

THE TRAINING EXPERIENCE IMPACT ON CONCENTRATION AND RELAXATION LEVEL IN ARCHERS ACCORDING TO THE EEG BIOFEEDBACK EQUIPMENT DIAGNOSIS

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Key words:

- biofeedback EEG,
- concentration,
- relaxation,
- stress.

Abstract:

The aim of this paper was to assess the training experience impact on the mental concentration and relaxation level in archery players measured with EEG biofeedback diagnosis.

The study encompassed 15 female and 15 male players in different age groups (seniors, juniors and recruiting group). The research consisted of two training sessions, i.e. concentration and relaxation session, and those comprised three one-minute rounds with 15 second intervals. The research served as the basis to conclude that the training experience has a fundamental impact on evaluated parameters.

INTRODUCTION

Contemporary competitive sport continuously refines the methods and procedures of physical training of male players. Those are based on measurements with the use of well known measurable scientific methods.

In terms of mental preparation reflected by means of resistance to stress, methods and procedures are based on immaterial as well as immeasurable and sometimes intuitive methods of preparation. The following paper strives at presenting a modern parameterization method of measuring the degree of mental preparation in male archery players.

The authors based on the modern medical interpretation of stress in their attempt to cope with the diagnosis of concentration and relaxation. The impact of stress that builds up due to various reasons can be relieved; however, it requires to be approached with proper understanding.

On the basis of the research papers of American scientists in particular, nowadays the contemporary man is exposed to 1,000 times more stress factors than the man who lived a hundred years ago.

It has been proven that we are exposed to 382.000, 000 factors that evoke stress on a daily basis. Also, tensions – both of psychological and social nature are only 10% of those factors. The remaining ones include nervous, physical, chemical and electromagnetic stresses. All stress related tensions evoke a similar reaction in our body. This is a so-called ‘fight-or-run reaction’ no matter if we fight against our enemy or we are exposed to toxic chemical. Our body gets rid of stress in a natural way during the 8 hours’ sleep. However, it is a way shorter time to relieve the stress tensions if new factors have a strong impact on the body. Thus, we are always left with some non-disposed amount of stress. It can manifest itself in sleep problems or even lack of sleep. One ought to remember that the very stress response takes place in all organs of our body. Nonetheless, keeping in mind all stress-related situations we need to increase our stress resistance reserves in our body as those are of fundamental importance to our physical well-being and health.

Dr. Hans Selye was right when he talked about stress and its impact on human physiology already in the fifties. Only now we begin to learn that what he talked about. Stress-evoking factors (often referred to as stressors) greatly reduce the energetic potential of the body exposing it to pathogens. Human body will not function properly in the stress-evoking environment and thus it will not be able to cope with a long-lasting physical effort. Moreover, it will not be able to keep proper focus on any given task. From the competitive sport point of view, we take an interest in two abilities. Those include the ability to concentrate on the physical or intellectual activity performed within sports rivalry as well as the relaxation ability (i.e. removing the effects of stress and physical workload) emerging as a result of training and sports rivalry. The last 20 years of research performed with the use of Biofeedback technology provided knowledge on possibilities of concentration improvement. Furthermore, brain waves (with a frequency of 5 to 12 cycles per second) generated through training with the use of EEG Biofeedback equipment remove stress effects up to 24 times faster if compared to regular night's sleep. Scientists concluded that EEG Biofeedback undoubtedly allows for checking the effectiveness of relaxation process and hence concentration. This was all due analyzing the individual brain waves frequencies and an improvement in the function of these activities without needless loss of time.

MATERIAL AND RESEARCH METHODS

Modern measuring methods are created due to technological advances in the field of electronics (miniaturization) methods. This progress enabled the development of new non-invasive methods of human brain examination. A great reinforcement (x 1 million) of electrical signals measured on the patient's scalp surface enabled the assessment of brain electrical activity and the computer signal processing made the basis for the creating the tool described below. The following results are part of a greater research. The study was conducted by means of EEG biofeedback (neurofeedback). EEG Biofeedback allows the brain training to improve its efficiency and gain control over physiological processes that occur in the human body and are usually inaccessible for his conscious mind. The functioning of brain bioelectric activity of the nervous system in healthy subjects may be improved by the use of this method and experiences that are applied in treatment of neurological, psychosomatic and psychiatric disorders.

The Biofeedback phenomenon is the ability to modify a physiological process and give it the desired direction, through giving immediate feedback on the process parameters. Clinical application of EEG biofeedback system involves regular measurement of physiological functions (brain wave parameters such as amplitude, frequency, and their average value combined with training in self-control, which in turn introduces to the area of conscious control over various physiological responses such as heart rate, blood pressure, breathing rhythm, etc). Due to training with the use of EEG Biofeedback it is possible to control all the functions of the body managed by the autonomic nervous system (ANS).

EEG Biofeedback training aims at achieving such a state of the brain that may produce the desired response pattern - optimize brain function in such a way to relax and at the same time have the ability to fully concentrate. EEG biofeedback operation principle is based on a computer analysis of the EEG record of the patient, who is connected to a computer system by means of electrodes. The individual subject to examination intentionally participates in training by monitoring the course of a video game only by means of his thoughts. During the training session, the therapist (trainer) adjusts the parameters of the desired brain waves of the patient to simulate the formation of new beneficial patterns or inhibit the inappropriate ones.

The spectrum of indications for EEG Biofeedback training is extensive. It can be used by both healthy people who wish to improve their brain efficiency, reduce stress level, as well as

those who suffer from various diseases of the central nervous system (CNS) and organ or psychosomatic disorders.

EEG Biofeedback method is especially helpful in the treatment of children and young people due to their ability to learn.

The authors of this article apply diagnostic investigation as a technique used for analysis. Methods of observation and documentation analysis allow a conclusion that the level of concentration and relaxation is directly proportional to age, length and level of sports training experience. These skills can be greatly improved by strict daily training with the Biofeedback EEG equipment.

The Biofeedback mechanism allows the instructor (a therapist who conducts a given session) to fully monitor, observe and thus indirectly help the players improve their performance.

The coach (therapist) should know the potential of the individual subject to examination to allow appropriate selection of such training and the task difficulty. One should also remember how the male player reacts to failures and successes when performing a given task. If colloquially speaking the player is positive then the task difficulty might be set at a slightly higher level than his potential possibilities. However, if the individual is negative then one cannot make such a mistake in any way as the player will give up completely and will not have the motivation to work. Obviously, one should consider the day order. It is nothing surprising that each player has better and worse days. This may be due to various factors (insufficient amount of sleep, family problems, school, work, and health related problems) and therefore the task threshold should be adequate to this factor.

