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STUDY ON THE PERCEPTION OF ATHLETES IN THE NATIONAL AEROBIC GYMNASTICS TEAM ABOUT THE EXECUTION OF TECHNICAL DIFFICULTY ELEMENTS

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Abstract: *Aerobic gymnastics, as a sports branch that highlights the practitioner's complex behavior, creates a wide field of investigation which associates both objective and subjective aspects. This study aims to identify the subjective echo of learning and executing technical elements over the performers, namely their perception about how they are aware of the movement and control it, and also how perception is influenced by variables such as age, gender, sports experience and performance level. To this purpose, a 21-item opinion questionnaire was developed and applied to a number of 25 subjects, members of the national aerobic gymnastics team of Romania.*

The study has practical valences, meaning that the information collected from questionnaire was used to design a programme for correcting typical execution mistakes according to the gymnasts' individual particularities. The obtained results imperatively require to approach in preparation some sequences/time for reflection, during which the repeated elements should be brought to discussion by the coach, each athlete providing feedback as regards the psychological pattern used, sensations felt, individual predictive aspects.

Key words: *perception, aerobic gymnastics, technical elements, training*

Introduction

Performance aerobic gymnastics is a spectacular technical-combinative sport, with complex kinematic elements that exert the athlete's body close to the limit. Competition routines must contain combinations of basic steps and arm movements, all performed to music for creating dynamic, rhythmic and continuous sequences, with changes in the level of execution.

The structure of an aerobic gymnastics routine leads to meeting the *difficulty criteria, artistic and execution-related ones* (Bota, Mezei, Bidiugan, 2014). The ten difficulty elements in the structure of a routine belong to the four fundamental groups: **A –**Dynamic strength, **B –**Static strength, **C –**Jumps and Leaps, **D –**Balance and Flexibility, which are reflected in the quality/accuracy of movement and expressiveness in the execution of artistic-motor act.

Technical preparation involves not only acquiring certain elements, but also perceptive or decisional-type learning (Dragnea, Teodorescu, 2002), useful when reaching higher preparation levels, which have actually represented the premises of our study. These types of learning should be approached homogeneously and progressively (Magill, 1998; Swinnen, 1996; Newell, 1991), obviously with particular notes, depending on the characteristics of each athlete.

In performance aerobic gymnastics, explanatory models of motor control (Schmidt, 1991; Gentile, 1972) provide interesting information on how the gymnast is aware of the movement, the main difficulty consisting in the complexity of actions that simultaneously engage the body segments on different directions, planes and axes, which requires the neuromuscular system to be able to structure and transmit various nervous commands to certain muscle groups recruited selectively, concomitantly or successively.

In this paper, we are concerned with the behavioral area of the learning process, which explains how technical execution can be controlled, as well as the source of possible errors that occur sometimes in both training and competition. These situations involve understanding the influence of feedback (Jordanova, 2005) from the coach or by means of a motion analysis device, and also how muscles and joints are coordinated during movements using a set of intrinsic and extrinsic information. In this context, the gymnast is no longer considered a

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mere mimetic performer, but a processor of information, including the one perceived after making a mistake.

Several authors (B. Cratty, 1973; B. Abernethy, V. Kippers, L. Mackinnon, M. Pandy, 2005; R. Schmidt, T. Lee, 2005) have imagined models that describe and explain how the nervous structure operates to adjust voluntary movements and the dynamics of this process. It is worth noting the aspects related to information processing, the relationship between attention and performance, the sensory and central contributions to achieving motor control.

A critical analysis of specialized literature reveals that the training lesson should represent a continuous source of information/instructions "localized" at different levels: some pieces of information have as source of origin the athlete's body, while others come from the coach or other observers; instructions have different timing as regards execution of the respective movement; practice demonstrates that the coach may indicate either ante-factum a sensory-perceptive objective that helps the athlete to successfully solve the "critical phase" of the practiced element, or post-factum, when the athlete is asked to describe the global sensations felt while performing the element; information may have the goal to increase motivation in the preparation process or make the athletes aware of their success or failure during execution, compared to a certain standard imposed by the Regulations; benchmarks can be designed to be transmitted through one or more sensory channels – demonstration (visual one), explanation (verbal-auditory one), manual guidance and practice while monitoring and objectifying the performed movement (proprioceptive-kinesthetic one).

