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DOES LIGHT LEVEL VISION NOISE DISTURBANCE AND FATIGUE EFFECT THE SHOOTING RATES OF FUTSAL PLAYERS

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ABSTRACT

In this study, it has been aimed to see if there is any effects of the foreseeable inconstant on the percentage of shots in a competitive environment and if so, to see the qualities of these effects. 22 volunteer's male futsal player between the ages of 18-28 that have been playing futsal for at least four years in Afyon Kocatepe University futsal team have participated in this study. In the study which is players in isolated light environment, the shot percentage in isolated low light environment the shot percentage in environments with noise and image disturbance behind the goal and the shot percentage of after having been exhausted, are evaluted. While evaluating the acquifed data, the relationship between the varriables are examined with the help of Pearson Correlation Analyze; an Covariance Analyze (ANCOVA) is used for comparison of variables. When analyzed the average percentage of the shot hits which have been done in different environment. It has been seen that the highest shot hit average occurs in isolated normal light environment. It has been notice that the shot hits that have been done in isolated low light environments with noise and image disturbance behind the goal have lower averages. As a conclusion, in a competetive environment it has been notice that it foreseeable inconstants have negative effects on the shot hit percentage averages.

Key words: Futsal. Light Level. lactate levels. Visual and Noise Disturbance. Fatigue. Accuracy Rates.

RESUMO

A taxa de visão leve e a fadiga afetam os índices de finalização dos jogadores de futsal

Neste estudo, objetivou-se ver se há algum efeito da inconstância previsível sobre a porcentagem de disparos em um ambiente competitivo e, em caso afirmativo, ver as qualidades desses efeitos. Participaram deste estudo 22 voluntários, jogadores de futsal do sexo masculino, com idades entre 18 e 28 anos, que jogam futsal há pelo menos quatro anos na equipe de futsal da Universidade Afyon Kocatepe. No estudo que envolve jogadores em ambiente de luz isolada, são avaliadas a porcentagem de chutes em ambiente isolado de pouca luz, a porcentagem de chutes em ambientes com ruído e distúrbio de imagem atrás do gol e a porcentagem de chutes após o esgotamento. Ao avaliar os dados, a relação, entre as variáveis são examinadas com a ajuda de Pearson Correlation Analyze; uma Análise de Covariância (ANCOVA) é usada para comparação de variáveis. Quando analisado o percentual médio de acertos de tiro que foram feitos em diferentes ambientes. Foi visto que a maior média de acertos de tiro ocorre em ambiente de luz normal isolado. Notou-se que os acertos de chute que foram feitos em ambientes isolados de pouca luz com ruído e perturbação da imagem atrás da baliza têm médias mais baixas. Em conclusão, em um ambiente competitivo, notou-se que as inconstantes previsíveis têm efeitos negativos nas médias percentuais de acerto.

Palavras-chave: Futsal. Nível de luz. níveis de lactato. Perturbação visual e sonora. Fadiga. Taxas de precisão.

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INTRODUCTION

People, groups and societies watch, idolize and identify with athletes. Developed countries prefer sports fields instead of battlefields to prove their superiority over each other. Athletes are, therefore, regarded as gladiators of the modern age. Sport industry has become tens of billions of dollars worth of sector.

Therefore, the success of athletes, clubs and countries has become more and more important and the success of athletes depends on healthy and high performance. Physical skills, performance and scientific knowledge will increase exponentially in the 21st century (Bayraktar, Kurtoğlu, 2009).

Sport performance depends not only on athletic characteristics but also on some other factors that can be measured and improved (Yıldız, Kale, 2018).

The more scientific training programs, the more successful the athletes. Scientific research, therefore, focuses more and more on goals-oriented performance and physical competence.

Originating from South America in the 1930s, futsal has become popular among European countries such as Spain and Portugal, and then spread worldwide under the umbrella of FIFA. In today's football, the opponent presses hard, there is not much open space on the field and players perform their duties more effectively, which are held accountable for the loss of aesthetics in football. Therefore, the popularity of futsal, which allows the display of individual skills and techniques, increases day by day.

