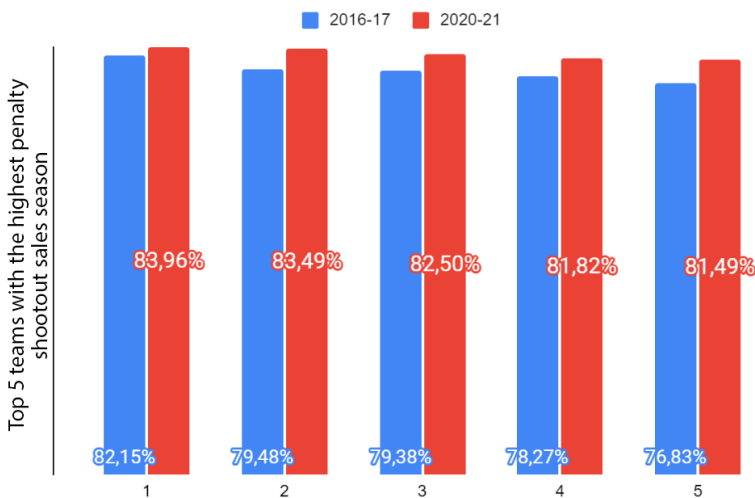


Figure 2. 2017–16. season and 2020–21. Top5 teams with the highest penalty shootout sales season (Euroleague statistic)

During this year’s TURKISH AIRLINES EUROLEAGUE season, 11 of the 18 TURKISH AIRLINES EUROLEAGUE teams started the season without spectators in the stands due to security measures during the Covid-19 pandemic. Two of these teams (2; 3) are the top 5 teams with the highest free-throw accuracy. In the last 20 years, only twice have all the top5 teams in the league taken more than 80% free throws. This happened for the first time in the 2018-19 season and was repeated this year.

The first conclusion is that the penalty shootout, as an element of basketball, along with the whole sport of basketball and its players, is evolving. The players' skills are growing, and the overall level of basketball in Europe is rising. And the second conclusion, the accuracy of this year's penalty shootout has grown exponentially because the games are played in empty arenas, without the attendance of spectators and fans, which eliminates two of the factors influencing the free throw – noise and psychological stress.

The authors also analyzed the implementation of free throws in the world's strongest basketball league – the NBA. The five leading teams that performed the best shots were investigated to make the data as reliable as possible.

Table 1. 2017–18 top 5 teams in the NBA season with the highest accuracy of penalties (NBA statistic)

	Team	Games	FTM	FTA	FT%
1	Golden States Warriors	82	20.3	16.6	81.5%
2	Minnesota Timberwolves	82	24.1	19.4	80.4%
3	Portland Trail Blazers	82	20.9	16.7	80.0%
4	Toronto Raptors	82	21.8	17.3	79.4%
5	New York Knicks	82	19.0	14.9	78.7%

Table 2. 2019–20. top 5 teams in the NBA season with the highest accuracy of free throws (NBA statistic)

	Team	Games	FTM	FTA	FT%
1	Pheonix Suns	72	23.8	19.9	83.4%
2	San Antonio Spurs	71	23.4	19.0	81.0%
3	Portland Trail Blazers	74	22.1	17.7	80.4%
4	Golden State Warriors	65	23.2	18.7	80.3%
5	Boston Celtics	72	23.2	18.6	80.1%

Analyzing Table 1 and Table 2, it can be concluded that the data of the NBA leading teams indicate the effect of noise on the presentation of free throws. All five teams in the 2019–2020 season, which showed the highest accuracy in the respective season, performed better than the five best teams before the pandemic in 2017/2018.

Practical research

They participated in the study – junior girls aged 15 to 20 years. 10 to 20 basketball players participated in the basketball training, and the number of students in training varied. The student’s skill levels ranged from high-achieving athletes and youth team players to sports school students. The practical research was conducted in March and April 2021. As a result of the study, technical training, and training process, a total of 14 pieces of training were completed.

The practice and training took place in the basketball hall of the basketball school “Ridzene.” The hall is equipped with two large baskets and four side baskets, and a penalty shot line is marked next to each basket. The training took place four days a week with one additional volunteer training. The research aims to find out how many different factors affect the accuracy of a basketball penalty shot. The research work consists of three types of tasks completed in three weeks, with one week dedicated to each task.

Task 1 – Penalty shots at rest

The task aims to determine the students’ penalty shot accuracy at rest without influencing factors. Use the obtained data as a median or average to observe the influence of elements on the accuracy of the free throw. The task is for each student to throw 150 free throws, changing to 10 for every free throw. Count the result. The results are recorded and summarized within a week.

