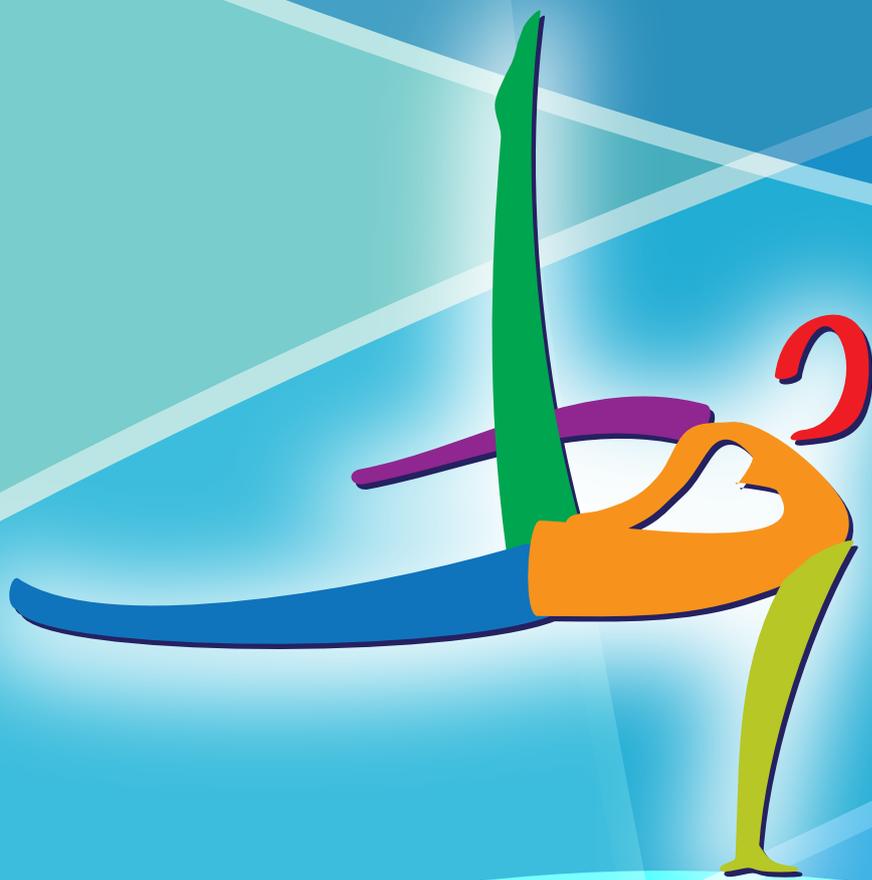


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Science of Gymnastics Journal (ScGYM®)

Science of Gymnastics Journal (ScGYM®) is an international journal that provide a wide range of scientific information specific to gymnastics. The journal is publishing both empirical and theoretical contributions related to gymnastics from the natural, social and human sciences. It is aimed at enhancing gymnastics knowledge (theoretical and practical) based on research and scientific methodology. We welcome articles concerned with performance analysis, judges' analysis, biomechanical analysis of gymnastics elements, medical analysis in gymnastics, pedagogical analysis related to gymnastics, biographies of important gymnastics personalities and other historical analysis, social aspects of gymnastics, motor learning and motor control in gymnastics, methodology of learning gymnastics elements, etc. Manuscripts based on quality research and comprehensive research reviews will also be considered for publication. The journal welcomes papers from all types of research paradigms.

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CONTENTS

Ivan Čuk	EDITORIAL	3
-----------------	------------------	----------

Lauritia Marconi Schiavon Roberto Rodrigues Paes	THE FORMATION OF BRAZILIAN FEMALE GYMNASTS TAKING PART IN THE OLYMPIC GAMES (1980-2004)	5
---	--	----------

José Ferreirinha, Joana Carvalho, Cristina Côrte-Real, António Silva	THE EVOLUTION OF REAL DIFFICULTY VALUE OF UNEVEN BARS ROUTINES FROM ELITE GYMNASTS IN LAST 5 OLYMPIC CYCLES	15
---	--	-----------

Saša Veličković Dragoljub Petković Emilija Petković	A CASE STUDY ABOUT DIFFERENCES IN CHARACTERISTICS OF THE RUN-UP APPROACH ON THE VAULT BETWEEN TOP-CLASS AND MIDDLE-CLASS GYMNASTS	25
--	--	-----------