Methodology

The purpose of this study is to identify the subjective echo of learning and executing technical elements over the Romanian athletes participating in major competitions organized for aerobic gymnastics.

In this context, *we were interested in associating technical preparation methodology with the identification of national team gymnasts' perceptions.* The occurrence of typical execution errors has led us to also reflect on the subjective perception of athletes related to the global sensations felt while executing technical elements, as relevant information that can be included in our further approaches to training.

Subjects of the research

Investigation included 25 gymnasts, members of senior teams between 2012 and 2015. They were applied the questionnaire in the month of September 2014, at the end of some training lessons conducted within the "Lia Manoliu" National Sports Complex.

Subjects agreed to be part of the study, showing their interest in the topic addressed.

Research methods used

Pedagogical observation (Peretz, 2002; Cerghit, 1997) aimed at finding: the athletes' concentration level in the preparatory phase of the element; how each athlete has created or not his/her own way of handling the respective element, his/her own formula for success; execution compliance with the ideal model, in terms of attitude, technical details, during the three movement phases (preparatory phase, flight and landing); the athletes' level of psycho-affective involvement in the execution; the degree of fatigue and the moment of its onset in the training lesson or during a competition routine.

Questionnaire-based survey method

The questionnaire (Rotariu, Iluț, 2006; Miftode, 1995) included 21 items out of which 4 introductory questions, 4 general questions about the specificity and difficulty of sports branch/ events, 10 specific questions about the sensations and perceptions accompanying execution of the two technical elements and 3 questions suggesting possible solutions to improve technical preparation.

The questionnaire is made up of open, unscaled questions, in which subjects had the freedom to express their opinions without the risk of suggestibility, they being offered variants of responses.

Processing methods and graphical-analytical interpretation

The responses of subjects were coded and entered into the statistical analysis software program SPSS (Labăr, 2008), so that data processing could provide a variety of analyses (Babbie, 2010; Epuran, 2005), allowing to extract as much information as possible from the responses received. We think that the combination of qualitative research with quantitative data analysis (Chelcea, 2007; Iluț, 1997) enhances the identification of all information of interest for this study, because statistical analysis provides a description of each variable in the conducted research.

Results obtained from applying the opinion questionnaire and their interpretation

In order to gather relevant data, we have chosen a qualitative-type research, because it enables an in-depth understanding and description of how the

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athletes perceive technical elements. Predictions resulting from data analysis can thus prove their validity in the training and competitive environment.

The construction of questions has a qualitative character, mainly including nominal and ordinal variables that offer the possibility to obtain personal responses, with direct reference to the practice and experience of each athlete.

The first indicator of interest in this research is the age of participants, which is analyzed as a quantitative variable. In the frequency table, it can be noted that the value with the highest frequency in this distribution is 17, which suggests that the majority of respondents are aged 17 years. The highest value is 28 years, and the average age is 19 years.

Table1 ***Statistical data regarding the age of respondents***

Statistics		
Age of respondents		
N	Valid	25
	Missing	0
Median		19.00
Mode		17
Minimum		15/17
Maximum		28

The sample included subjects from two generations of athletes, whose particularity was their belonging to two age stages, namely adolescence and young adult periods. This aspect involves several variables related to functional indicators, exercise capacity, level of psycho-emotional function, expressive maturity, level of awareness of the rigors in the preparation process etc.

Table 2 ***Statistical data regarding the age of respondents***

Age of respondents					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15	1	4.0	4.0	4.0
	17	7	28.0	28.0	32.0
	18	3	12.0	12.0	44.0
	19	3	12.0	12.0	56.0
	21	3	12.0	12.0	68.0
	22	1	4.0	4.0	72.0
	23	4	16.0	16.0	88.0
	26	1	4.0	4.0	92.0
	28	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

Another indicator of interest analyzed in this research refers to each athlete's seniority in performance sports. This indicator highlights the nature of participants' experience and confirms its importance in formulating opinions about technical execution of difficulty elements. We can note that the average years of practicing performance sports is 10 years, most athletes practicing sports for 8, respectively 10 years, the highest value being 24 years.