Biofeedback activity also allows the level of concentration and relaxation ability to rise and shows of a number of factors that may distract the player from achieving the results that would be satisfactory for himself and people working with him. When leading the training session in the following way it should be considered how the individual actions of brain waves influence our body (taking into consideration the simplified specification given below):

Alpha activity increases in the state of increased alertness, it prevails in people with a high IQ and correlates with passive attention, improved memory, positive thinking (1 healthy person in 10 does not have alpha activity).

SMR rhythm with eyes open is responsible for staying alert in a state of relaxation as well as external attention in the states of serenity, reduced anxiety blocked by motion, mental focus not blocked visual stimuli.

Beta activity is a state of concentration focus on task solving and spot details. Beta 2 activity (an extension of Beta range) consists in the increase of emotional tension, stress, anxiety, negative thinking in the states of depression. It is associated with a high consumption of energy and correlates with the release of stress hormones mainly adrenaline, and releases toxic effects on the body.

Theta activity is the basic rhythm in children in the state of alertness, and in drowsiness it replaces alpha activity. Its high level is associated with attention disorders or micro brain damage within the range of 6-7 Hz Height value of immunity and the production of endorphins. It is associated with memory reconstruction.

Delta activity prevails in delta sleep.

By analyzing these factors, one can say which elements are most distracting and prevent him from achieving high scores. Two forms of training concentration were employed in the research with the use of beta/theta protocol and SMR/hetta relaxation.

Developmental evidence

By observing the sessions conducted by means of EEG Biofeedback equipment authors paid attention to the fact of systematically collected data on the brain activity of individuals that were not the subject of analysis. After their careful analysis the authors came to a conclusion that they can be a source of knowledge and scientific progress in the field of sport.

Diagnostic test results obtained during the training sessions were randomly selected for specific analyzed research groups:

RESEARCH RESULTS

Tab. 1 Female Senior Players. [N=5]

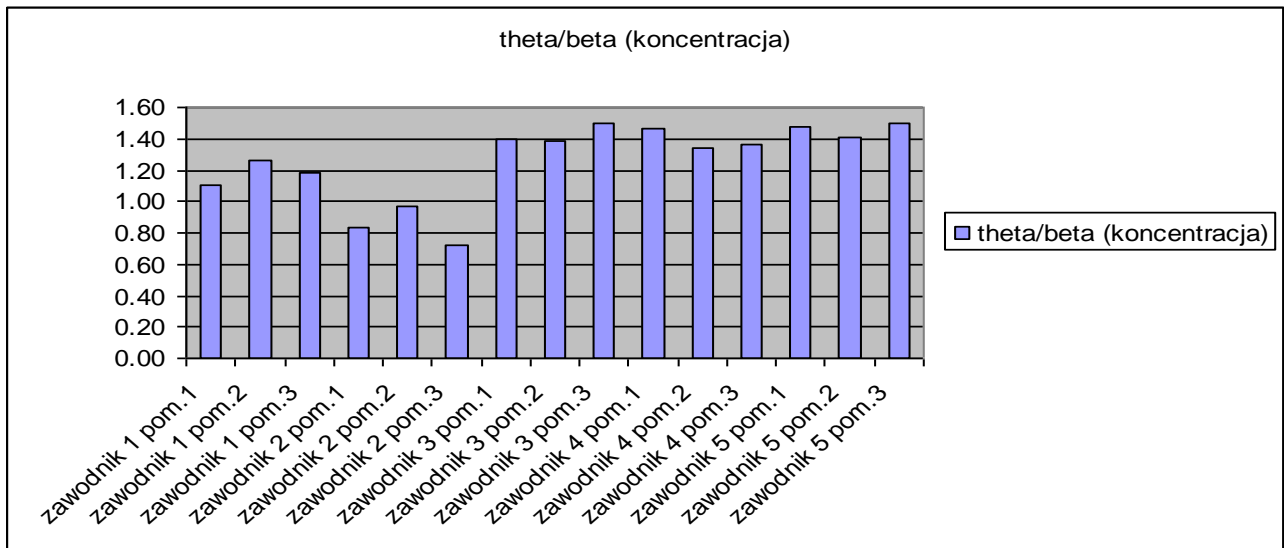
Item no.	Weight [kg]	Height [cm]	BMI
Female player 1	70	175	24
Female player 2	56	173	18
Female player 3	82	161	41
Female player 4	60	177	20
Female player 5	55	168	18

Source: own data collection

Tab. 2 Brain wave amplitude specification (Female senior players)

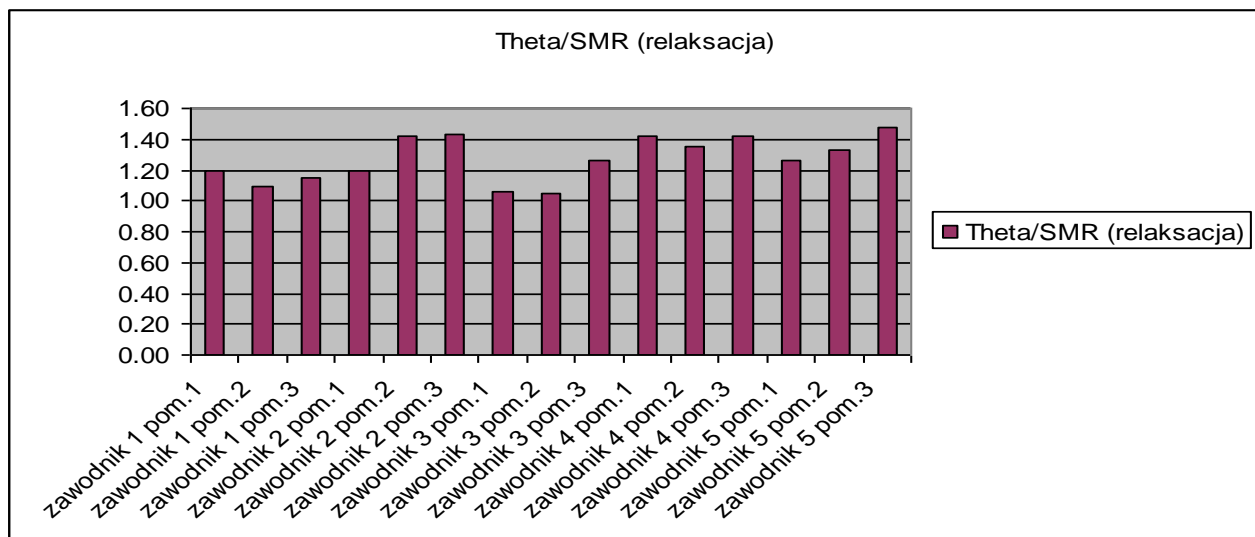
	Delta < 20 uV	Theta do 10 uV	Alfa < 10 uV	SMR ok. 10 uV	Beta 1 5-10 uV	Beta2 10-12 uV	Theta/Beta (concentration)	Theta/SMR (relaxation)
1	19,32 22,11 17,07	10,15 11,86 10,25	6,73 7,06 6,72	8,45 10,88 8,91	9,22 9,41 8,68	7,08 8,63 8,81	1,10 1,26 1,18	1,20 1,09 1,15
2	22,44 22,37 18,61	10,63 10,62 10,00	10,32 9,07 8,79	8,83 7,47 6,99	12,73 10,97 10,97	9,93 9,61 12,73	0,83 0,97 0,72	1,20 1,42 1,43
3	14,85 16,88 16,13	11,33 11,67 13,14	8,87 8,53 10,40	10,06 11,10 10,42	8,08 8,40 8,78	8,84 8,39 9,11	1,40 1,39 1,50	1,06 1,05 1,26
4	16,99 15,74 15,44	13,29 14,09 14,45	18,92 22,49 22,51	9,35 10,43 10,17	9,08 10,48 10,63	8,22 8,23 10,38	1,46 1,34 1,36	1,42 1,35 1,42
5	23,20 22,71 22,81	12,80 12,55 13,60	8,85 8,52 9,38	10,15 9,43 9,18	8,67 8,90 9,06	9,17 8,73 8,94	1,48 1,41 1,50	1,26 1,33 1,48