Marise Botti Juarez Vieira do Nascimento	THE TEACHING-LEARNING-TRAINING PROCESS IN RHYTHMIC GYMNASTICS SUPPORTED BY THE ECOLOGICAL THEORY	35
---	---	-----------

Vasilis Kaimakamis George Dallas Panagiotis Stefanidis George Papadopoulos	THE SPREAD OF GYMNASTICS IN EUROPE AND AMERICA BY PEDAGOGUE-GYMNASTS DURING THE FIRST HALF OF THE 19TH CENTURY	49
---	---	-----------

	SLOVENSKI IZVLEČKI / SLOVENE ABSTRACTS	57
--	---	-----------

EDITORIAL

Dear friends,

last October we attended the World Championship in Artistic Gymnastics in Rotterdam. We had a lot of meetings, but the most important was meeting with the president of the International Gymnastics Federation professor Bruno Grandi. We presented him our work during the last year. At the end of December we have reached agreement about collaboration between FIG and Science of Gymnastics Journal. We have got a new editorial board member –Keith Russell, Ph.D., who is the president of the FIG Scientific Commission and Hardy Fink, M.Sc., a member of editorial board as the director of the FIG Academy. Both FIG institutions – scientific and educational ones will be involved in further development of our journal.

The last issue of Journal was visited by more than 5500 visitors, what gives us a true compliment for our endeavor. However we would also like to have some feedback from you, the readers and researchers, as well. Researchers and authors show their interest in specific topics and their articles are blindly reviewed before publication. But we would like to hear positive or negative opinions about articles, perhaps some suggestions and additional ideas, anything in your opinion beneficial to further research. We will therefore open a forum for visitors to express their views and you are kindly invited to join the forum but also to send letters to the editor whenever feel appropriate. The letters will be published in the journal if judged so by the editor and editorial board.

February issue of the Journal starts with the article on Brazilian women gymnastics development in the last 30 years. Lauritia Marconi Schiavon and Roberto Rodrigues Paes performed a comparative analysis of their Olympic gymnasts sport life. All those federations who are starting with the first steps in gymnastics and want to win medals as soon as possible will highly value this excellent article. It is worth to note again that the coach's expertise is a key point on the way to success. It is always better to learn on somebody's other mistakes than to make your own.

The second article is by Portuguese team of authors Joana Carvalho, Cristina Côrte-Real and António Silva lead by José Ferreirinha. They analyzed evolution of the real difficulty value of uneven bars routines from elite gymnasts in the last 5 Olympic cycles. From their article the coaches can obtain important information about where the routines on uneven bars are headed in the future.

The third article comes from Serbia. Saša Veličković, Dragoljub Petković and Emilija Petković report interesting research dealing with the problem why their gymnasts can not perform the most difficult vaults well. They found the causes to lie in the runway strategy and technique. Sometimes we do forget the runway is the most important part of the vault.

The fourth article is from rhythmic gymnastics and deals with teaching and learning process. Brazilian authors Marise Botti and Juarez Vieira do Nascimento found that the teams investigated presented almost the same structure of trainings and differed only in their teaching methods.

The last article is about the history again. The Greeks Vasilis Kaimakamis, George Dallas, Panagiotis Stefanidou, George Papadopoulos write about the spread of gymnastics in Europe and America by pedagogue-gymnasts during the first half of the 19th century, an overview of era before our time and to whom we have to be grateful for the development of our beloved sport.

I wish you pleasant reading and a lot of inspiration,

Ivan Čuk
Editor-in-Chief

THE FORMATION OF BRAZILIAN FEMALE GYMNASTS TAKING PART IN THE OLYMPIC GAMES (1980-2004)

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Original research article

Abstract

The results of Brazilian women athletes in international level artistic gymnastics competitions have taken evolutionary strides in the last ten years. In search of scientific information to understand this evolution we focused long-term development of Brazilian women artistic gymnasts who participated in the Olympic Games from 1980 to 2004. In order to do so, the qualitative research method of oral history was used. Testimonials were gathered from the ten ranked Brazilian athletes from the Olympic Games in this period of time, to obtain an account of their sporting life. From the field research and testimonials 14 themes emerged and were analyzed: Sport initiation in artistic gymnastics, participation in other sports, the athlete's idols, training facilities, designing training programs, nutritional aspects, psychological aspects, injuries, participation in the Olympic Games, the coach-athlete relationship, parental support, financial situation, important influences and retirement from artistic gymnastics. As a result of this analysis educational guidelines are proposed for long-term athlete development in women's artistic gymnastics.

