

## THE EFFECT OF INTRODUCING VISUAL FEEDBACK ON SPORTS TRAINING

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**ABSTRACT. Introduction:** Mobile devices are always close to today's young people, contributing to a sedentary lifestyle, but also to the efficiency of sports lesson and training. **Objective:** In this paper we have proposed to analyze the effect of using equipment that provides athletes with visual feedback on the yield in boxing training. **Materials and methods:** The research was carried out between 19/04/2021 – 24/05/2021, being included in the study 27 athletes, divided into two groups: the experiment group (N = 13, the age M = 15.61 (0.31) years)) and the control group (N = 14, age M = 15.28 (0.35)). Equipment was used to record the number of punches performed on the punching bag and the heart rate of the subjects. The data were analyzed with the help of the SPSS 22 program. **Results:** In the sample the maximum number of punches transmitted in 30 seconds, in the initial test the control group recorded averages significantly higher than the experiment group (t = - 2.65, df = 25, p = 0.01). In the final test, the experiment group recorded an increase in the average by 35.7 punches, while in the control group the average increased by 1.71 punches, the difference between the averages the two groups being significant (t = 4.97, df = 25, p < 0.001). **Conclusions:** The results of this study show us that the motivation elements and the visual feedback introduced in the case of the experiment group had the effect of increasing the number of punches transmitted in the boxing bag, compared to the control group.

**Keywords:** *boxing, visual feedback, sports training*

**REZUMAT. Efectul introducerii feedback-ului vizual în antrenamentul sportiv. Introducere:** Dispozitivele mobile sunt mereu în apropierea tinerilor din zilele noastre, contribuind la un stil de viață sedentar, dar și la eficientizarea lecțiilor și antrenamentelor sportive. **Obiectiv:** În prezenta lucrare ne-am propus să analizăm efectul utilizării echipamentelor care oferă sportivilor feedback vizual asupra randamentului în antrenamentele de box. **Materiale și metode:** Cercetarea s-a desfășurat în perioada 19/04/2021 – 24/05/2021, fiind incluși în studiu 27 de sportivi, împărțiți în două grupe: grupa de experiment (N = 13,

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vârsta  $M = 15,61$  ( $0,31$  ani)) și grupa de control ( $N = 14$ , vârsta  $M = 15,28$  ( $0,35$ )). A fost folosit un echipament pentru înregistrarea numărului de lovituri efectuate la sacul de box și frecvența cardiacă a subiecților. Datele au fost analizate cu ajutorul programului SPSS 22. **Rezultate:** La proba număr maxim de lovituri transmise în 30 de secunde, la testarea inițială grupa de control a înregistrat medii semnificativ mai mari decât grupa experiment ( $t = -2,65$ ,  $df = 25$ ,  $p = 0,01$ ). La testarea finală, grupa experiment a înregistrat o creștere a mediei cu 35,7 lovituri, în timp ce la grupa de control media a crescut cu 1,71 lovituri, diferența dintre mediilor cele două grupe fiind semnificativă ( $t = 4,97$ ,  $df = 25$ ,  $p < 0,001$ ). **Concluzii:** Rezultatele acestui studiu ne arată că elementele de motivare și feedbackul vizual introduse în cazul grupei experiment au avut ca efect creșterea numărului de lovituri transmise în sacul de box, față de grupa de control.

*Cuvinte cheie: box, feedback vizual, antrenament sportiv*

## Introduction

In the last decade, a wide variety of devices have emerged that provide information about the health and fitness level of people who perform physical activities for leisure, or for assessing sports performance (Statista, 2014). Coaches are pushed to look for new methods of integrating technological means in sports training, given that there is an almost intrinsic connection between young people and their mobile devices - tablet, phone (Elmore, 2010). However, excessive use of mobile devices can lead to attention deficits among users, including athletes, who are also a category of consumers of IT technology. Analyzing the literature we can see that the vast majority of devices come from or are closely related to the field of fitness, health or sports performance (Lara & Labrador, 2013; Patel, Park, Bonato, Chan, & Rodgers, 2012).

One strategy that physical education teachers and coaches implement in lessons is the introduction of competing elements that have the effect of motivating athletes or students, engaging them in competitions with others or even with themselves.