Futsal is played between two teams of five players each on a small court, which makes them participate more in the game.

Futsal players run, move and exert efforts to create open space more than football players. There is also a need for futsal players who can play one-on-one.

The most basic characteristics of futsal players are to run a lot, dribble in tight spaces, change positions quickly and exhibit game intelligence (Ocak, Buğdaycı, 2012).

The understanding of modern sports pushes the limits of performance. Sports have started to play a key role in developing national economy and promoting international relations (Bayraktar, Kurtoğlu, 2009).

The amount of investments in sports is increasing every year with an increase in people‘s interest in them. The assessment and development of the performance of athletes is of paramount significance in this intensely competitive global industry.

Futsal is becoming popular in many countries, including Turkey. Visuality is at the forefront in futsal, in which every team wants to score a lot of goals, and, of course, win. To win, one must score goals. To score goals, one must shoot.

The aim of this study is to determine the effect of visual and noise disturbance behind the goal, light conditions and fatigue on shooting accuracy rates in futsal.

MATERIALS AND METHODS

Sampling

The sample consisted of 22 male futsal players aged 18-28 years who had been playing futsal for at least 4 years. The study was conducted in the gym of the School of Physical Education and Sports of Afyon Kocatepe University.

All participants were volunteers and provided informed consent.

The study was approved by the Clinical Research Ethics Committee of Antalya Training and Research Hospital (Decision Date: 06.11.2014 and No: 49/10).

Measurements

Body Weight and Length

Weight and height were measured using a stadiometer with a precision of 0.01 kg. The values were recorded on an information form as meters and kilograms. The following formula was used to calculate the body mass index (BMI): BMI = Weight (kg)/(height (m))^2.

Shooting Accuracy Rates

Three of the factors that could impact athletes' shooting rates were low light, fatigue, and noise and visual disturbance behind the goal.

Light and Noise levels

The light and noise levels of the gym were determined using a DT 8820 Multi-Purpose Media Meter with a precision of ± 5.

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Shooting Speed and Accuracy

Shooting speed and accuracy were determined using the test procedure proposed by Sterzing et al., (2009) (Figure 1).

A target point the diameter of a football was drawn at the midpoint (at a height of 1 m) of a rectangular area of 3x2m transparent tarp. The target point was fixed to one of the goal posts and a camera was placed on the rear of the transparent tarp (Samsung CV, South Korea).

The participant kicked the ball and at the time the ball touched the tarp, its shape in the background area was detected by the camera and analyzed using the Kinovea program.

The distance between the target point and the area the ball touched was calculated in cm. The distance between the kick point and the target point was 10 m. Participants were asked to hit as hard and accurate as possible. Each participant used his dominant leg to perform instep kicking 6 times.

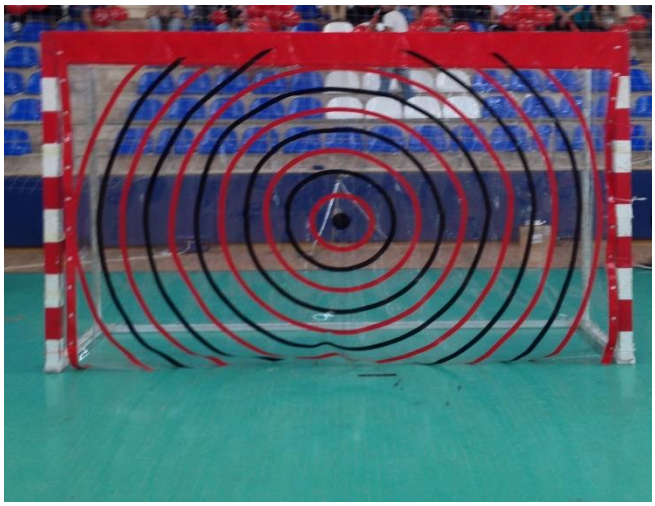

Figure 1 - Shooting Accuracy Points.