Fig.1. Concentration session results (Female Senior Players)



Source: own data collection

Fig. 2. Concentration session results (Female Senior Players)



Source: own data collection

Table 3 Male Senior players [N=5]

Item no.	Weight [kg]	Height [cm]	BMI
Male player 1	72	185	28
Male player 2	75	181	31
Male player 3	80	183	34
Male player 4	75	170	33
Male player 5	71	180	28

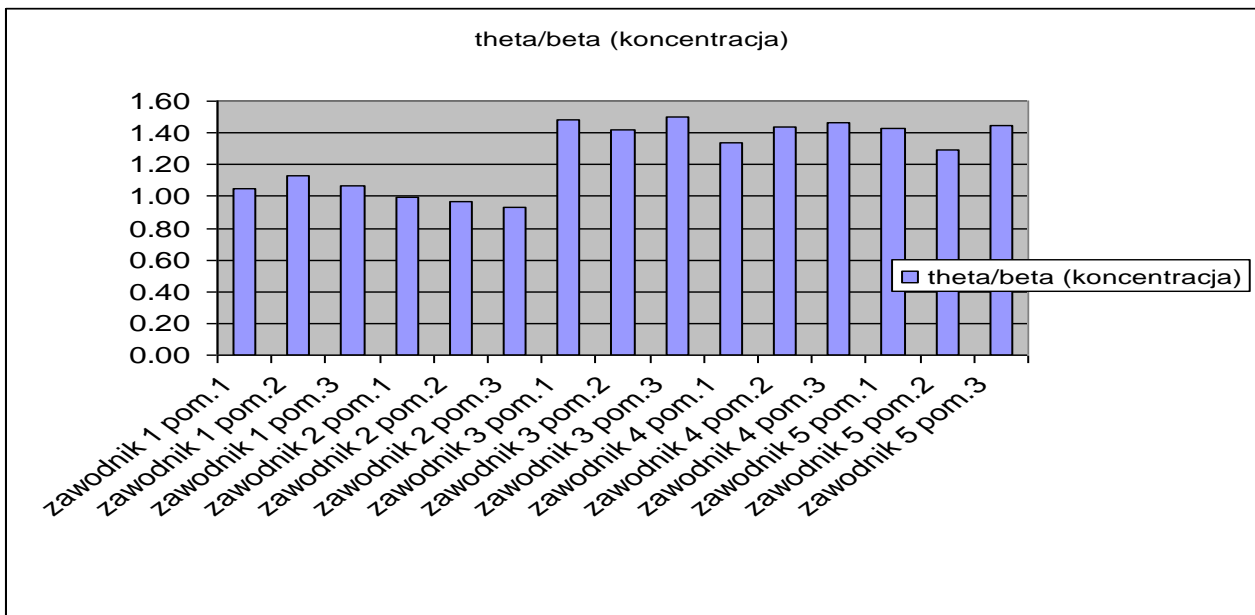
Source: own data collection

Table 4 Brain wave amplitude specification (Male senior players)

	Delta < 20 uV	Theta do 10 uV	Alfa <10 uV	SMR ok. 10 uV	Beta 1 5-10 uV	Beta2 10-12 uV	Theta/Beta (concentration)	Theta/SMR (relaxation)
1	16,22, 16,98 17,07	10,35 11,26 10,45	8,09 8,43 7,98	8,08 9,22 8,85	9,85 9,96 9,76	7,56 8,23 7,90	1.05 1,13 1.07	1,28 1,22 1,18
2	15,78 16,04 16,61	10,13 10,12 10,29	10,45 10,00 9,79	8,80 7,33 7,73	10,23 10,43 11,06	9,90 11,20 12,15	0,99 0,97 0,93	1,15 1,38 1,33
3	15,85 17,88 17,13	10,33 10,67 12,14	8,78 8,90 9,40	8,19 7,90 9,48	6,97 7,51 8,09	9,12 8,47 9,05	1,48 1,42 1,50	1,26 1,35 1,28
4	16,67 15,56 16,04	12,29 12,09 12,45	11,30 12,04 11,99	9,31 8,95 8,76	9,17 8,39 8,52	8,33 8,54 9,38	1,34 1,44 1,46	1,32 1,35 1,42
5	17,20 16,71 16,81	10,80 10,55 11,60	9,90 9,40 9,33	8,85 7,64 7,78	7,55 8,17 8,00	8,47 8,23 8,74	1,43 1,29 1,45	1,22 1,38 1,49

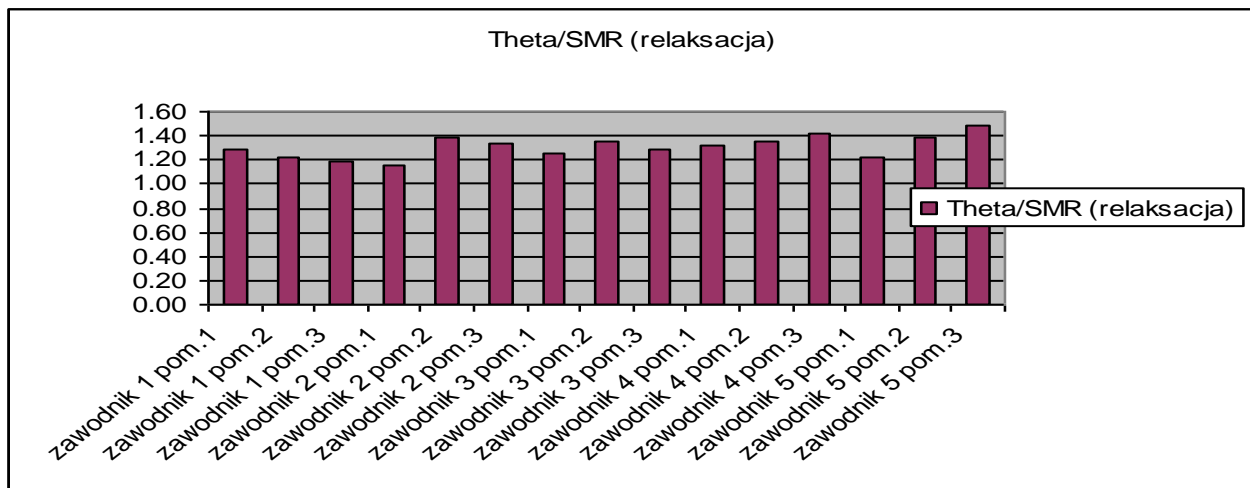
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Fig. 3 Concentration session results (Male Senior Players)