In order to evaluate and increase performance, athletes need constant feedback in relation to their training program. Feedback can be offered in many forms. Current technology allows the very precise evaluation of many parameters specific to sports performance and, at the same time, their transmission, in real time, to athletes and coaches, who thus have access to a "new world of information" (Phillips, Farrow, Ball & Helmer, 2013). In addition to exact quantification of the monitored parameters, it is possible to obtain, through the specific adaptation of the trainings, the improvement of the respective parameters with

the afferent increase of the sports performance. The real-time feedback given to athletes can - through intrinsic, neuro-physiological and individual psychological mechanisms - effectively complete the training program.

The visual feedback obtained in real time has been used mainly in recent years both to evaluate sports performance and to increase training performance. Significant results in this regard were obtained in many disciplines or branches of sport, and the aspects related to the technology used, the type of feedback used and the monitored parameters were adapted to the general or specific performance objectives in the respective sport discipline. Thus, real-time visual feedback is currently used successfully in many sports. Recent studies confirm the effectiveness of the method in: rowing - with visual feedback of developed power (Lintmeijer, Robbers, Hofmijster & Beek, 2019), artistic gymnastics - with monitoring muscle strength and intersegmental synchronization (Puiu, Dragomir & Bidiugan, 2018), rugby - by assessing the speed of the bar used in endurance training (Weakley et al., 2019), hockey - to develop anaerobic power by highlighting power developed during the Wingate test (Stastny et al., 2018), in learning the optimal technique of running in performance athletes (Eriksson, Halvorsen & Gullstrand, 2018), swimming - for speed control by providing information about the speed of opponents (Szczepan , Zaton & Klarowicz, 2016).

## **Objectives**

In the present research we aimed to analyze the effect of using the visual feedback provided to athletes. We also aimed to evaluate the effects that the introduction of motivating elements in the boxing training program has on the performance and involvement of athletes in each training session.

The hypothesis from which this study has started refers to the fact that the introduction of motivational elements and visual feedback in boxing training will contribute to its efficiency, by increasing the number of punches thrown at the punching bag.

## **Materials and methods**

### ***Subjects***

The study was performed on a sample of 27 athletes from Timișoara, whose selection was made based on the criterion of experience in boxing for at least one year. The selected athletes were divided into two groups: the experiment group (GE) - consisting of 13 subjects with a mean age of 15.61

( $\pm 0.31$ ) years - and the control group (GC) - 14 subjects with a mean age of 15.28 ( $\pm 0.35$ ) years. The experimental protocol was implemented for a period of five weeks, between 19/04/2021 - 24/05/2021, which included the following stages: stage I - initial testing performed on 19/04/2021; stage II - experimental intervention; stage III - the final test performed on 24/05/2021. During this period, the athletes were not performing any kind of training at their clubs, due to the restrictions imposed by the pandemic context.

### ***Equipment used***

The assessment of the maximum number of punches transmitted in the boxing bag in 30 seconds was achieved using a set of sensors composed of an accelerometer and three-axis gyroscope (Hykso sensors). Spss software - version 22 was used to analyze the data, using descriptive analysis tests, data distribution verification and mean comparison (student "t" test for independent samples and student "t" test for paired samples).

### ***Intervention programme***

The intervention consisted in applying the same training program to both groups of subjects. The training program that the athletes went through was designed as a five-week mesocycle, with a frequency of five workouts a week. The workouts included in this mesocycle have been designed in such a way as to gradually increase the complexity and intensity of the effort in the training lessons. In this regard, in the first microcycle the athletes had to perform combinations of punches consisting of two, three or four punches, without using any defense techniques which will be introduced in the following microcycles. A weekly training cycle was composed of five sessions of training. Workouts one and five were composed of six monitored rounds, and workouts two, three and four out of eight rounds for each training session. The total number of punches transmitted to the bag and the average heart rate for each athlete were recorded. The training facility was equipped with a sufficiently large number of punching bags, assigning one athlete to a punching bag, and throughout the trainings to carry out his activity in the same place. At the beginning of each training, the athletes performed 10 minutes of warm-up, consisting of static and dynamic stretching exercises, but also specific dynamic movements. After the warm-up, both groups performed two rope jumping rounds, two rounds of punches and two shadow boxing rounds. Each round last two minutes, at an intensity of 60 to 70% of the maximum heart rate. The monitoring of these trainings was carried out with the help of a boxing punch monitoring equipment (Arnăutu, Buruntia, Hanțiu, 2020).