First Accuracy Rates under Normal Light Conditions

The gym was completely isolated and illuminated (823 lux) according to the TS EN 12193 Light and Lighting - Sports lighting standards. Each participant performed 6 trials and their shooting rates were averaged.

Accuracy Rates under Low Light Conditions

The gym was completely isolated and illuminated (115 lux) according to the TS EN 12193 Light and Lighting - Sports lighting standards. Each participant performed 6 trials and their shooting rates were averaged.

Accuracy Rates under Behind-the-Goal Visual and Noise Disturbance

The gym was illuminated (823 lux) according to the TS EN 12193 Light and Lighting - Sports lighting standards. Fans with stick balloons in their hands were seated behind the goals and asked to distract the participants‘ attention. Participants were also exposed to the sound of vuvuzela emitting a noise level of 90 dB measured using a multi-function environment meter (DT- 8820). Each participant performed 6 trials and their shooting rates were averaged.

Accuracy Rates under Fatigue Conditions

A maximal exercise test was performed on a bicycle ergometer. Participants were informed about the test protocol and test termination criteria prior to participation. They were allowed to familiarize themselves with the test apparatus.

Maximum exercise heart rate was measured using a Polar watch during the test, which was a 6-min single-stage test. The initial load on the bicycle ergometer was adjusted to body weight in such a way that it was 7.5 g/kg. Age predicted maximum heart rate was calculated using the fórmula 220-Age.

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The target heart rate was determined according to the fórmula 0.80 × (220 - age) (Mohr et al., 2003).

Loading was performed on a cycle ergometer Monark Ergomedic 839E. The height of the seat was adjusted to each participant. Participants pedaled for 5 min for adaptation and then the loading protocol was applied. They reached the target heart rate in the first 2 minutes.

If the participant‘s heart rate did not reach the target heart rate in the first 2 minutes, an extra load was added. If the participant‘s heart rate exceeded the target heart rate, the load was reduced, and the test was terminated and repeated after the participant were allowed to rest.

The termination criteria for the test are as follows:
- Unwillingness,
- Participant‘s heart rate < target heart rate in the first 2 min
- Exhaustion (< 50 rpm)
- Possibility of health risks

Blood Lactate levels

Blood samples were taken from the most distal part of the third or fourth fingers right after the test to perform lactate measurements using a Lactate Plus analyzer (NOVA Biomedical).

The participant‘s fingertip was cleaned and then pierced with a lancet (the first drop of blood was discarded, and the second drop was used) and blood lactate levels were measured with the help of a strip. Afterwards, each participant performed 6 trials and their shooting rates were averaged.

Data Analysis

The Kolmogorov-Smirnov test was used for normality. When the data were normally distributed, Pearson's correlation was used to determine the relationship between the variables while Covariance Analysis (ANCOVA) was used to compare the independent variables at a significance level of 0.05.

RESULTS

Table 1 shows the participants‘ demographic characteristics.

Participants‘heart rate and fatigue lactate levels significantly differed from condition to condition ($p<0.05$).

Table 1 - Demographic Characteristics.

Variables	n	Average ± Stand. Dev.
Age (years)	22	25,18 ± 3,67
Height(cm) (cm.)	22	176,32 ± 5,64
Weight (kg)	22	73,32 ± 7,97
BMİ (m/kg^2)	22	23,54 ± 1,85
Max.Heart Rate	22	175,09 ± 10,08
Fatigue Lactate (mmol/L)	22	17,30 ± 3,18

Table 2 - Correlation between Demographic Variables.