Keywords: *women artistic gymnastics, Brazil, history, olympic games, long-term development.*

INTRODUCTION

Artistic gymnastics (AG) has experienced an improvement in international results over the last 10 years in Brazil and consequently has received a large amount of media exposure. This has generated an unprecedented growth in gymnastics audiences. AG has therefore become the subject of current discussions, especially among spectators. However, these discussions have not been carried out to the same degree among academic researchers, and the enthusiasm shown by the general population has not been shared by the academic community.

This situation may be due to several factors, such as the lack of studies in this

area, lack of interest in the subject, or the absence of links between university studies and the agencies responsible for the organization of sports. This situation is not only observed in the Brazilian Gymnastics Confederation - CBG (Confederação Brasileira de Ginástica), but also in other sports in Brazil.

Another point which raises discussion on the subject of Brazilian AG is the lack of a preparatory program aimed at coaches. During the period of nine years in which the Ukrainian coaches stayed in Brazil (1999-2008), who clearly helped such fast evolvement of the Brazilian results, there was no training program for Brazilian

coaches in order to prepare them to carry on their work. Therefore, it is possible that without their support our international results may not have been as good as the ones recently obtained, since there was no preparation of national coaches or communication of our training of sports gymnasts formation to continue with future generations.

The lack of communication of this information about the training process of gymnasts in Brazil is corroborated by the lack of national scientific publications on this topic. In other countries, the increase in publications follows the evolution of results.

From the perception of this problem came the doctoral studies of Schiavon (2009). This was entitled "Women's Artistic Gymnastics and Oral History: the Sport formation of Brazilian gymnasts taking part in Olympic Games (1980-2004)". Schiavon's work is summarized in the present article, which aims to search original information from Brazilian researchers and coaches. This is not restricted to quantitative matters of training, but also to qualitative aspects of the preparation of young athletes, which especially in this sport, requires specialization at an early age (around the age of eight), due to the specificities of AG, which are discussed in the course of this study.

The general goal of the research was to understand and report the formation process of the Brazilian women gymnasts who participated in the Olympic Games (OG). The specific goals were to: analyze the sporting life history of the Brazilian women gymnasts who participated in the OG; and provide guidelines that will enable the development of artistic gymnastic athletes in the long-term.

When organizing the research theoretical mark, among other possibilities, references related to sports formation were used and based mainly on authors from countries with tradition in gymnastics (Arkaev & Suchilin, 2004; Platonov, 2004; Smoleuskiy & Gaverdouskiy, 1996; Zakharov & Gomes, 2003). The topics

related to sports formation were organized into 14 themes: identification and sports initiation in gymnastics, participation in other sports, role models, infrastructure on gymnastics training sections, structure and organization of the training; nutritional aspects related to the gymnast career, psychological aspects related to the gymnast career, injuries throughout the sports career, participation in the Olympic Games, coach-athlete relationship, family support and gymnastics, financial conditions in their career, determining influences in their careers and end of their career in gymnastics.

METHODS

For this piece of qualitative research the oral history method was used (Meihy, 2005; Simson, 1988; Simson, 2006; Thompson, 1992). This method collects information from individuals who participated in the important periods of women's artistic gymnastics in Brazil, establishing the formation process of the athletes.

The use of this method is justified mainly due to the fact that there is no documentation of the formation of the gymnasts by means of documents or other published research..

Portelli (1997) stresses that the use of this method highlights the "subjectivity of the speaker" and comments that "oral sources tells us not only what people did, but what they meant to do, what they believed they were doing and what they now think they have done" (p.31).

Of the several techniques available in the oral history method, "oral testimonials" were used for this research. In the oral testimonial, the researcher proposes a theme for organizing the life story of the people under analysis. The study is focused on a given theme, in this case, the "sports life history" of these gymnasts (Queiroz, 1988, p.21).

The criterion established to determine the scope of the study was Brazilian gymnasts who participated (or that were

ranked) for the Olympic Games, in women's artistic gymnastics until 2004.

A total of ten gymnasts took part in the study, and are listed below in chronological order of participation in the Olympic Games: Cláudia Magalhães (1980), Tatiana Figueiredo (1984), Luisa Parente (1988 and 1992), Soraya Carvalho (1996), Daniele Hypólito (2000, 2004 and 2008), Camila Comin (2000 and 2004), Ana Paula Rodrigues (2004), Caroline Molinari (2004), Daiane dos Santos (2004 and 2008) and Laís Souza (2004 and 2008).

