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THE INFLUENCE OF AUDIOVISUAL STIMULATION ON SELECTED INDICATORS IN TOP SPORTSMEN

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Abstract In the paper authors decided to influence the adverse mental and emotional conditions in sportsmen by means of psycho-walkmans (audio-visual stimulators – AVS Zen Master and Proteus of Chinese production, from the company Hemispheres). The authors monitored subjective feelings, lactate levels and the average heart rates during relaxation in three members of the Slovak national team (2 men, 1 woman) in athletic walking at the age of 27 ± 4 years, men´s BM 65 ± 1 kg (woman 48 kg), men's BH 177 ± 1 cm, (woman 168 cm), resting heart rate 40 ± 2 bpm. The average heart rate lower by 4 % – 10 % indicates a substantially higher state of relaxation of the organism using an audio-visual stimulator. The measurements after the relaxation with an audio-visual stimulator showed that the lactate level was by 0.54 mmol/L lower compared to the relaxation without an audio-visual stimulator. Similar differences were also found in the measurement of heart rate when they fell asleep. However, more important was the fact that the sportsmen fell asleep as early as 10 – 15 minutes after going to bed and an average length of sleep after the same volume of load was from 15 minutes to two hours longer. These values confirmed a positive influence of the AVS on the competitors' organisms.
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Key words: psycho-walkman (audiovisual stimulator - AVS), top athletes, mental load, relaxation

INTRODUCTION

In all spheres of life, as well as in sport, we encounter non-physical forms of load such as mental and emotional load, which are usually connected with working load. It is difficult to determine to what extent a performance may be influenced by tactics, psyche, physical condition, technique or something totally different. According to Trojan [10], mental and emotional load are important in terms of the physiology of work primarily because it is difficult to quantify them physically, since the manifestations of their effect often interfere with the effect of physical load on the organism. Mental load on the organism can, beside the increase in muscle tonus, cause various vegetative reactions, the consequences of which are similar to those caused by physical load. The most frequent manifestations are the increase in heart rate, increase in pulmonary ventilation, skin perfusion, increased perspiration or adrenaline excretion in the blood. Extreme emotional situations considerably increase the influence of the sympathetic nervous system, which can subsequently negatively influence the overall sporting performance.

Within the research assignment 1/4500/07 of the grant VEGA (Adaptation to Load during a Year's Training Cycle in Athletics and Other Sports) we decided to influence the adverse mental and emotional conditions in sportsmen by means of psycho-walkmans (audio-visual stimulators – AVS). This method is almost unknown in our conditions. In the world, several authors have dealt with this topic, e. g. Zaichkowsky & Fuchs [11], Sahni [6], Behncke [1], however, Slovak authors have not dealt with the problems of audio-visual stimulation of a sportsman's organism yet. On the other hand, it is important to mention that our research was inspired by the findings of scientists from the Institute for

Measurements of the Slovak Academy of Sciences [3, 8, 9], who in their works confirmed the influence of AVS on human organisms, primarily from the physical and psychological point of view. Some other psychologists (e. g. Dr. Zachar, or Dr. Gurský) confirmed the efficiency of these devices during our personal consultations. The AVS has been used by some top sportsmen in sports preparation, e. g. Šárka Kašpárková, Matt Biondi, Garry Hall, Debbi Lawrence, some ice-hockey players and cyclists and even some well-known personalities in politics and show business, e. g. Arnold Schwarzenegger, Patrick Swayze, and Demi Moor. At present, sportsmen in warm-up areas do not use traditional walkmans but psychowalkmans instead. Also some Slovak Olympic competitors have had some experience with these devices, e. g. the biathletes – Miroslav Matiaško, Dušan Šimočko, Matej Kazár, the sledgers Walter Marx and Ľubomír Mick, the athletes Peter Korčok, Miloš Bátovský, Kazimír Verkin and Zuzana Malíková, the gymnast Samuel Piasecký, but also some ice-hockey players and many others.