Variables		Age	BMİ	Max.Heart Rate	Lactate
Age (years)	r	-			
	p				
	n	22			
BMİ (m/kg^2)	r	0,288	-		
	p	0,194			
	n	22	22		
Max.Heart Rate	r	-0,101	-0,137	-	
	p	0,655	0,545		
	n	22	22	22	
Lactate (mmol/L)	r	-0,129	-0,114	0,960	-
	p	0,566	0,615	0,000***	
	n	22	22	22	22

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Table 3 - Mean Accuracy Rates.

Variables	n	Average ± Stand. Dev.
Normal Light	22	70,19±6,92
Low Light	22	51,22±11,79
Visual and Noise Disturbance	22	51,85±7,71
Fatigue	22	43,44±8,13

Table 4 - Correlation between Participants' Mean Accuracy Rates.

Variables		Normal Light	Low Light	Visual and Noise Disturbance	Fatigue
Normal Light	r	-			
	p				
	n	22			
Low Light	r	0,238	-		
	p	0,285			
	n	22	22		
Visual and Noise Disturbance	r	0,480	-0,400	-	
	p	0,024*	0,065		
	n	22	22	22	
Fatigue	r	-0,004	-0,424	0,054	-
	p	0,566	0,050*	0,810	
	n	22	22	22	22

Table 5 - Correlation between Participants' Heart Rates, Lactate Levels and Accuracy Rates.

Variables		Max.Heart Rate	Lactate	Fatigue
Max.Heart Rate	r	-		
	p			
	n	22		
Lactate (mmol/L)	r	0,960	-	
	p	0,000***		
	n	22	22	
Fatigue	r	-0,965	-0,950	-
	p	0,000***	0,000***	
	n	22	22	22

Table 6 - Comparison of Mean Accuracy Rates.

Variables		Average Differences	Standard Error	p
Normal Light	Low Light	18,973	2,527	0,000***
	Visual and Noise Disturbance	18,345	2,527	0,000***
	Fatigue	26,755	2,527	0,000***
Low Light	Visual and Noise Disturbance	-0,627	2,527	0,805
	Fatigue	8,409	2,527	0,003**
Visual and Noise Disturbance	Fatigue	8,409	2,527	0,001**

Table 3 shows the participants' mean accuracy rates.

Participants' accuracy rates under normal light and sound conditions were significantly higher than their accuracy rates under low light, fatigue and behind-the-goal visual and noise disturbance conditions ($p<0.05$).

Participants' heart rates, lactate levels and accuracy rates were statistically significantly correlated ($p<0.001$).

There was no statistically significant difference between participants' shooting accuracy rates under normal light/sound conditions and behind-the-goal visual and noise disturbance conditions ($p>0.05$) while there was a statistically significant difference between all other variables ($p<0.01$).

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DISCUSSION

This study investigated the relationship between participants' demographic characteristics, accuracy rates under behind-the-goal visual and noise disturbance conditions and accuracy rates under fatigue conditions.

The mean age, weight, height and BMI of the participants were 25.18 ± 3.67 years, 176.32 ± 5.64 cm, 73.32 ± 7.97 kg and 23.54 ± 1.85 m/kg^2, respectively.

Participants' mean accuracy rates under normal light and sound, low light, behind-the-goal visual and noise disturbance and fatigue conditions were 70.19 ± 6.92, 51.22 ± 11.79, 51.85 ± 7.71 and 43.44 ± 8.13, respectively.

The existing sport facilities are illuminated according to the TS EN 12193 Light and Lighting - Sports Lighting standard introduced in March 2000, which stipulates that the intensity of lighting of an indoor sports hall should not be less than 750 lux during national and international competitions (Özenç, Güler, 2009).

The purpose of lighting is to illuminate a space to enable people to perform visual tasks accurately and detect objects around them (Güler, 1997).

Participants' mean shooting accuracy rates under normal light and sound (823 lux) and low light (115 lux) conditions were 70.19 ± 6.92 and 51.22 ± 11.79, respectively. This statistically significant difference ($p<0.001$) indicates that low light conditions severely impair athletes' performance.