The present study was approved by the research Ethical Committee of the Campinas State University Medical School on March 27, 2007, under opinion number: 136/2007.

RESULTS

Analysis was carried out on the data collected during the testimonials given by the participants. Later, gymnast's information was crossed with other gymnasts in order to make it possible to establish relationships between them and, from this point, compare them, considering and paying special attention to the differences and similarities found in the gymnasts' sports formation.

Each of the categories studied was sorted into different files, called topics of analysis, and for which there are testimonials of the gymnasts on the same theme. Each "excerpt" on the gymnast's testimonial was identified with their names and the page from where it was extracted. From this point, analysis and discussions were carried out on the data from the testimonials, based on the information gathered from literature, disagreeing, confirming, or even offering collaboration with new approaches.

The topics for analysis were organized into 14 themes; each of them supplied information for developing the analysis of the testimonials, trying to unveil the key-elements for the sports formation process:

1. identification and Sports Initiation in Gymnastics,
2. participation in other sports,
3. role models,
4. infrastructure on Gymnastics training sections,
5. structure and organization of the training,
6. nutritional aspects related to the gymnast career,
7. psychological aspects related to the gymnast career,
8. injuries throughout the sports career,
9. participation in the Olympic Games,
10. coach-Athlete Relationship,
11. family support and Gymnastics,
12. financial conditions in their career,
13. determining influences in their careers,
14. end of their career in Gymnastics.

Later, in each topic of analysis was performed a grouping of testimonials that were then sorted into three groups:

Group of pioneer gymnasts: This group comprises testimonials from Cláudia Magalhães, Tatiana Figueiredo and Luisa Parente. They were the first gymnasts to represent Brazil in the OG. These gymnasts, compared to the other participants, had less training support in terms of financial, material, and human resources. There was a lack of support in these aspects from both the sports clubs and the Brazilian national team. At that time the Brazilian Gymnastic Confederation (CBG) was not yet adequately structured. These gymnasts were looking to participate in the OG, however had little chance of achieving medals, or even reaching the finals.

Transition group: The gymnasts in this group lived initially without support and structure. Then, at a given moment, similar to what had happened to the pioneer gymnasts, they experienced a second phase with more support. The athletes from this group also participated in the first Brazilian international competitions. This group was comprised of Soraya Carvalho, Daniele

Hypólito, Camila Comin and Daiane dos Santos.

New generation group: Gymnasts in this group joined the sport when there was structure and support in place, and were met with conditions similar to those countries winning medals on the international stage. This group is comprised of: Laís Souza, Caroline Molinari e Ana Paula Rodrigues.

DICSUSION

After the presentation and discussion of the data from these 14 topics of analysis carried out during the doctoral thesis, it was possible to have an overall view of the formation of Brazilian women's gymnasts in the Olympic Games and trigger some reflections about this formation. Some topics could be discussed in depth due to the existing literature, while others, due to poor references, can be discussed for the first time and may be used in future discussions.

Furthermore, there is also a clear view of the difficulties and barriers related to Brazilian gymnasts in different regions of the country, which does not depict nor resemble the organization and support experienced by the Brazilian gymnast team. Such problems, which show a concentration of this sports development in a single location and restricted to certain people, became evident when the data is exposed, not only in Brazil but in other countries and their sports agencies when compared to the Brazil. Some reflections will be highlighted in order to contribute to discussions on the development and improvement of gymnastics in Brazil.

The number of Brazilian adult gymnasts is almost the same as the number of gymnasts required for the national team, which gives the national coaches few options. There are few quality gymnasts developing in the sport, so the same gymnasts remain in the national team for several Olympic cycles. Although sometimes carrying injuries, these gymnasts will compete for their country until other gymnasts are able to replace them. Data

from the American Gymnastics Federation shows that there are two main teams in the United States, composed of 24 gymnasts each (one junior team and one senior team). In addition to this there are 400 gymnasts who participate in Junior national championships in order to be selected for the junior national team. In Brazil, in 2008, combining all categories (ages 9-10, 11-12, 13-15 and >16) the total was 146 gymnasts participating in Brazilian championships, which represents 36.5% of one of the North-American categories.