The aim of our work is to assess the influence of audio-visual stimulators (Zen Master and Proteus) on the recovery in top walkers by monitoring the selected indicators (heart rate, the level of blood lactate, the length of sleep, the speed of falling asleep and some subjective feelings). In order to improve the quality of sports performance, it is important to reduce mental stress in long-term preparation, which often causes a slow-down of information transfer, a decline in thinking and decision-making, but also a decline in sensomotor functions [10]. In addition to the above symptoms, we can often observe a decline in muscle performance, irritability, an inclination to depression and aversion to training (and associated processes – recuperation, stretching and some others). For this reason it is necessary to suppress mental fatigue already in the preparation period, and it is very important to stabilize the psyche of a sportsman before a race, when we can often observe emotional instability, fear, impairment in concentration ability, insomnia, but also some other manifestations of pre-start stress, which can adversely influence sports performance. According to Sangbaek [7], an intensive training load induces disorders in concentration ability, sleep disturbances and some other temporary mental states. An important role in psychological preparation is played by the coach, who makes decisions about the means and forms of this psychological preparation [4].

Since top sports performance can only be achieved on the basis of psychosomatic relaxation, the external signs of which are ease, elasticity, feeling of lightness, coolness and easy co-ordination, top sportsmen were among the first who started to use relaxation devices for the stimulation of the mind (psycho-walkmans) in their regular psychological preparation. Many of them have found out that the use of these relaxation devices significantly affected their overall performance (www.relaxans.sk). The function of an AVS is based on simple periodic optical stimuli which are conveyed to LED diodes on a pair of glasses, and at the same time on periodic sound stimulation which is led to stereo headphones. This neurotechnology enables more or less complicated courses of AVS (the frequency and type of stimulation gradually changes) and are designed for a variety of specific purposes. The stimulation induces in the human brain the so called "phenomenon of rhythm entrainment", which causes a gradual shift from one state of mind to another. In many situations, a simple "switching" to another state of the brain brings about the final and desirable aim (relaxation, falling asleep, energizing). In more complicated aims, it may be useful to use the attained states of mind for certain purposes by means of intentional "mind programming" through verbal instructions or pictures [3].

METHODS

SAMPLES

During our research we monitored three members of the Slovak national team in athletic walking, who were preparing for the European Cup (May 2005). P. K. was also preparing for the World Championship in athletics (August 2005) and Z. M. for the European Championship under 23. We also monitored the athletes during their winter preparation (2005/06). The tested athletes were 27 ± 4 years old, men's BM 65 ± 1 kg (woman 48 kg), men's BH 177 ± 1 cm, (woman 168 cm), resting heart rate 40 ± 2 bpm. Brief characteristics of the monitored walkers are:

- P. K. – a multiple champion of the Slovak Republic in 50 km walk, 14th place in the Olympic Games 2004, 13th place in the World Championship 2003 in Paris, a member of the silver team in the World Cup and the bronze team in the European Cup, 10th place in the World Championship 2005, 8th place in the European Championship 2006;

- Z. M. – a multiple champion of the Slovak Republic, 22nd place in the Olympic Games 2004, 5th place in the European Championship under 23, 6th place in the World University Games 2005, 13th place in the European Championship 2006;
- M. P. – the champion of the Slovak Republic in 50 km walk, bronze medal in the European Championship for juniors, participant in several world competitions.

The monitored athletes used AVS (psycho-walkmans) during their preparation for the European Cup, World Championship, or during their winter preparation. They employed psycho-walkmans Zen Master and Proteus of Chinese production from the company Hemispheres. To plan an exacting training programme, which a competitor for a 20 or 50 km race has to complete, is one side of the problem. However, it is more difficult to complete the training together with all negative physical and psychical feelings. It is not easy to assess to what extent an average performance may be influenced by the psyche. The publications dealing with the problems of setback in sports say that uncontrolled pre-start states can adversely influence the performance by up to 90%. It is known that the human mind passes through different states, which have their typical characteristics basically corresponding to the requirements of the organism. Owing to various extreme situations, we often get into the states that we can hardly influence by our will. A psycho-walkman uses several frequencies with a different influence on the organism [3]:

- BETA – active concentration, 30 – 14 Hz
- ALFA – relaxation, 13 – 8 Hz
- THETA – dreaming, 7 - 4 Hz
- DELTA – sleep, 3 – 0.5 Hz

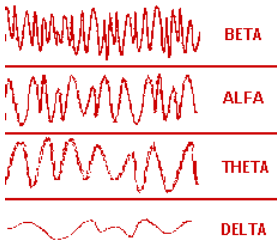

Figure 1. A psycho-walkman different characteristical frequencies

The sportsmen whom we monitored utilized all four levels, the level Beta as a stimulation before the second phase after an exacting endurance body force (e. g. 30 – 40 km), the level Alfa during an afternoon rest and the level Delta in insomnia caused by extreme exhaustion of the organism accompanied by a natural hypoxia, because a substantial part of our research took place in a highland district at the altitude of about 1400 m above sea level (according to www.psychowalkman.sk). The apparatus had 50 programmes with a wide choice of corresponding options supplemented by accompanying relaxation music, which should help during concentration.

They started to use the AVS more than a month before the European Cup, respectively 3 months before the main top of the season. The acquisition of "skills" that are needed for the use of the AVS requires approximately 10 – 20 trials. Measurements were always conducted after the same load, followed by the same form of recuperation and with the same food. We compared resting heart rate and lactate levels after 30 minutes of relaxation without an AVS and with an AVS. We employed a sport-tester POLAR S 800i for measuring heart rate and we focused on an average heart rate during 30-minute relaxation. After the relaxation we measured the lactate level in capillary blood using the apparatus LactatePro. The length of sleep was monitored by another person. All measurements were carried out in training camps, so that the roommate of a monitored person triggered a stop-watch when he/she observed, by breathing, that the monitored person fell asleep. The monitored person stopped the stop-watch as soon as he/she woke up in the morning. The evaluation of subjective feelings of the tested athletes was performed on the basis of records in training diaries of the sportsmen; however, we do not analyze them in detail in our paper.

STATISTICAL ANALYSIS

The data were processed using the statistical programme MS Excel (Microsoft Office Excel 2003). Data processing was performed according to Chajdiak [2]. When evaluating the influence of AVS on the athletes' organism, we used 5% and 1% significance levels.

RESULTS AND DISCUSSION

AVS were primarily used as a means of psychoregeneration, i. e. a form of psycho-hygiene. In order to evaluate the quality of relaxation, we monitored subjective feelings and an average heart rate during relaxation (Figure 2).

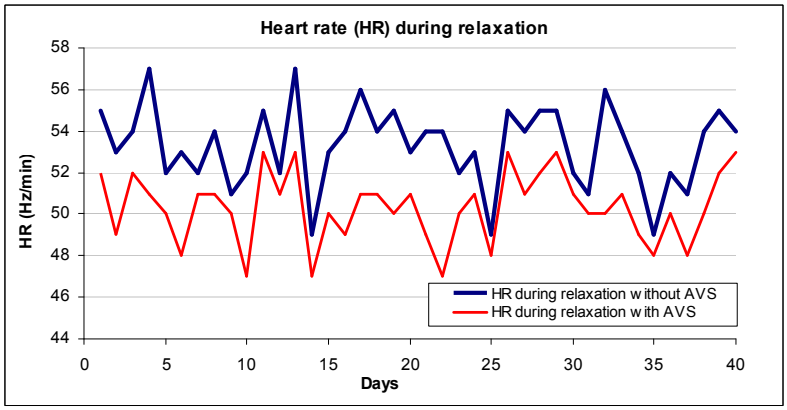

Figure 2. Comparison of heart rate during relaxation without and with an AVS (P. K. and M. P.)