In the GE group, during the trainings, the subjects had the possibility to constantly view, in real time, on a monitor the number of shots transmitted in the boxing bag (Figure 1).



**Figure 1.** Workout data playback monitor

The subjects were informed that at the end of each training they will be evaluated by a scoring system, and at the end of the training the athlete with the most points will be declared the winner. The standings were made according to the number of punches transmitted to the bag as follows: 1st place – 10 points, 2nd place – 8 points, 3rd place – 6 points, 4th place – 4 points, 5th place – 2 points. Also, a general ranking of athletes was made based on the points accumulated at each training. The control group did not have access to the monitor providing this information and the scoring system was not applied. Instead, they were asked at the end of each round to evaluate themselves by appreciating the number of punches they had sent to the boxing bag.

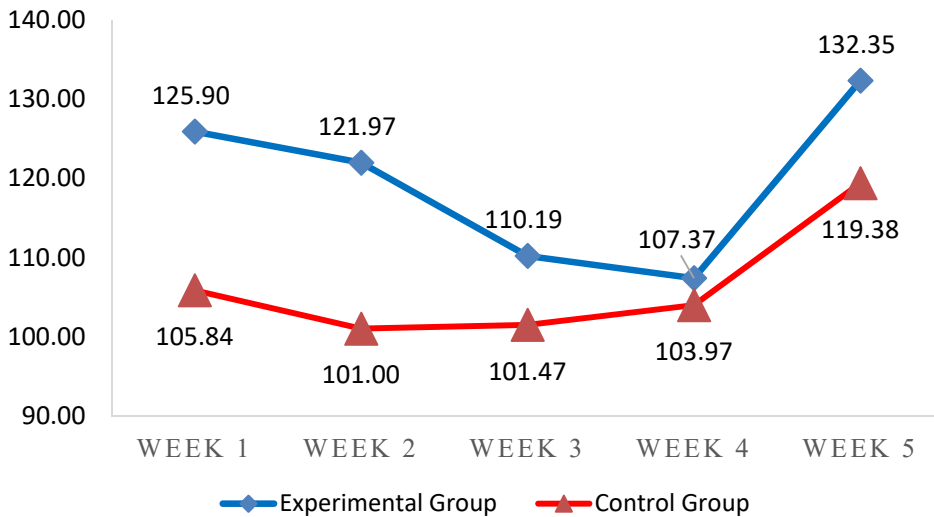
## Results

Evaluating the maximal number of punches transmitted in 30 seconds, GC recorded significantly higher mean than the GE at the initial testing ( $t = -2.65$ ,  $df = 25$ ,  $p = 0.01$ ), the effect size being 0.5, which indicates a medium effect. In contrast, in the case of the final testing, the GE recorded an increase in the mean by 35.7 punches, while in the GC the average increased by 1.71 punches. The difference in the averages between the two groups was 19.25 punches in favor of the GE, resulting in significant differences between the two groups ( $t = 4.97$ ,  $df = 25$ ,  $p < 0.001$ ), the size effect being 0.95 which indicates a strong effect (Table 1).

**Table 1.** Comparison of the means of the punches transmitted to the bag in 30 seconds according to the evaluation time (N=27)

Variable	Time	Group (N)	Mean	SD	Independent t-test			
					t	df	p	d
<b>Number of punches in 30 sec.</b>	T1	GE (13)	91.77	8.992	-2.656	25	0.014	-.511
		GC (14)	106.50	17.999				
<b>Number of punches in 30 sec.</b>	T2	GE (13)	127.46	8.263	4.970	25	0.000	.956
		GC (14)	108.21	11.464				

Regarding the weekly average number of punches to the punching bag, the analysis of the data showed a decrease in the number of punches transmitted in a round from the first week to the fourth week for the experiment group, while the control group recorded a decrease in the mean in the second week, and then increases until the fifth week (Figure 2). The combinations of simple punches, without the introduction of other defense elements, were executed in greater numbers than those combinations that had defensive techniques.