Source: own data collection

Fig. 4 Concentration session results (Male senior players)



Source: own data collection

Table 5 Female Junior Players [N=5]

Item no.	Weight [kg]	Height [cm]	BMI
Female player 1	57	168	19
Female player 2	58	174	19
Female player 3	69	165	28
Female player 4	52	165	16
Female player 5	54	168	17

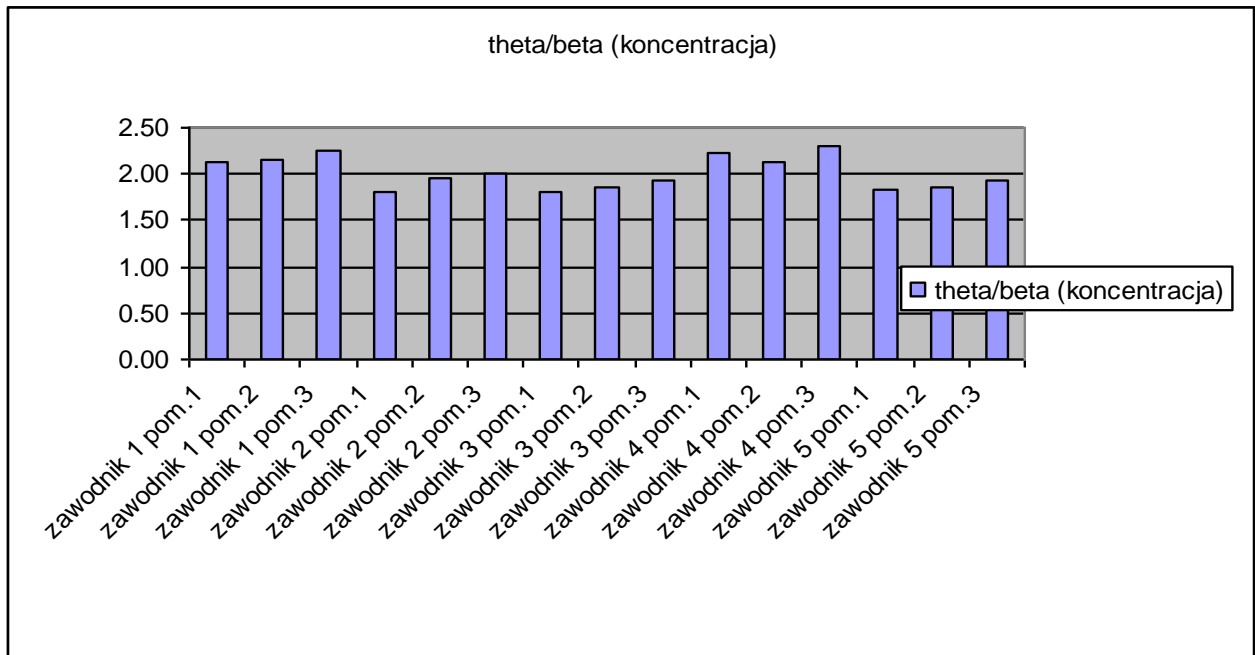
Source: own data collection

Table 6 Brain wave amplitude specification (Female Junior Players)

	Delta <20 uV	Theta do 10 uV	Alfa <10 uV	SMR ok. 10 uV	Beta 1 5-10 uV	Beta2 10-12 uV	Theta/Beta (concentration)	Theta/SMR (relaxation)
1	20,99 19,09 22,11	14,94 15,17 14,40	7,99 8,40 8,99	6,25 6,37 6,26	7,00 7,05 6,40	7,90 8,78 8,45	2,12 2,15 2,25	2,39 2,38 2,30
2	17,99 18,28 19,23	8,11 7,72 8,83	10,86 10,26 9,06	3,95 3,80 4,39	4,48 3,95 4,41	7,54 8,61 8,90	1,81 1,95 2,00	2,05 2,03 2,01
3	17,60 15,31 17,02	10,20 10,44 10,31	8,90 8,38 8,13	4,08 4,22 4,52	5,66 5,64 5,36	8,23 7,50 7,90	1,80 1,85 1,92	2,50 2,47 2,28
4	18,09 20,55 19,24	20,13 19,82 20,11	9,34 8,57 8,88	8,98 9,26 8,59	8,98 9,30 8,78	6,90 7,61 7,74	2,24 2,13 2,29	2,24 2,14 2,34
5	19,09 17,56 18,65	10,82 10,61 10,75	7,20 7,69 8,05	4,85 4,63 4,84	5,94 5,73 5,59	7,20 7,38 8,02	1,82 1,85 1,92	2,23 2,29 2,22