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Table 3 ***Statistical data regarding seniority in performance sports***

Statistics

Seniority in performance sports

N	Valid	25
	Missing	0
Median		10.00
Mode		8[a]
Std. Deviation		4.723
Minimum		6
Maximum		24

a. Multiple modes exist. The smallest value is shown

Seniority in performance sports

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6	1	4.0	4.0	4.0
	7	1	4.0	4.0	8.0
	8	5	20.0	20.0	28.0
	9	1	4.0	4.0	32.0
	10	5	20.0	20.0	52.0
	11	2	8.0	8.0	60.0
	13	1	4.0	4.0	64.0
	14	2	8.0	8.0	72.0
	15	1	4.0	4.0	76.0
	16	2	8.0	8.0	84.0
	17	1	4.0	4.0	88.0
	20	1	4.0	4.0	92.0
	21	1	4.0	4.0	96.0
	24	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

Another important aspect is related to the results achieved by the athletes in their careers. We think that this element is suggestive because, on the one hand, it provides better knowledge of respondents as subjects, and on the other hand, it may reveal the extent to which the results, the performances achieved in their careers match with the responses they are to give. We notice, in the contingency table, that 13 respondents are medalists at the World Championships, 15 are medalists at the European Championships, 10 at the World Games and 14 gymnasts at the World Cup stages.

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Table 4 ***Statistical data regarding the sports results of respondents***

Gender of respondents* sports carrier achievements- Crosstabulation

Count

		Sports carrier achievements					
		World Championship Medalist	European Championship Medalist	World Games Medalist	World Cup Medalist	National Championship Medalist	Total
Gender of respondents	Male	5	5	5	7	9	31
	Female	8	10	5	7	15	45
Total		13	15	10	14	24	76

Identification of crucial elements for the investigated group was followed by some general questions directly related to the technical element studied. Analyzing the following 3 frequency tables, where respondents listed three elements for which they received penalties for *execution* in recent competitions, we noticed that the *Air Turn* (Straight Jump 540^0 Turn) and *Cossack Jump Turn* elements were nominated 12 times. Besides the two elements the most frequently listed as technical elements penalized according to *execution* criterion, the third place was taken by the Pike Jump element, which received 11 nominations.

Table 5 ***Statistical data regarding the perceived difficulty of the groups of technical elements***

Gender of respondents * group of elements considered to be difficult- Crosstabulation

Count

		Group of elements considered to be difficult				
		Dynamic strength	Static strength	Jumps and Leaps	Balance and Flexibility	Total
Gender of respondents	Male	2	3	0	4	9
	Female	7	8	1	0	16
Total		9	11	1	4	25

The statistically processed results for this item reveal an interesting and significant aspect for the purpose of this preliminary research. Independently of having chosen for our study the difficulty element C.105, we can find that specific skills in group C are the most frequently listed by the athletes.

Although this group has not been nominated as a difficult one (to the previous item), however the athletes admit that the most frequent execution mistakes are found in the *Jumps group.*

Table 6 ***Statistical data regarding the penalties received for technical elements, according to Execution criterion***

Technical elements that received penalties according to execution criterion					
		Frequency	Percent	Valid percent	Cumulative percent
Valid	free illusion to free vertical split	2	8.0	8.0	8.0
	2/1 air turn	4	16.0	16.0	24.0
	1/1 turn Cossack jump	3	12.0	12.0	36.0
	1/2 turn pike jump 1/2 twist to push up	6	24.0	24.0	60.0
	1/1 turn straddle jump to push up (Susunova)	1	4.0	4.0	64.0
	straddle planche to lifted Wenson	1	4.0	4.0	68.0

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	straddle support	5	20.0	20.0	88.0
	high V- support reverse cut 1/2 twist to split	1	4.0	4.0	92.0
	explosive A- frame to Wenson	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