**Figure 2.** Weekly means of the punches of the subjects from the two groups

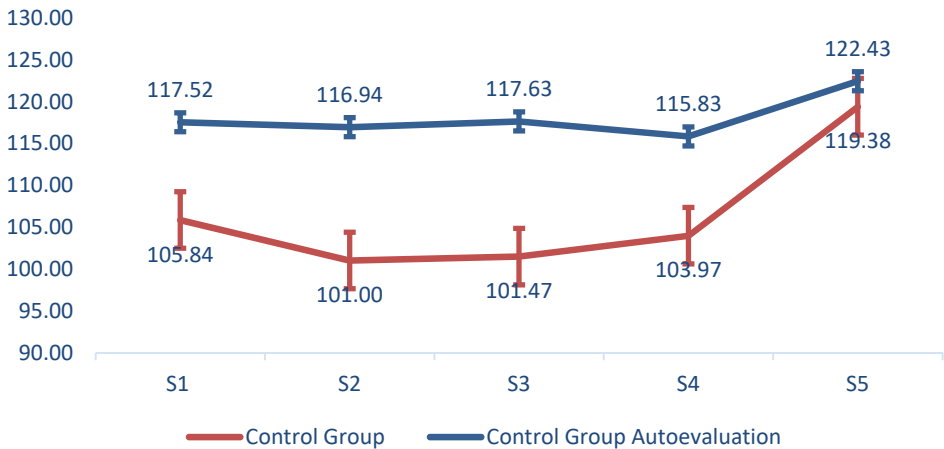
Comparing the results of the experiment group in the initial testing with the final one, we notice that the differences that occurred after the training were significant. The mean value of the maximum number of punches transmitted in 30 seconds in the initial test was 91.76 (8.99), and in the final test 127.46 (8.26), the difference of 35.7 punches being significant ( $t = -10.79$ ,  $df = 12$ ,  $p < 0.001$ ). In the case of the control group, an increase of 1.71 punches could be observed

between the two testing moments, the average of the initial testing being 106.50 (17.99) and that of the final test being 108.21 (11.46). the value of the test “t” being  $t = -0.32$ ,  $df = 13$ ,  $p = 0.75$ . Comparing the average weekly heart rate we could see that the two groups recorded significantly different values only in weeks one and two (Table 2).

**Table 2.** Comparison of weekly heart rate means for the experiment group and control group

Variable	Group (N)	Mean	SD	Independent t-test			
				t	df	p	d
S1	GE (13)	141.70	3.41	2.78	25	0.01	0.53
	GC (14)	138.50	17.999				
S2	GE (13)	145.44	3.75	6.97	25	0.00	1.34
	GC (14)	137.95	1.39				
S3	GE (13)	140.86	2.75	0.60	25	0.55	0.11
	GC (14)	140.11	3.56				
S4	GE (13)	138.18	2.27	-1.25	25	0.22	0.24
	GC (14)	139.55	3.27				
S5	GE (13)	144.38	2.53	0.44	25	0.66	0.08
	GC (14)	143.92	2.77				

Analyzing the number of punches transmitted by the athletes of the control group and the self-assessment carried out, it results that the entire GC overestimated its effort. An appreciation closer to the actual situation can be seen in the last week of training (Figure 2).



**Figure 3.** Weekly round means of the punches transmitted by the athletes to the control group and their self-assessment

The sum of the punches transmitted in the boxing bag during all halves was significantly lower than the estimate made by the control group athletes 17,826.28 (221.82) compared to 19,905.71 (279.59),  $t = -26.24$ ,  $df = 13$ ,  $p < 0.001$ ]. An interesting fact is that the athlete who accumulated the highest number of punches transmitted in the boxing bag did not accumulate the most points. He managed to accumulate 80 points with a total of 20,399 punches, while the athlete who scored a total of 20,357 punches scored 88 points.

Discutions In boxing, the evaluation of the strength and frequency of the punches, as well as the determination of the reaction time are extremely useful in assessing the level of performance, for tracking the evolution of the physical and technical-tactical training of the athletes and, at the same time, for their selection in the performance sport (Chadli, Ababoua & Ababoua, 2014).