Lighting is critical for comfort and productivity. Poor lighting can cause accidents (slip-and-fall or trip-and-fall), physical discomfort (eye strain, headaches etc.) and psychological discomfort (irritability, anxiety, reduced efficiency etc.) (Güler, 1997).

Atiş (2009) reported that two out of three people suffer from physical exhaustion due to poor lighting, which causes eye fatigue and serious work-related problems.

Research clearly shows that lighting is strongly associated with visual comfort and performance (Veıtch, et al., 1995; Mann, 2018; Leichtfried et al., 2016).

Good quality lighting is not high intensity of light. Illumination should be adequate for all activities because low light reduces performance and efficiency. In this study, the low lighting in the gym negatively affected participants' performance.

Noise is an important pollutant causing various health hazards. It can cause hearing impairment, annoyance and irritability, hinders communication, adversely affects the nervous system and lowers productivity (Güler, 1997).

Arslan et al., (2002) reported that noise impairs memory, motor performance and concentration with age.

Frequency and decibel are two basic elements of sound. The audible range for humans is 0-140 dB. Noise sources ranging from 30 to 65 dB cause restlessness, insomnia, irritability and impairment of concentration.

Noise sources ranging from 65 to 95 dB increase heart rate, respiratory rate and blood pressure. Noise sources ranging from 90 to 120 dB reduce productivity, block thinking and negatively affect learning experiences (Güler, 1997).

Sound is used as a warning signal in cases requiring intellectual skills and fast decision-making. The tone, frequency and intensity of sound affect performance especially in cases requiring voluntary behavior in seconds or even milliseconds (Binboğa et al., 2007).

Hassmen and Koivula, (2001) conducted a study on 19 elite golfers and found that increased noise decreased their tee shot accuracy and increased their heart rate.

Audience noise in sport halls during competitions negatively affects the psychological and physiological health of all who are there. Noises above 85 dB. can cause hearing fatigue, buzzing, tinnitus and hearing loss (Arslan, et al., 2012).

Price et al., (2009) conducted a study on 30 participants. In the first part, they performed 40 free shots in a quiet environment. In the second part, they were exposed to an auditory stimulus as they performed the same task. Results showed that the auditory stimulus reduced participants' accuracy.

Arslan et al., (2012) reported that audience has a positive effect on athletes' performance and motivation. The noise level ranged from 70 to 120 dB and from 65 to 113 dB in outdoor and indoor sport halls, respectively.

According to the participants, the most annoying noise sources are when spectators hiss, boo or chant (29.4%), when they use such instruments as drums, rattle, whistles,

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etc. (28.7%), when they individually cheer and chant (27.4%) and when they boo and chant against the opponent team (18.3%). Noise causes loss of concentration (49.4%) (Arslan, et al., 2012).

Bodur and Kucur (1994) state that visual pollution differs and has different effects such as eye strain, unwillingness, loss of concentration and productivity, desensitization, mood swings, reduced diversity of thought, difficulty in adaptation, irritability, anger, behavior disorder and psychosomatic diseases.

In this study, participants had significantly lower mean accuracy under behind-the-goal visual and noise disturbance conditions (51.85 ± 7.71) than under isolated normal light and sound conditions (70.19 ± 6.92) ($p<0.001$).

The dB level of the gym was within acceptable range. The visual disturbance behind the goal prevented participants from focusing on the target point, resulting in reduced mean shooting accuracy rates. This result is similar to those reported by previous studies.

Fatigue is another factor believed to affect shooting accuracy. Participants had significantly higher mean accuracy under resting and normal light/sound conditions (70.19 ± 6.92) than under fatigue conditions (43.44 ± 8.13) ($p<0.001$).

80% of the maximum heart rate was considered the target heart rate as a marker of fatigue. Participants who achieved the target heart rate in the first 2 minutes completed the shooting accuracy test. Before the test, blood samples were taken to determine their lactate levels.