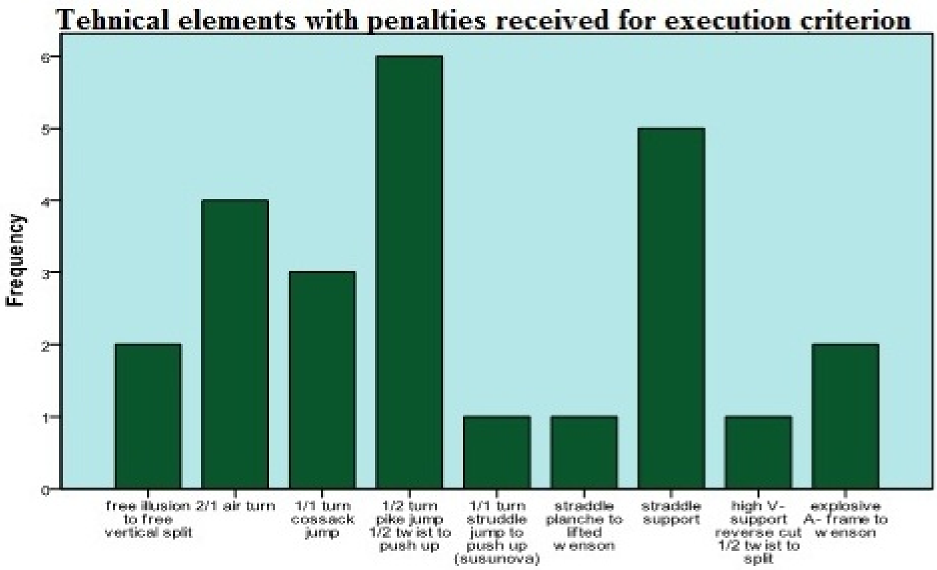

Fig. 1 ***Distribution of technical elements that received penalties***

The Pike Jump element, listed 1st, is also included into the *Jumps* group*,* having the same biomechanical structure of swing phase as element C.105. Flight phase is also performed with rotation around the vertical axis, which involves the same mechanism of ante-factum movement adjusting and the same possibilities of generating an execution error, especially in the swing phase.

The following items mainly analyze element **C.105 - Air Turn**, the first variable of interest being related to its phase that requires the highest mental concentration, namely the swing, as considered by the respondent.

Table 7 ***Statistical data regarding the phases of elements requiring intense concentration***

Phase of element C.105 that requires the most intense concentration					
		Frequency	Percent	Valid Percent	Cumulative percent
Valid	Swing	12	48.0	48.0	48.0
	Flight phase	6	24.0	24.0	72.0
	Landing	7	28.0	28.0	100.0
	Total	25	100.0	100.0	

Athletes are aware that, for this jump, the body position does not present changes in its form during the flight phase, but only involves an increased rotation speed, which, theoretically, is correctly perceived by the respondents.

To have an even more accurate picture of how the element frequency has been achieved, we associated this variable with the gender variable, therefore we can notice that 4 of the 9 male respondents consider the swing as the element phase that requires the highest concentration, and 8 of the 16 female respondents share the same opinion.

Table 8 ***Statistical data regarding the phases of elements that require intense concentration, by gender***

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Gender of respondents * phase of element C.105 that requires the most intense concentration- Crosstabulation

Count

		Phase of element C.105 that requires the most intense concentration			Total
		Swing	Flight phase	Landing	
Gender of respondents	Male	4	4	1	9
	Female	8	2	6	16
Total		12	6		25

We also notice that landing represents the element phase requiring intense concentration only for female respondents, 6 of the 8 gymnasts ticking this response.