An average heart rate lower by 4% – 10 % indicates a substantially higher state of relaxation of the organism using a psycho-walkman, which is a necessary condition in extreme endurance load, because an approximate 4-hour load which a competitor undertakes in a 50 km race at the border of 93% of anaerobic threshold is exacting not only physically [5], but also mentally. In terms of statistical significance, we can see in Table 1 that the test statistic t and also the p-value for double t-test in both tested sportsmen show a very significant difference between the mean values of heart rate without an AVS and with an AVS (at both 5% and 1% significance levels). This difference is very significant, because p-values are much lower than 0.05 or 0.01 (p = 0.000).

Table 1. Statistical analysis of the influence of AVS on resting heart rate during relaxation

Heart rate	M.P.	P.K.
p-value	0.000	0.000
t statistic	9.496	6.994
critical value at α = 0.05	2.086	2.101
critical value at α = 0.01	2.845	2.878

The state of relaxation was also noticeable during the control of the state of muscle relaxation by touch, which however cannot be expressed numerically, but only on the basis of sensory evaluation. Muscle tonus was monitored either by a physiotherapist or by an informed person. Another significant variable which we compared during the relaxation with or without an AVS was the level of blood lactate (Figure 2).

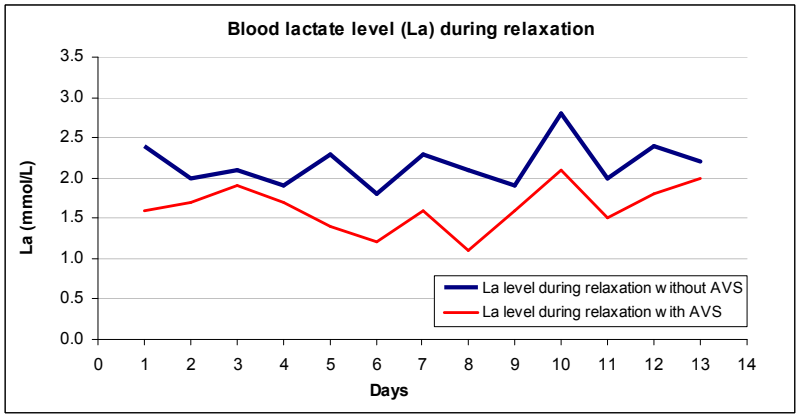

Figure 2. Comparison of blood lactate levels after the relaxation with and without an AVS (M. P. 1-7, P. K. 8-13)

As we can see in Figure 2, the measurements after the relaxation with an AVS showed that lactate level was by 0.54 mmol/L lower compared to the relaxation without an AVS. This confirms the fact that muscles, and basically the whole organism, after the relaxation with an AVS are more relaxed, since it is known that lactate degrades primarily in relaxed (not working) muscles. All 13 measurements were always carried out after the same load as far as the intensity and volume are concerned. As we can see in Table 2, the improvement was statistically significant when the p-value in both tested sportsmen was lower than 0.05 (it was even lower than 0.01). The critical value at $\alpha = 0.05$ (and also at $\alpha = 0.01$) was lower than the t statistic, and that is why we can say that the lactate level while using AVS was in both tested sportsmen lower than without AVS at 5% (and also at 1%) statistical significance level.

Table 2. Statistical analysis of the influence of AVS on the blood lactate after relaxation

Lactate level	M.P.	P.K.
p-value	0.003	0.005
t statistic	4.777	4.676
critical value at $\alpha = 0.05$	2.447	2.571
critical value at $\alpha = 0.01$	3.707	4.032

Similar differences in heart rate (and lactate levels) were also found in the measurement of heart rate during falling asleep. However, more important was the fact that the sportsmen fell asleep as early as 10 – 15 minutes after going to bed, which otherwise usually takes 1 – 2 hours after an exacting training. Due to energy exhaustion the organism is tense and an athlete is not able to relax and thus concentrate on the process of falling asleep. The audio-visual stimulators that we used significantly facilitated mind relaxation and the overall relaxation of the organism. The fact that the monitored competitors were not able to remember their dreams and basically lost orientation in time indicated good quality and depth of sleep. Equally important was also the fact that they did not wake up during sleep either spontaneously or due to slight noises, which had a positive impact on their further training load, because sleep is one of the most important constituents of recuperation. An average length of sleep after the same volume of load was by 15 minutes to two hours longer (Figure 3), which resulted in the fact that the monitored sportsmen were able to cope better with training load, but they also had a good feeling about training. Thanks to this they were able to better cope with training volume and intensity.