There was a high positive correlation between participants‘ mean maximum heart rate (175.09 ± 10.08) and blood lactate levels (17.30 ± 3.18), which means that the latter increased with an increase in the former. However, participants‘ fatigue accuracy rates decreased with an increase in heart rate. In other words, there was a high negative correlation between heart rate and fatigue accuracy rates. This shows that muscular fatigue reduces shooting accuracy rates.

Futsal players move very quickly, play one-on-one well, gather in defensive, spread in attack and shoot well and perform all of these with a 80-100% performance, which means that they have a good anaerobic capacity (Günay, et al., 2018).

This, however, also shows that futsal players are constantly exposed to high fatigue. Ocak, states that high effort leads to fatigue resulting in reduced performance (Ocak, Buğdaycı, 2012).

Fatigue refers to the failure of the individual to maintain the expected power or force (Mohr, et al., 2005).

Fatigue is also defined as a decline in maximum capacity required to sustain the exercise and, consequently, a decline in performance (Reılly, 1994).

Research shows that no matter what type of exercise is performed, the duration of the sustainment of strength is reduced with an increase in workload. Therefore, fatigue also refers to the inability to reveal the strength required for a particular exercise (Edwars, 1983).

Mohr et al., (2003) analyzed the 5-minute time periods during a competition. During these time periods, the intensity and pace of the game increased. The results showed that players‘ performance decreased for 5 minutes after sprinting and fell below the average.

In Mohr et al., (2005) players performed a repetitive sprint test after short-term severe periods and at the end of both halves. Their sprint performance immediately after high performance periods in the first half decreased. This performance remained the same at the end of the first half, however, decreased significantly at the end of the second half.

In futsal competitions, the mean load intensity is about 90% of the maximum heart rate (Barbero-Alvarez, et al., 2008). In this study, the participants‘ mean heart rate was 175.09 beats/min. during the test protocol and their mean lactate level was 17.30 mmol/L during the fatigue protocol.

In football, lactate levels during competition range from 3 to 6 mmol/L (Mohr, et al., 2005; Ekblom, 1986; Bangsbo, 1994).

Bangsbo et al., (1991) examined the lactate levels of professional football players during competition and reported that they ranged from 2.1 to 10.3 mmol/L and from 1.8 to 5.2 mmol/L in the first and second half, respectively.

Brewer and Davis (1994), also analyzed the lactate levels of football players during competition and reported that female football players‘ lactate levels were 5.1 mmol/L and 4.6 mmol/L in the first and second half, respectively.

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Castagna et al., (2009) reported that futsal players' lactate levels ranged from 1.1 to 10.4 mmol/L during competition. This result shows that the fatigue protocol achieves the target heart rate.

There are numerous types of kicks in futsal. Accurate pass and shooting on the target requires a special technique (Bauer, 1993).

The basic principles of accurate shooting and pass are similar. The shooting technique is harder than the pass technique, and therefore, athletes shoot faster than they pass the ball (Skogvang, et al., 2000).

In this study, there was a significant difference between participants' resting accuracy rate (70.19) and fatigue accuracy rate (43.44) ($p < 0.001$), indicating that muscular fatigue has a negative effect on shooting accuracy.

Apriantono et al., (2006) investigated the effect of muscular fatigue on shooting speed and accuracy. Shooting performance, speed and accuracy rate decreased after the test performed until knee extension and flexion reached fatigue. In a similar study.

In conclusion, predictable variables (low light, visual and noise pollution and fatigue) during competition had a negative effect on participants' shooting accuracy rates. Participants had the highest shooting accuracy under normal light conditions and the lowest shooting accuracy rate under fatigue conditions.

It is impossible to isolate these variables in a competition. Athletes should, therefore, take them into account when they exercise. The better the athletes adapt to different situations, the more they can improve their focus skills, which, in turn, increases their shooting accuracy rates.

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