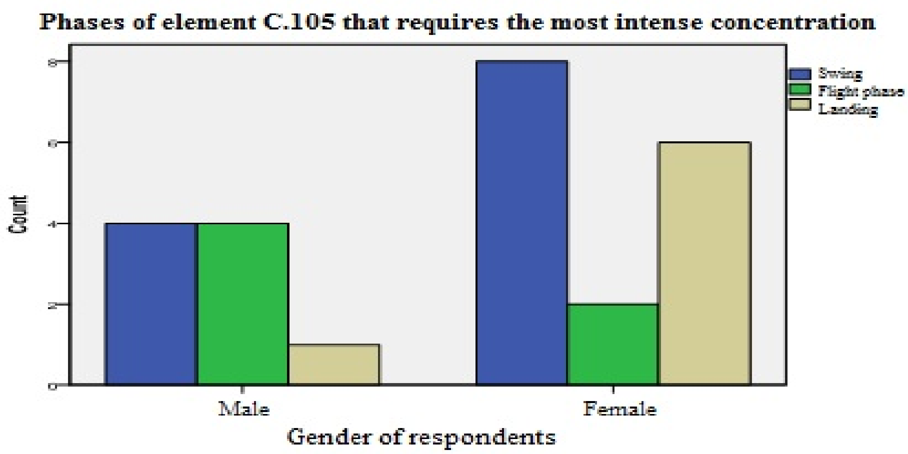

Fig. 2 ***Distribution of intense concentration phase, by gender***

The next variable refers to the frequency of execution mistakes in the phases of element C.105 - Air Turn. It can be noted that the phase where most mistakes are made is that of swing, 13 of the 25 gymnasts ticking this response.

Table 9 ***Statistical data regarding the phase of technical elements where execution mistakes occur frequently***

		Frequency	Percent	Valid Percent	Cumulative percent
Frequency of execution mistakes when performing element C.105					
Valid	Swing	13	52.0	52.0	52.0
	Flight phase	2	8.0	8.0	60.0
	Landing	10	40.0	40.0	100.0
	Total	25	100.0	100.0	

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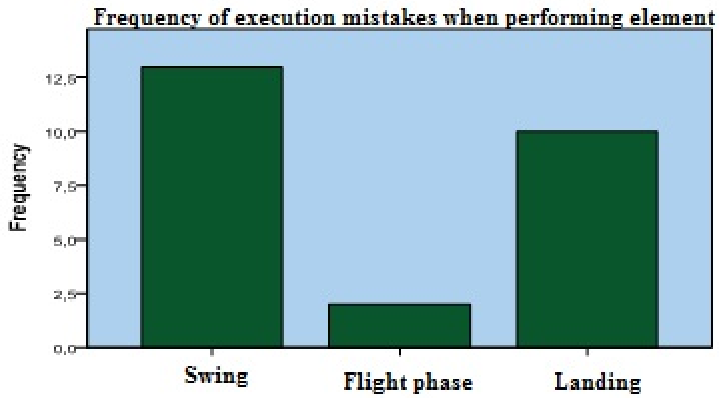

Fig.3 ***Distribution of occurred execution mistakes in the three phases of technical element***

Athletes believe, to an almost equal extent, that execution errors frequently occur in the swing phase and landing phase, which is also confirmed by the judging sheets. Actually, the judge can penalize both the first and last phase, the two movement sequences being in influential relationships.

In the table below, we correlated two variables, namely the phase requiring the most intense concentration and the phase during which most execution mistakes occur, in order to see if there is a positive association between them, more exactly if they influence each other.

According to the correlation coefficient value of 0.614 shown in the table below, we note that there is a positive association between the two variables, which suggests that those who consider a certain phase of the element as requiring the most intense concentration also consider it as the phase where they make the greatest number of mistakes. The lowest values of the variable *phase of element C.105 that requires the most intense concentration* correspond to the lowest values of the variable *frequency of execution mistakes when performing element C.105*. Given that the correlation coefficient can be calculated between two numerical variables, we coded the "swing", "flight phase" and "landing" values of the two ordinal variables with conventionally-chosen numerical values, namely 1, 2 and 3, in order to measure the relationship between the two variables. The result of SPSS statistical analysis indicates the existence of a positive correlation between the two variables, which helps us make certain predictions and facilitates our exploration and a more accurate knowledge of the defining components in the execution of element *C.105 - Air Turn*.

Statistical correlation is highly significant for a threshold of 99%.