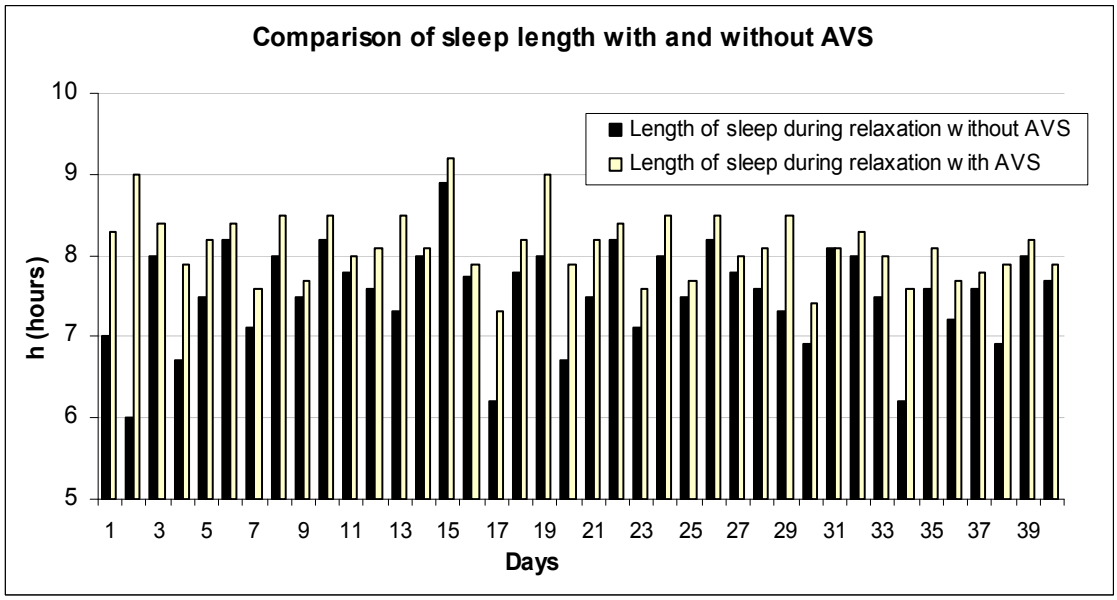

Figure 3. Comparison of sleep length during the day with and without AVS
(1-16 M. P., 17-31 P. K., 32-40 Z. M.)

As mentioned above, statistically significant improvement was observed not only in the heart rate and lactate levels, but also in the length of sleep. The p-value and t statistic show a statistically significant difference in mean values of the length of sleep without using an AVS and with an AVS in all three tested athletes (at $\alpha = 0.01$) (more in Table 3).

Table 3. Statistical analysis of the influence of AVS on the length of sleep

Length of sleep	M.P.	P.K.	Z.M.
p -value	0.002	0.000	0.005
t statistic	3.662	5.622	3.881
critical value at $\alpha = 0.05$	2.131	2.145	2.306
critical value at $\alpha = 0.01$	2.947	2.977	3.355