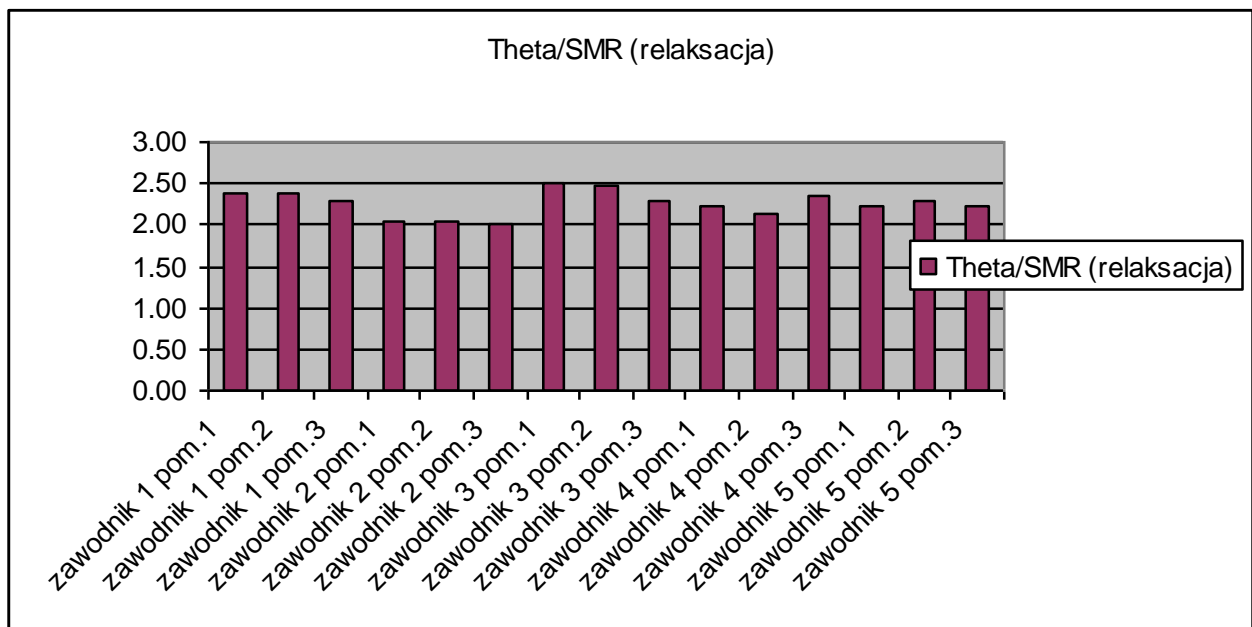
Source: own data collection

Fig. 5 Concentration session results (Female Junior Players)



Source: own data collection

Fig. 6 Concentration session results (Female Junior Players)



Source: own data collection

Table 7 Male Junior Players [N=5]

Item no.	Weight [kg]	Height [cm]	BMI
Male player 1	73	181	29
Male player 2	63	175	22
Male player 3	62	171	22
Male player 4	70	182	26
Male player 5	72	180	29

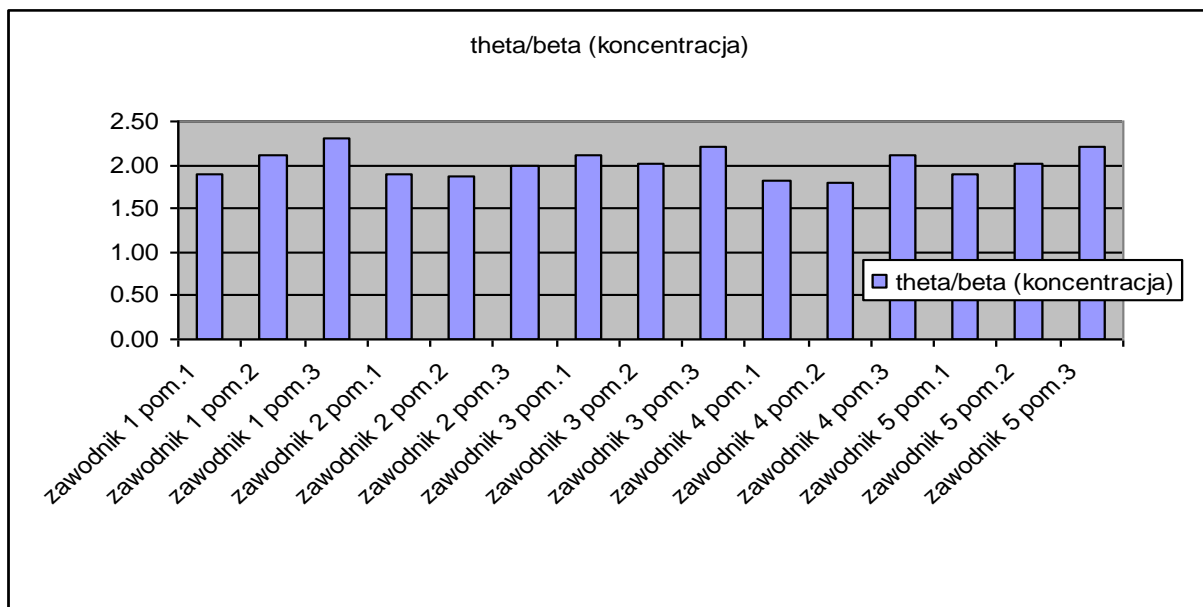
Source: own data collection

Table 8 Brain wave amplitude specification (Male Junior Players)

	Delta < 20 uV	Theta do 10 uV	Alfa <10 uV	SMR ok. 10 uV	Beta 1 5-10 uV	Beta2 10-12 uV	Theta/Beta (concentration)	Theta/SMR (relaxation)
1	17,29 18,84 18,11	14,94 15,17 14,40	9,45 8,90 8,79	4,40 4,49 4,37	6,25 7,58 6,26	8,93 7,20 7,76	1,90 2,10 2,30	2,39 2,00 2,30
2	16,58 15,05 15,80	8,11 7,72 8,83	11,31 10,82 11,55	9,59 7,97 5,41	4,03 3,65 3,66	9,33 9,06 8,61	1,90 1,88 2,00	2,10 2,12 2,41
3	17,41 19,01 18,02	10,20 10,44 10,31	9,90 8,28 8,13	4,01 4,23 4,00	4,57 4,81 4,42	6,56 7,29 6,68	2,10 2,01 2,20	2,23 2,17 2,33
4	17,98 18,78 17,24	20,13 19,82 20,11	11,55 12,01 11,85	7,63 8,13 7,93	8,75 8,92 8,70	9,11 8,40 8,27	1,81 1,80 2,10	2,3 2,22 2,31
5	19,09 18,68 18,30	10,82 10,61 10,75	9,39 10,03 9,60	4,84 4,64 4,84	5,12 4,82 4,84	7,45 6,97 7,32	1,90 2,01 2,20	2,11 2,20 2,22