Table 10 ***Statistical data regarding the correlation between mental concentration required and frequency of execution mistakes occurred***

Correlation

Variables		Phase of elementC.105 requiring the most intense concentration	Frequency of execution mistakes when performing element C.105
Phase of elementC.105 requiring the most intense concentration	**Pearson Correlation**	*1*	*.614***
	Sig. (2-tailed)		*.001*
	N	*25*	*25*
Frequency of execution mistakes when performing element C.105	**Pearson Correlation**	*.614***	*1*
	Sig. (2-tailed)	*.001*	
	N	*25*	*25*

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The variable related to the factors leading to execution mistakes for element C.105 - Air Turn reveals, according to the frequency table below, that the lack of concentration is the main factor leading to execution mistakes, 11 of the 25 gymnasts ticking this response.

Table 11 ***Statistical data regarding the factors leading to execution mistakes***

Factors leading to execution mistakes for the technical element C.105					
		Frequency	Percent	Valid Percent	Cumulative percent
Valid	Lack of concentration	11	44.0	44.0	44.0
	Inappropriate movement pattern	8	32.0	32.0	76.0
	Element inclusion into the choreographic composition	6	24.0	24.0	100.0
	Total	25	100.0	100.0	

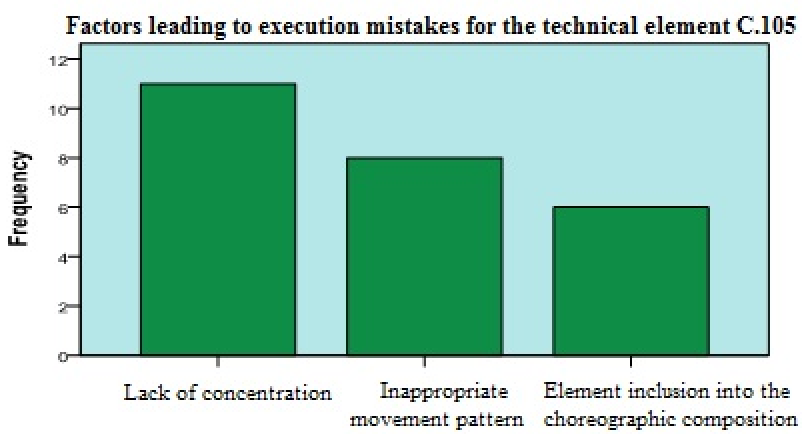

Fig. 4 ***Distribution of factors leading to occurrence of execution mistakes***

The analysis of factors leading to execution errors shows a hierarchy indicating that lack of concentration is on the 1st place, inappropriate movement pattern is on the 2nd place, and element positioning within the routine, on the 3rd place. Responses to this item correlate with those that aim at the phase requiring the most intense concentration. Improper learning of execution technique is another reason listed by the respondents, which involves the need to apply programmes designed for correcting and properly learning the respective motor skill.

To item 13, relating to the aspects on which the gymnast focuses when performing the element, we have noticed that the majority of subjects generically nominate only the swing and landing phases, without taking into account the flight and implicitly the body position in the air, which should be felt specifically by each gymnast. We could say that many times the athletes are not aware and do not internalize sufficiently the corrections of coaches, purposely directed to these aspects.

The next question refers to the number of repetitions that each respondent performs during a training lesson for the two elements, being followed by an item referring to the optimal number of repetitions that should be performed for each element, in the opinion of respondents. It can be noted from the table below that there is a minimum of 5 repetitions for the 4 numerical variables mentioned in the questionnaire and a maximum of 20 repetitions for the number of repetitions performed during the training lessons, for element C.105.

As regards the optimal number of repetitions that should be performed for both elements, the subjects indicated a maximal number of 40 repetitions, twice more than the maximal number of repetitions that they normally perform during training.

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Table 12 ***Statistical data regarding the number of repetitions performed and the optimal number of repetitions for the technical element***

Descriptive statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Number of repetitions performed for element C.105	25	5	20	11.60	3.640
Optimal number of repetitions that should be performed for element C.105	25	5	40	15.64	7.675
Valid N (listwise)	25				

The contingency tables below show the distribution of the number of repetitions performed, as well as those considered to be optimal for each element, in the opinion of respondents, by gender. It is noticed that male respondents perform a greater number of repetitions for both elements, and as regards the number of repetitions considered to be optimal, the male respondents also opt for a greater number of executions.