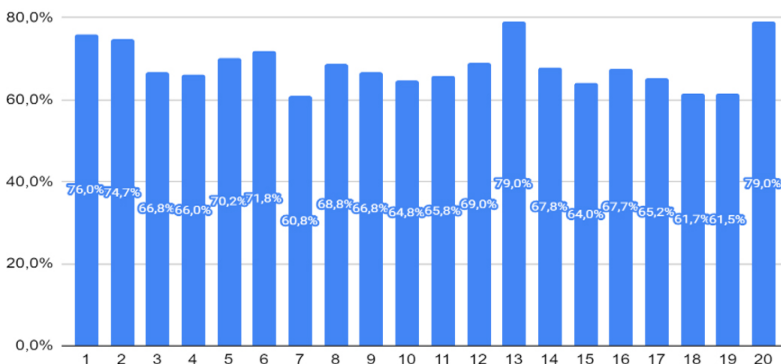


Figure 3. Free throws in a state of peace

The accuracy of students’ total free throws at rest is 68.4%, which is a satisfactory result, considering the age and skill level differences between students.

Task 2 – Penalty shots with a physical factor

The task aims to determine how much the physical fitness factor affects the accuracy of the free throw. The task is for each student to throw 100 free throws, alternating every ten free throws. Between every ten free throws, two full basketball courts are run in the sprint (70–80%). This increases heart rate and respiration. The results are recorded and summarized within a week.

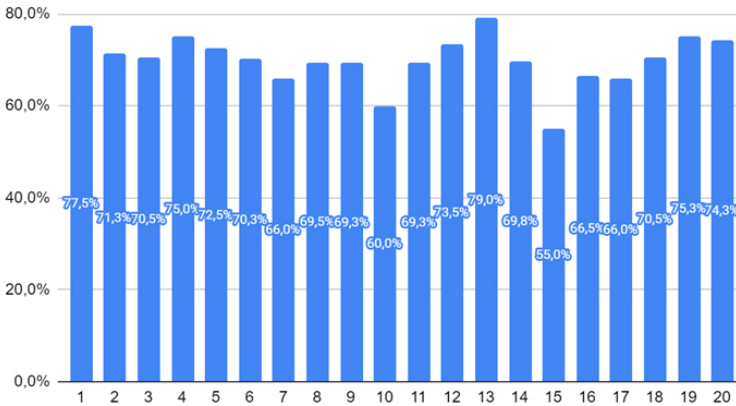


Figure 4. Penalty shots with physical exertion

Analyzing Figure 4, we can see that the accuracy of free throws, despite the physical factor, is constant. Or even in some cases, the accuracy has increased. The accuracy of the free throw of all students with a physical factor is 70.0%.

We can conclude that the data are partly misleading because the number of throws thrown is not the same. Because the conditions of Task 2 are to run two full basketball courts between every ten throws thrown. Each student had to throw 200 free throws less than in the 1st task. This is reflected in the accuracy being higher, although, in theory, it should be lower.

Three separate studies studied the effect of three different levels of fatigue factor on the realization of a junior player’s litter from both 2 pt and 3 pt litters. It was observed that at 0, 50, and 80% of maximal heart rate, players showed factors of fatigue, loss of concentration, and decreased response. The accuracy of the 3pt litter decreased by 28% at 80% of the maximum heart rate compared to the results of 0% of the maximum heart rate or resting state.

The task aims to investigate how much noise affects the accuracy of penalty shootouts as both a physical and psychological factor. Of all

students, five were selected that would most widely reflect the range of study participants. Two participants with the best free throws in both previous tasks were selected, and one with a penalty shot accuracy above the team average. And two participants with below-team scores.

“Believe it or not”

Task. Play the game “Believe it or not,” where one of the five girls enters the penalty line and is about to take ten free throws. Before that, the other participants of the training (~20 participants) are divided into two groups:

- 1) Believe that the thrower will throw at least 8 out of 10 free throws.
- 2) A free thrower is not expected to throw at least 8 out of 10 free throws.

Depending on the group they choose, these other participants may support or hinder the execution of the free throw. Techniques such as making noise, encouraging, and distracting simulate a game situation where supporters and deniers are involved—creating a stressful situation by subjecting the penalty thrower to the psychological stress caused by noise.

But extra strain and responsibility are placed on the thrower, depending on whether or not these 8 out of 10 free throws are thrown. The one who made a mistake runs the pitch.