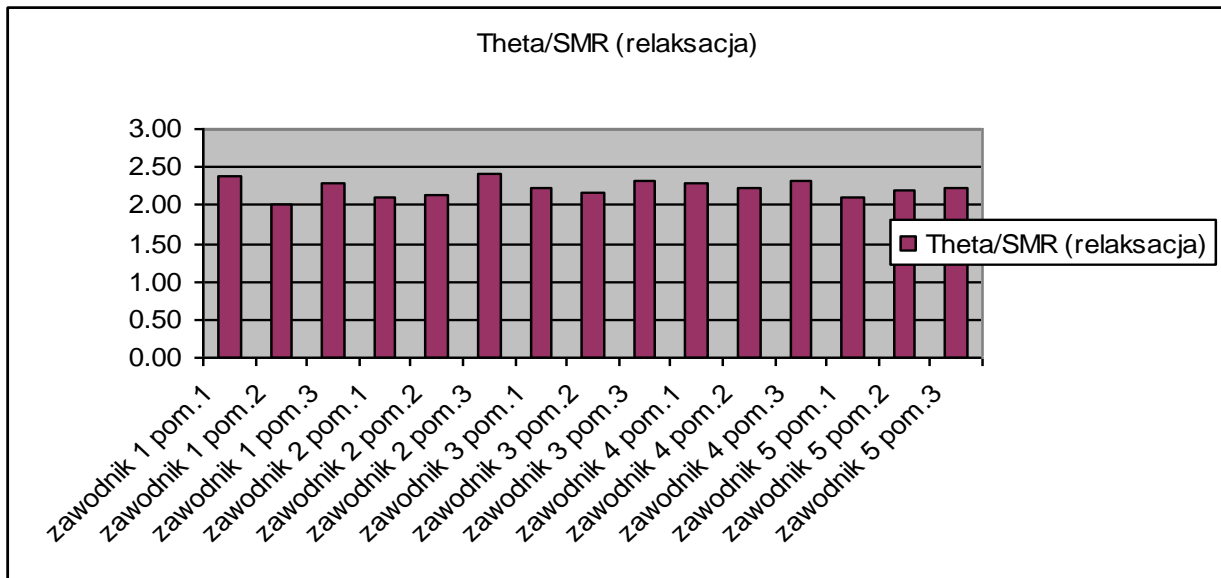
Source: own data collection

Fig. 7 Concentration session results (Male Junior Players)



Source: own data collection

Table 8 (Male Junior Players)



Source: own data collection

Table 8 Recruiting group: Girls [N=5]

Item no.	Weight [kg]	Height [cm]	BMI
Female player 1	49	152	15
Female player 2	41	150	11
Female player 3	50	151	16
Female player 4	47	149	14
Female player 5	45	146	13

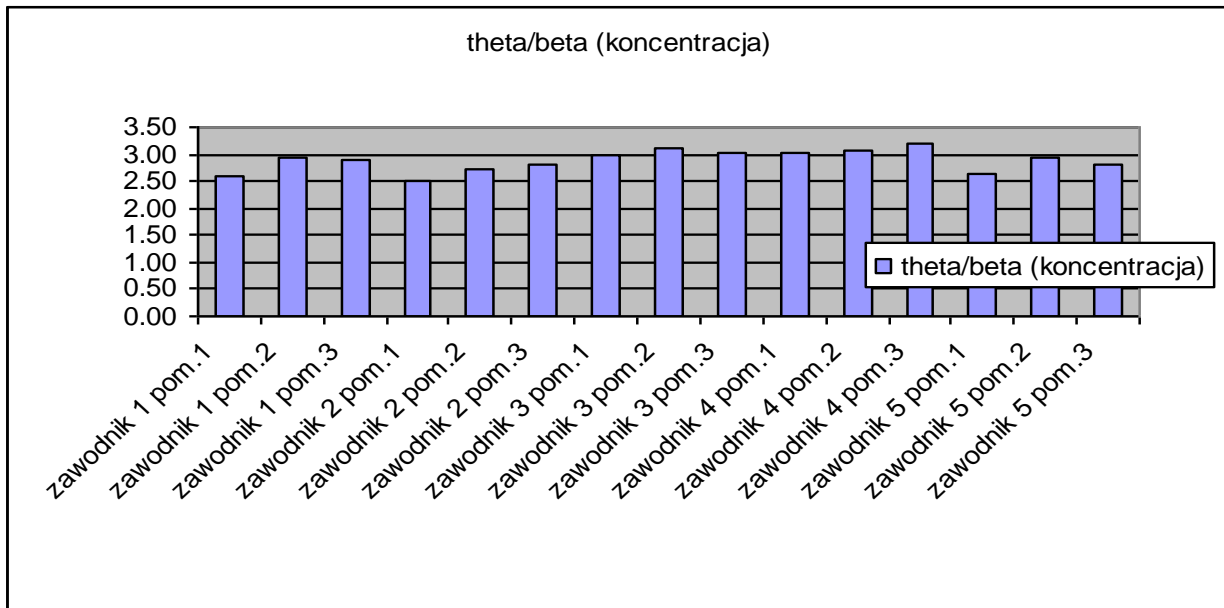
Source: own data collection

Table 9 Brain wave amplitude specification (Recruiting group: Girls)

	Delta <20 uV	Theta do 10 uV	Alfa <10 uV	SMR ok. 10 uV	Beta 1 5-10 uV	Beta2 10-12 uV	Theta/Beta (concentration)	Theta/SMR (relaxation)
1	19,41 18,42 17,91	16,94 15,17 16,40	7,34 7,89 8,16	5,38 4,62 5,44	6,49 5,19 5,67	9,26 9,09 8,97	2,61 2,92 2,89	3,09 3,28 3,01
2	17,62 16,65 16,81	10,11 10,72 10,83	10,75 9,26 9,54	3,54 3,60 4,16	4,04 3,95 3,84	7,76 8,21 8,43	2,5 2,71 2,82	2,85 2,97 2,60
3	14,20 15,72 14,93	14,20 14,44 14,31	6,94 7,81 7,56	4,17 4,41 4,64	4,76 4,67 4,75	8,21 7,99 8,13	2,98 3,09 3,01	3,40 3,27 3,08
4	17,09 18,50 18,14	21,13 22,82 21,11	9,80 8,97 9,23	5,86 6,63 6,55	7,01 7,40 6,99	8,32 7,28 7,71	3,01 3,08 3,20	3,60 3,44 3,22
5	17,19 18,52 16,30	16,82 16,61 16,75	10,32 9,93 8,61	5,20 5,20 5,77	6,41 5,63 5,93	9,78 9,52 8,66	2,62 2,95 2,82	3,23 3,19 2,90