Table 13 ***Statistical data regarding the number of repetitions performed, by gender***

Gender of respondents * number of repetitions performed for the technical element C.105 - Crosstabulation

		Number of repetitions performed for the technical element C.105								
		5	7	8	10	15	16	17	20	Total
Gender of respondents	Male	1	0	0	5	2	0	0	1	9
	Female	0	2	1	7	4	1	1	0	16

The different number of repetitions performed and their optimal number for girls and boys can be argued by the increased level of explosive strength of the latter, which favors economical energy consumption and the possibility to perform a greater volume of repetitions. In their turn, the female gymnasts accuse overstrain symptoms in the lower limb joints, also caused by the characteristics of the hard surface on which they work.

We considered it interesting to find if the age of respondents interferes with the number of repetitions they perform. From the correlation table below, it is noted that there is a positive association between the age of respondents and the number of repetitions, younger respondents performing a smaller number of repetitions, while older respondents, an increased number of repetitions. It is also noted that this correlation is stronger for element C.105, which suggests that respondents perform a different number of repetitions for the two elements, according to age.

Table 14 ***Statistical data regarding the correlation between the number of repetitions performed, by age/ element C.105***

		Age of respondents	Number of repetitions performed for the technical element C.105
Age of respondents	Pearson Correlation	1	.107
	Sig. (1-tailed)		.305
	N	25	25
Number of repetitions performed for element C.105	Pearson Correlation	.107	1
	Sig. (1-tailed)	.305	
	N	25	25

At the same time, it is noted that the Pearson coefficient value is 0.107 for the correlation between the *age* variable and the variable relating to the *number of repetitions performed for element C.105*.

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Secondly, we can see that the two dependent variables, *number of repetitions performed for element C.105*, show a positive relationship with the *age* variable, but of low intensity, determined by the correlation values close to 0. Statistical significance of the coefficient (Sig.) is 0.01, which suggests that the error probability is negligible, and this analysis is significant for the athletes studied.

The upward direction of point cloud in the positive correlation graph suggests that as one of the variables increases, the other has the same upward trend.

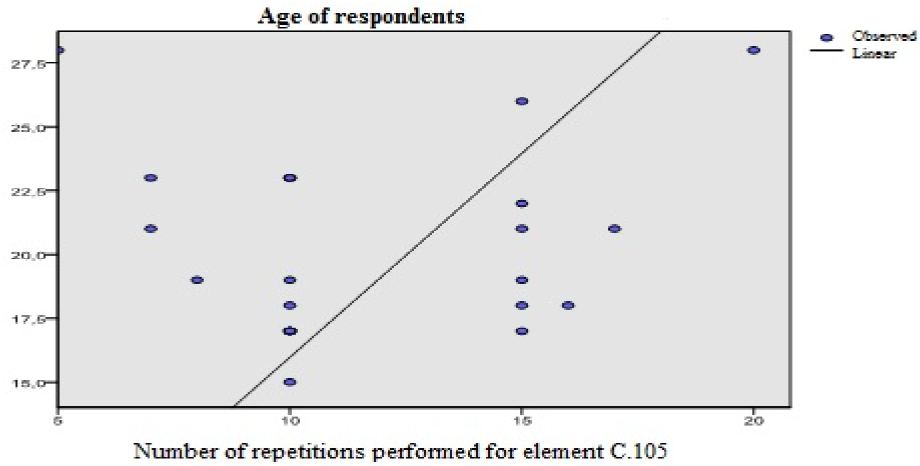

Fig. 5 ***Representation of the correlation between the number of repetitions performed and the age of gymnasts, for element C.105 - 2/1 Air turn***

The explanation for this positive correlation lies undoubtedly in the higher level of maturity of the experienced gymnasts, aware that only the over learning of technical elements reduces the occurrence of execution mistakes and creates the premises for specialized senses, through which gymnasts can detect and finely tune the movement parameters, under stress and fatigue conditions.

A final question refers to how the respondents think that they can eliminate execution mistakes. According to the frequency table below, it can be firmly stated that the use of technique correction exercises in the training lessons is the variant for which most of the respondents have opted.