Deochand, Costello & Fuqua (2020) analyzed the effect of using visual feedback (related to the force and speed of punches) and auditory feedback (using the rhythm and volume of music preferred by each subject as a measure of performance) on boxing punches; the intervention was performed on a group of subjects who did not practice boxing previously. Mixed feedback, auditory and visual, determined the increase in the frequency of punches from 63.5 to 87.5 punches per minute and at the same time, an average increase in their force by 468 N. Subjects considered as motivating, in descending order, the following elements: 1 - the rhythm of the music, 2 - its volume, 3 - the color of the visual stimulus and 4 - the visualization of the timer. In our study, a decrease in the averages of punches in rounds in weeks two, three and four could be observed, which confirms those mentioned by Havlucu et al. (2021). During these three weeks, a decrease in the average weekly heart rate could also be observed, resulting in a lower working intensity compared to the first week. This effect may be due to distraction as mentioned by Havlucu et al. (2021), but at the same time it can also be attributed to the fact that subjects could see the scores of their peers, thus the emphasis was placed on overcoming the other and not on improving their own performance. In the last week of training the increase in the average of punches was significant compared to previous weeks.

It is worth noting that the athlete who transmitted the most punches to the boxing bag was not also the athlete who accumulated the most points. This may suggest a new direction of research on the influence (if any) of the type of strategy chosen by each individual athlete in the approach to training on individual performance. The present study did not follow this direction, which is a limitation in terms of the results obtained, and it is not possible to confirm that they were obtained as a result of such an organized approach or were accidental. In the literature of the preferences are available questionnaires that can evaluate the athletes' strategy regarding their approach during competitions: Intrinsic



motivation inventory, Test of performance strategy, Psychological skills inventory for sports, Athlete coping skills inventory. Thomas, Murphy & Hardy (1999) have implemented a questionnaire with which you can evaluate the mental strategies and abilities that athletes turn to in training and competition (TOPS - Test of performance strategy). The authors have shown that elite athletes differentiate themselves from others through a high level of self-confidence, increased attention, systematically use goal setting, visualize the performance they want to reach and have high levels of motivation and involvement.

Gill (1988) observed that male athletes are victorious-oriented and comparing their results with others, so they turn to strategies that focus on problem solving (Hammermeister & Burton, 2004; Thomas et al., 1999). Katsikas, Argeitaki & Smirniotou (2009) analyzed with the help of the TOPS questionnaire how athletes turn to their psychic abilities to achieve maximum performance. Thus, elite athletes recorded higher scores than other athletes in terms of emotional control but also the ability to set goals. It is well known that in order to achieve maximum performances athletes adjust their working intensity (Abbiss & Laursen, 2008). Tucker (2009) examined the ways in which athletes adjust their working tempo in advance in order to achieve good results by developing psychological models of perception of exhaustion. Thus, he observed that in the case of athletes who have been incorrectly informed about the duration of an exercise, they will work at a lower or higher intensity depending on how each individual perceives exhaustion.

## **Conclusions**

In this study it was intended to analyze the introduction of two elements that could influence sports training. These two elements were real-time visual feedback and the elements of motivation introduced in sports training. The tests of statistical significance showed us that the differences between the means recorded by the two groups were significant, thus suggesting that the implementation of the two elements led to the improvement of the performance of the experiment group. During the trainings we were able to observe different approaches of the subjects, some athletes aiming for a large total number of punches, while others took into account the score. This can give us information about the strategy of each athlete during training at the time of planning a goal. However, further research into this project should contain an assessment of the motivation and strategies they apply in training and competition.

The results of this study show us that the motivation elements introduced in the case of the experiment group have the effect of increasing the number of punches transmitted in the boxing bag, compared to the control group. The reason for the decrease in the mean number of punches transmitted in the boxing bag for the experiment group in the second, third and fourth weeks is not well known, but we can consider that the possibility of viewing the results of all subjects and the increase in the complexity of the series of punches influenced this aspect.

### **Research limitations**

The research presents certain limits, caused by the small number of subjects involved, the duration of the research, but also by the use of other methods of motivating the subjects.

### **Conflicts of interest:**

There is no conflict of interest.

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