In sports preparation it is also very important for a competitor to be able to concentrate on repetitive training load. For this purpose we used the programmes for energy recovery, thanks to which the monitored athletes were able to cope with repetitive training load without any notable negative states of mind (aversion, sluggishness, etc.), which was reflected in the whole atmosphere during training. The main part of our research was conducted before the peak competitions (the European Cup, the World Championship, and the European Championship under 23), because it is known that pre-start states bring about nervousness, disorders in concentration and sleep and the increase in resting metabolism, which adversely influences energy reserves. Before the competitions, the competitors looked steady, had a quiet sleep, which together with some other factors influencing performance produced the best ever results of the walkers in the European Cup; P. K. came in 7th in 50 km walk, M. P. came in 26th (4th in team competition). P. K. also utilized AVS before the World Championship in athletics where he came in 10th, which is the best ever place of a Slovak walker in a 50 km race. Equally successful was Z. M., who finished 5th in the European Cup and 6th in the World University Games, which no other Slovak woman had achieved before her. All competitors evaluated the quality of sleep as very good, which is not quite usual before competitions, as the competitors either consciously or unconsciously think about competitions and this deteriorates their concentration on falling asleep and decreases their energy reserves. A subjective feeling of nervousness before the start was also successfully reduced by the AVS.

The monitored athletes subjectively evaluated the influence of the AVS on their organism as positive, which was also confirmed by objective measurements. The measurements of heart rate, lactate level, and the prolongation of the length of sleep confirmed that the use of appropriate audiovisual programmes helped the organism to attain a higher state of relaxation, which resulted in the decline in the heart rate, the lactate level, and muscle tonus and a better quality of sleep.

CONCLUSIONS

The selected athletes, and perhaps many other people, had a sceptic opinion about the use of an AVS apparatus for recuperation and learning and did not believe in this method very much or they even did not know about it. However, in spite of this, they started the testing and as early as 4 – 6 days later they came to the conclusion that this world-wide acknowledged method really worked. The work with an AVS can be fully mastered after approximately 20 sessions.

Since the placebo effect can play a certain role in similar situations, we also monitored alterations in the heart rate. Relaxation using an AVS resulted in the decline by 4 % – 10 %. A similar significant decrease occurred in the lactate levels after relaxation, when we recorded a decrease by 0.54 mmol/L. These values together with the prolongation of sleep duration confirmed a positive influence of the AVS on the competitors' organisms.

The p-value and the t statistic of resting heart rate monitored during relaxation with an AVS, the lactate levels monitored after relaxation with an AVS, as well as the length of sleep with an AVS all show, in all three athletes, a statistically significant difference (improvement) in mean values with and without using an AVS at the significance level of 1% and 5%, respectively, (that is at $\alpha = 0.05$ and at $\alpha = 0.01$, respectively).

Subjectively the athletes evaluated the period during which they used the AVS as mentally less exhausting, which was reflected in the training process, but also in good atmosphere, which helped them to cope with common life situations more easily. The results in competitions showed that the AVS proved

good. P. K. won participation in the World Championship in athletics in August, where he finished 10th, which was the best result of a Slovak walker in 50 km race in history. P. K. and M. P. took advantage of monitoring the state of relaxation by means of biofeedback during the last week before the European Cup, which proved a good state of organism relaxation; however, an objective evaluation will require a long-term use of this device. Z. M. used the AVS for rapid falling asleep and improving the quality of sleep in preparation and before the competition.

PRACTICAL APPLICATION

In conclusion, we can say that the stimulation by means of the AVS before a performance can induce for a certain period of time sensual and physical performance and reduce pre-start stress. Pre-start fever can be reduced by means of the programmes using the theta level and are used together with visualisation, i. e. by imagining that we are able to cope with the situations in which we normally fail. These exercises have to be performed regularly and for a sufficient period of time (about 30 – 60 repetitions). The energization and meditation programmes help to attain excitement before a performance. The concentration programmes help to increase concentration before a performance. The programmes working at the frequency of 13 – 16 Hz help to induce an optimum state of the mind (the mind is calm, your decisions are clear and rapid, your motor co-ordination is very good). After a performance, the stimulation by the apparatus is used for recuperation. Relaxation and regeneration of the organism at the level theta by means of relaxation and sleep programmes accelerate recovery after a sports performance. The sportsman and the coach have to determine the goals that they want to achieve by means of the psycho-walkman so that the stabilization of psyche will be realized in those spheres that are considered as the most problematic in a particular competitor.

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