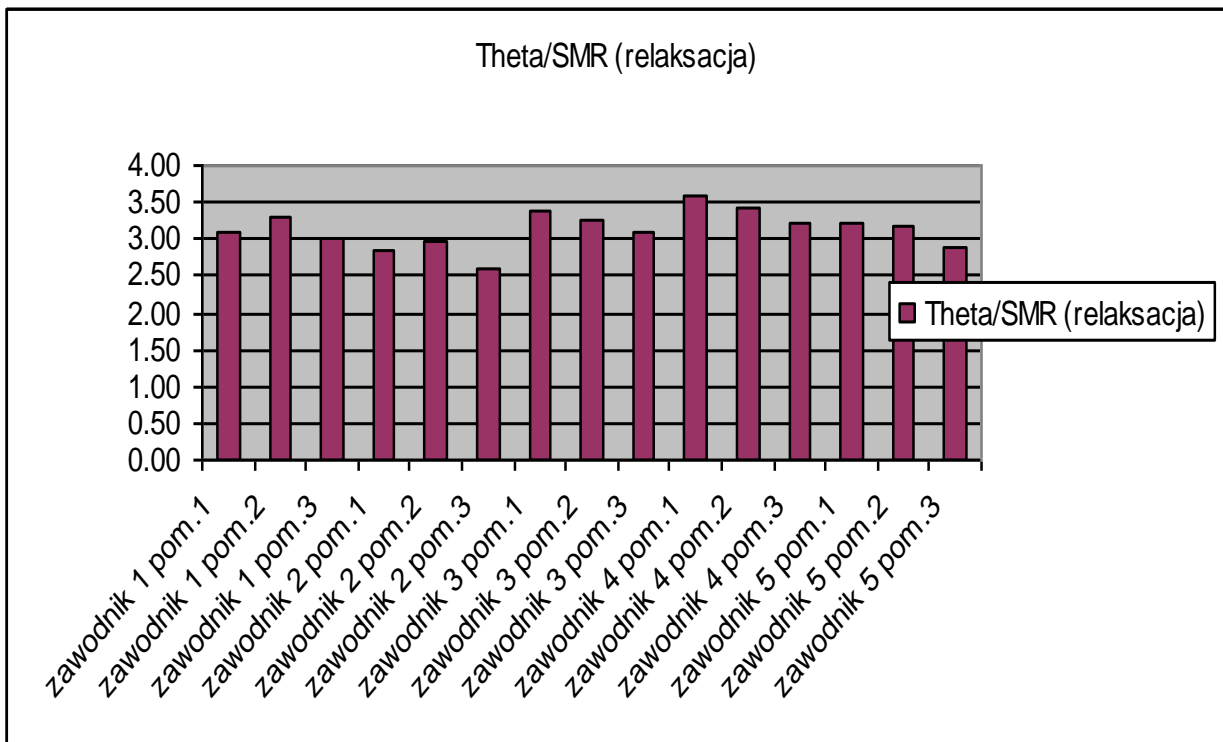
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Fig. 9 Concentration session results (Recruiting group: Girls)



Source: own data collection

Fig. 10 Concentration session results (Recruiting group: Girls)



Source: own data collection

Table 10 Recruiting group: Boys [N=5]

Item no.	Weight [kg]	Height [cm]	BMI
Male player 1	42	153	12
Male player 2	84	168	42
Male player 3	40	147	11
Male player 4	43	150	12
Male player 5	42	151	12

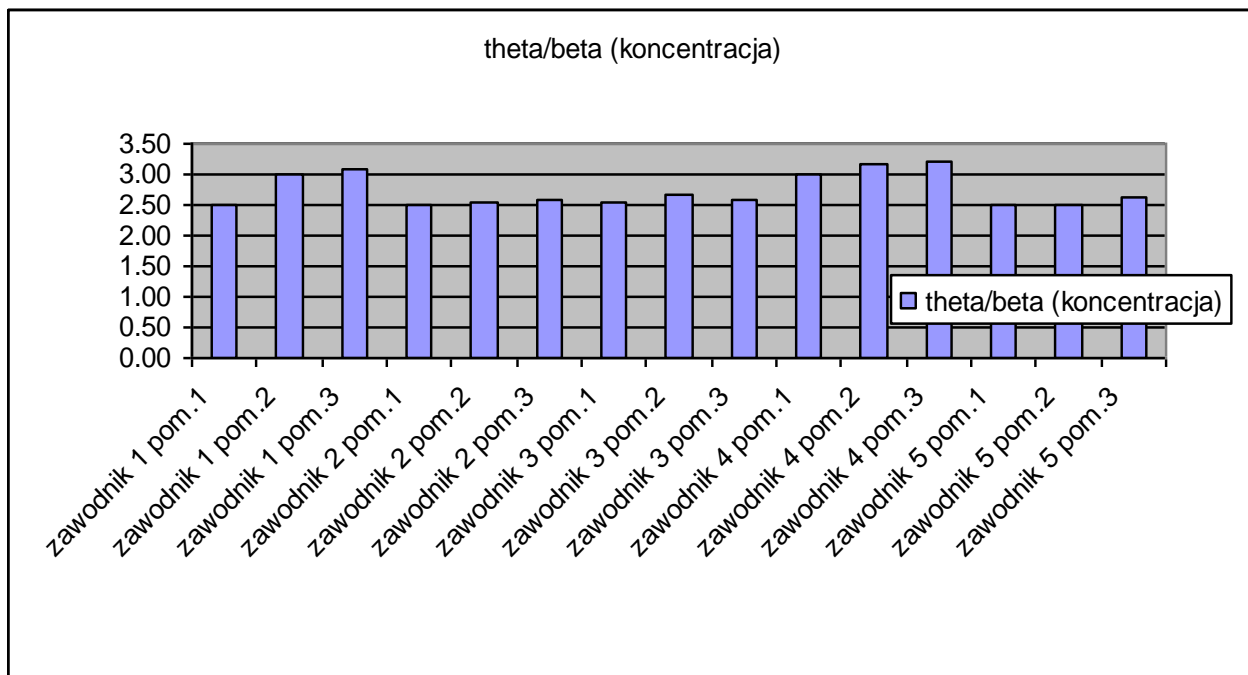
Source: own data collection

Table 11 Brain wave amplitude specification (Recruiting group: Boys)

	Delta < 20 uV	Theta do 10 uV	Alfa <10 uV	SMR ok. 10 uV	Beta 1 5-10 uV	Beta2 10-12 uV	Theta/Beta (concentration)	Theta/SMR (relaxation)
1	18,45 17,86 18,01	14,94 15,17 14,40	6,99 7,33 8,04	4,65 4,77 4,78	5,95 5,09 4,67	9,34 8,29 8,56	2,51 2,98 3,09	3,21 3,18 3,01
2	16,63 17,15 15,88	8,11 7,72 8,83	11,17 8,93 9,73	3,06 2,95 3,39	3,24 3,03 3,42	7,98 8,31 8,62	2,50 2,54 2,58	2,65 2,61 2,60
3	15,61 17,34 16,85	10,20 10,44 10,31	7,63 8,39 8,25	3,64 3,67 3,84	4,00 3,93 3,99	8,15 8,61 8,27	2,55 2,65 2,58	2,80 2,84 2,68
4	19,43 20,95 19,03	20,13 19,82 20,11	10,49 11,17 9,98	5,59 5,93 6,02	6,66 6,29 6,28	8,41 6,94 7,29	3,02 3,15 3,20	3,60 3,44 3,34
5	16,69 17,82 17,22	10,82 10,61 10,75	9,59 10,20 11,34	4,14 3,90 4,13	4,32 4,22 4,10	7,45 6,86 7,35	2,50 2,51 2,62	2,61 2,72 2,60