Example 1 – A free thrower throws 7 out of 10 free throws, and the penalty shooter himself and his supporters are running.

Example 2 – A free thrower throws 9 out of 10 free throws. Those who choose not to believe do not run.

The numbers are the girls’ order no. from previous schedules. The main idea was to choose five girls who best represented the whole group of girls.

Analyzing Figure 5, the percentage of free throws sold has increased. But comparing the number of free throws thrown out, we can conclude that these results do not fully reflect the effect of the factor.

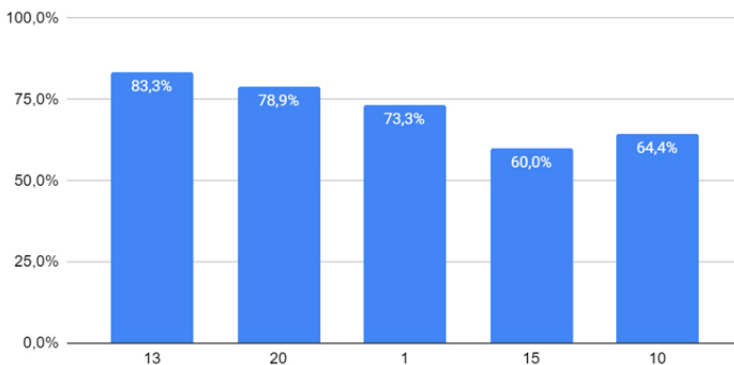


Figure 5. Free throws with a psychological factor – sound effect

The study's authors, analyzing the performance of the task, observed that the participants had more difficulties with the psychological noise factor than with the physical aspect of the noise.

The participants' accuracy of the free throws was influenced by how much people supported and were against him. And what these other participants said and distraction techniques was the influencing factor. Of course, the noise achieved during the study did not nearly reach the atmosphere and noise of a professional basketball game. And according to the author of the work, the louder the noise, the more significant the physical impact it would have on the player.

At the end of the basketball game, the importance of free throws and their impact on the game's outcome grows drastically. The number of free throws in the game's last minutes increases statistically. They comprised 48% of the winning team's final points scored in the last 5 minutes of the game. And 69% of all points were scored at the last minute of the game. The noise at these moments will be the highest in all games. That is why teams need to find ways to train their players' mental stamina to prepare for those final moments of the game.

Conclusion

Through an analysis of TURKISH AIRLINES EUROLEAGUE penalty shooting statistics over the last five years, the authors observed and concluded a gradual increase in team penalty shootout sales, which is related to the global development of the basketball game and the growth of players' skills.

Analyzing free throw statistics for the top5 European basketball clubs over the last five years, the author concluded that the accuracy of free throws is increasing every year compared to TURKISH AIRLINES EUROLEAGUE 2016–17. season with 2020–21. season, the accuracy of the free-throw sale has risen by 3.37%

Analyzing the EUROLEAGUE penalty shoot statistics, the author concluded that due to the security measures of the covid-19 pandemic and the fact that the games take place without the presence of spectators, players were less exposed to psychological factors caused by the noise in the game. In this way, this season, the teams take free throws with the highest-ever free throw. Similar data can be seen in NBA statistics.

Noise, as an influencing factor, has two ways in which it affects an athlete during a game. The first is the physical type, and the second is the psychological one.

Noise is a physical factor. During the game, the player stays in a noisy environment for a long time, which can cause physical discomfort

over time. This results in distraction and reduces the player's ability to concentrate.

In the first task of the research work – punishment throws at rest. The author concluded that the level of individual free throws and basketball skills in practice with students and research participants is very different. In general, it was found that the participants threw free throws with an accuracy of 67.6% on average.

In the second task of the research work – penalty throws with a physical factor. The author of the paper concluded that the physical condition of the study participants (endurance and ability to recover) is at a satisfactory level so that it does not drastically affect the accuracy of the free throw. Accuracy increased by an average of 2.4%, with participants taking penalty shots with an average accuracy of 70%. However, some pupils showed a decrease in litter quality.

The number of free throws was different during the first and third tasks. During the first task, one participant threw a total of 600 free throws, but during the third task, only 90 free throws. The fact that in such a small number of shots, the study participants showed a decrease in accuracy leads to the conclusion that the noise influences the quality of the player's penalty shots and the final result.

By paying increased attention to the psychological factors that affect the accuracy of the litter, it is possible to improve litter sales statistics.

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