Table15 ***Statistical data regarding some useful methods to eliminate execution mistakes***

Methods to eliminate execution mistakes					
		Frequency	Percent	Valid percent	Cumulative percent
Valid	using in the training lesson some motion analysis devices that allow visualization of one's own executions	4	16.0	16.0	16.0
	using mental training	1	4.0	4.0	20.0
	using equipment for the biomechanical study of difficulty elements	3	12.0	12.0	32.0
	using technique correction exercises during the training lessons	17	68.0	68.0	100.0
	Total	25	100.0	100.0	

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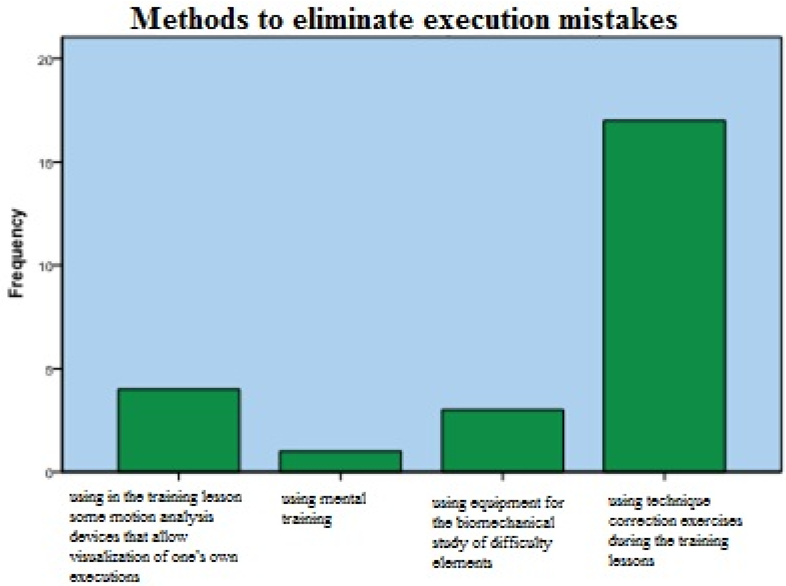

Fig. 6 ***Distribution of methods to eliminate execution mistakes***

As regards the hierarchy of methods to correct execution mistakes, one can clearly notice that the athletes give credit to traditional approaches used in the process of their formation as athletes. It becomes obvious that modern training methodology, which combines biomechanical and psychological approaches, is still insufficiently valued by the subjects, despite the clear advantages they provide.
The obtained results imperatively require to approach in preparation some sequences/time for reflection, during which the repeated element should be brought to discussion by the coach, each athlete providing feedback as regards the psychological pattern used, sensations felt, individual predictive aspects. On the other hand, athletes should become familiar with the benefits of training based on prosthetic information, as a complementary means that adjusts/corrects aspects which usually escape their conscious sphere.

CONCLUSIONS

After the first stages of learning the technique, in aerobic gymnastics it is necessary to create mechanisms able to ensure, through a trans-disciplinary strategy, the perfect motor control of movement.
The 21 items of the opinion questionnaire included general aspects regarding the subjects' sports profile, elements aimed at the specificity and difficulty of sports branch/events, aspects aimed at the sensations and perceptions accompanying execution of the two technical elements and questions suggesting possible solutions to improve technical preparation.
An interesting aspect revealed by statistical calculation refers to the positive correlations between the technical phase/phases that require(s) the most intense concentration and that/those where most execution mistakes are made.
The intrinsic analysis of data regarding the factors that lead to execution mistakes for element C.105 highlights a majority opinion related to the importance of mental concentration and the inappropriate mechanism of performing the two skills.
Information about the number of executions performed and the optimal number of repetitions reflects that the athletes have different approaches, according to their age and gender, which means a more mature understanding of the importance of the practice volume, in the case of experienced gymnasts.
As regards the hierarchy of methods to correct execution mistakes, one can clearly notice that the athletes give credit to traditional approaches used in the process of their formation as athletes. It becomes obvious that

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modern training methodology, which combines biomechanical and psychological approaches, is still insufficiently valued by the subjects, despite the clear advantages they provide.

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