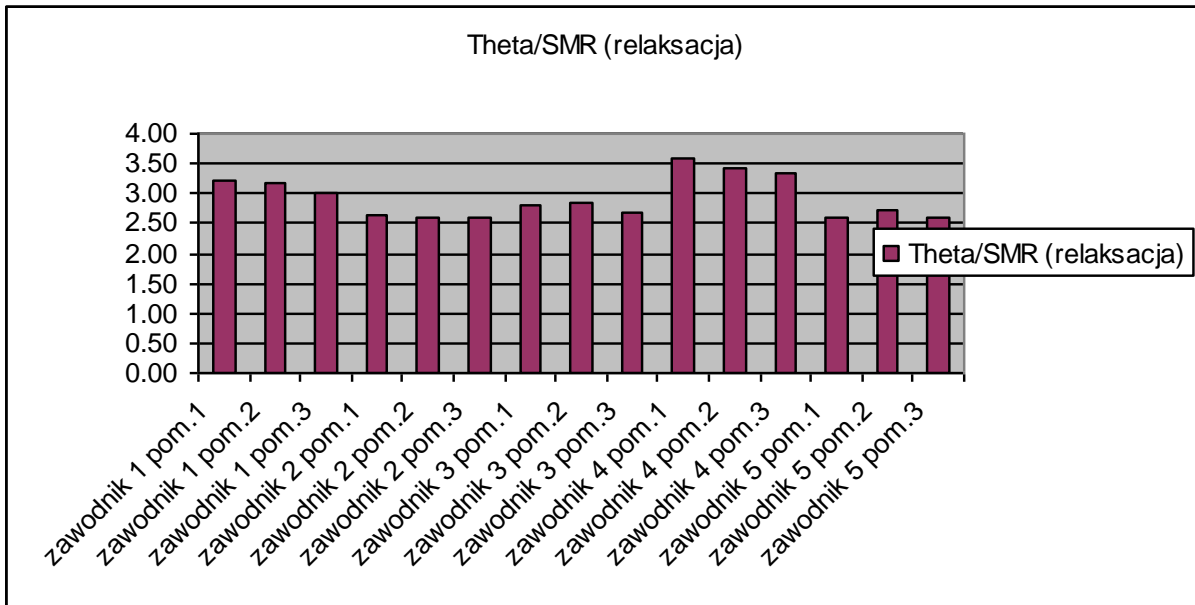
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Fig.11 Concentration session results (Recruiting group: Boys)



Source: own data collection

Fig. 12 Concentration session results (Recruiting group: Boys)



Source: own data collection

CONCLUSIONS

By analyzing the research results, their most spectacular area has been presented due to arouse interest in the subject on the part of the widest possible audience of professionals in the field of competitive sport. The results analysis revealed a variety of areas to be studied from a perspective of their usefulness for sport. (in sports training sessions)

On the basis of research (measurements) and their results analysis one can (undoubtedly) conclude that the applied equipment measures the brainwave parameters the patterns of those can be separately determined for each research group, indicating the direction of these changes. Tests used in the process of sports training in archery showed that along with raising the result and sporting level the ability to concentrate and relax expressed the appropriate ratio increases:

The concentration measure is:

Concentration= theta/beta

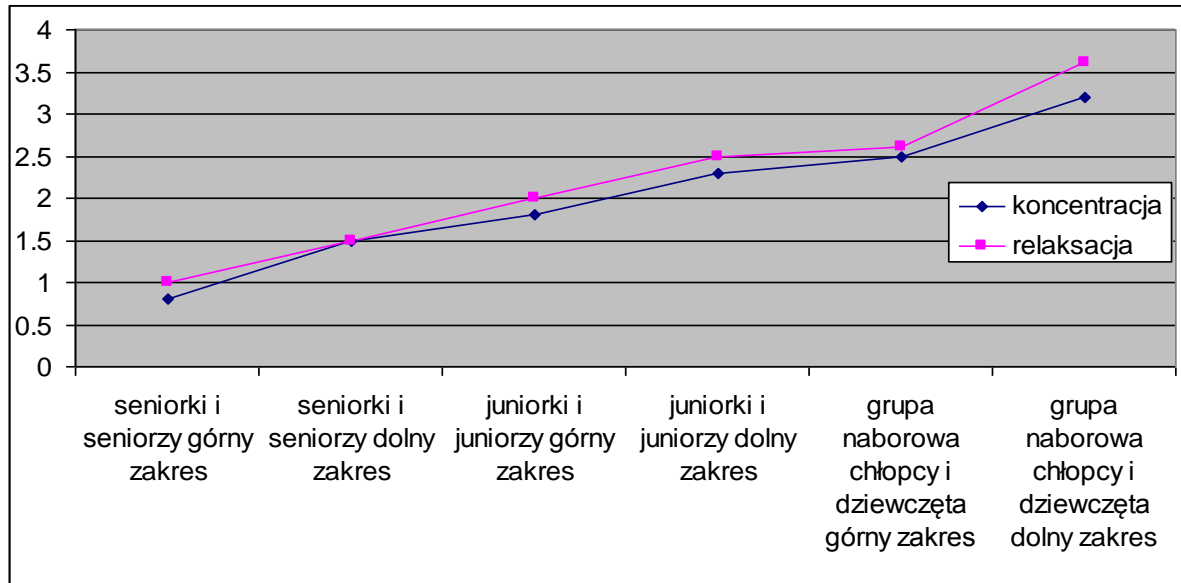
The relaxation measure is:

Relaxation=theta/SMR

Table 12 Direction and scope of changes in the model [avg.N=5]

Tested ability	Male and Female Senior players	Male and Female Junior players	Recruiting group: boys and girls
Concentration	0,8-1,5	1,8-2,3	2,5-3,2
Relaxation	1-1,5	2,0-2,5	2,6-3,6

Fig. 13 Direction and scope of changes in the model [avg.N=5]



The results presented in the chart above show that they are consistent with the objectives of sports training or raising the level of concentration and the ability to relax (expressed by means of decreasing value ratio) is in the process of sports training in archery for the given groups. Also, it should be noted that such complete explicitness of the results surprised even the authors of the paper when taking into account the existing ability to quickly improve parameters in the process of training with EEG biofeedback.

On the basis of the above results it can be concluded that the method is of extreme usefulness and that the concentration and relaxation level is coachable. EEG biofeedback equipment and training with its use could be the basis (one of the elements) for selection and assessment of the level of individual training in concentration and relaxation. However, the results achieved within age groups were arranged by sports advancement which was one of the research hypotheses.

Nevertheless, the problem requires a throughout analysis by means of scientific methods. The results show that the level of concentration and relaxation is the result of sports training experience, fitness level and the achieved results.

On the basis of research analysis, one can propose a thesis that gender and environmental factors have no greater influence on the development of these capabilities in the training process. It should be also noted that the use of existing training methods in the process of sports and ontogenic development can cause trainers and coaches some technical problems due to the fact that it requires a long period of controlling the method that is nowadays more suitable for therapists and people with experience in psychiatric and psychological work rather than sports training.

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