Concentration of gymnasts in the South and Southeast regions of Brazil: after 30 years of the Brazilian Gymnast Confederation (CBG), the federal states comprising these regions are still the ones that stand out and the only ones represented in competitions. Moreover, considering the maximum possible number of 27 state federations (26 States plus the Federal District) and that there are only 18 gymnastics federations in Brazil, we observe that some States not only have no representatives in the main championships but do not even have entities affiliated to CBG despite sometimes having a Gymnastics State Federation. It is interesting to note that these federations have existed for certain years and, nevertheless, they have not yet been able to mobilize state entities in order to promote gymnastics or to affiliate themselves to the federation. They do not have gymnasts with the technical ability to participate in major championships. Logically, this kind of problem also involves each State regional policy; however, State Federations could promote and foster sports organizations. Therefore, it can be observed that these regions need incentives for gymnastics development, with coach education for the development of good sports initiation in these States.

Grigoryants (2004), while citing current problems in Russian gymnastics, shows that some regions in Russia have been totally forgotten after the country had concentrated all their gymnasts in a single location and under the supervision of one

person. Grigoryants points out that it is necessary to start the development of gymnastics in small cities, and allow coaches to practice freely.

The same has happened in Brazil with the centralization of gymnasts in Curitiba-PR (a State in the Southern region of Brazil). Knowledge was concentrated and the only people who benefited were the professionals at the Excellence Center (*Centro de Excelência*).

Training of coaches: considering the results obtained by gymnasts coached by Ukrainian coaches, and the testimonials of the gymnasts on the differences between them and the Brazilian coaches, and the lack of experience of the latter, it is possible to point out the lack of coach development. The 10-year period of the Ukrainian coaches in Brazil did not contribute to improved preparation of the Brazilian coaches. Since Brazil is a young country with regards to Gymnastics, it was necessary for experienced coaches from other countries to coach the national team. However, only athletes and coaches involved with the national team set-up benefited from these visiting coaches, and their knowledge was not imparted to general gymnastics coaches across the country.

In testimonies given by the gymnasts (Schiavon, 2009), it is possible to identify a lack of organization in the Brazilian gymnastics institutions, which relies on luck in order to identify talented athletes, and then expects these athletes to achieve a good technical level at the adult Brazilian Championship, which will allow them to represent the national team in World Championships. This method was adopted for years, during the generation of the pioneer and transition gymnasts, and was not successful at producing world-class gymnasts. During the past decade, the Ukrainian system of coaching has been imported to Brazil and has developed many Olympic champions. This has served to highlight the current poor standard of coach preparation in comparison to the Ukrainian system.

Since their arrival in Brazil, the Ukrainian coaches have complained about technical gaps identified in the Brazilian gymnasts. These were mentioned in *Folha de São Paulo* newspaper (2007), that quotes the coach Oleg Ostapenko: "I coach the national team, however I have to correct basic mistakes. Correcting is more difficult than creating new moves. It is a waste of time. There are not many coaches who really know gymnastics in depth and who make the gymnasts practice until they do not present basic mistakes". Based on this article, it is possible to observe that he approaches the consequences of the lack of preparation of the Brazilian coaches, which consequently leads to gymnasts often spending years to correct these problems. Nevertheless, without adequate and continuous preparation, gymnasts will continue to reach the national team with the same technical mistakes, since the coaches will continue to work in the same way, without any significant improvement.

Laís Souza, in her testimony (Schiavon, 2009), stresses that she suffered very much in order to correct some basic mistakes when she started to practice with the Ukrainian coaches. This shows that even coaches with good national results, such as Laís' coaches, still present technical gaps in their preparation, which makes the development of these athletes even more difficult. This is the case with most Brazilian coaches. These coaches are aware of this situation, and are therefore willing to gain knowledge and receive guidance that may be acquired by attending courses or by contact with other foreign coaches in Brazil, or during exchanges with other countries. Caroline Molinari and Camila Comin expressed in their testimonials that their former coaches did not fully explore their potential. However, after only one year under Iryna Ilyashenko these two gymnasts achieved significant improvements in ability, both in technical execution and level of difficulty.

As previously mentioned, according to Públio (2005), the last record of a continuous training course for coaches

offered in Brazil was carried out in 1973. This was carried out in partnership with MEC (Brazilian Ministry of Education and Culture) and aimed to train coaches for the Brazilian School Games.

However, it is even more curious that the use of resources from the Law Agnelo/Piva, as per a report issued by CBG to the Brazilian Olympic Committee (COB), pertaining to the years 2006-2007, there is absolutely no record of investments in the area of human resources, which could develop training courses for Brazilian coaches as part of the CBG budget.

Recently, there was a technical course in Brazil, which was part of a training program run by the International Gymnastics Federation (FIG). Unfortunately this course was only offered to a few Brazilian coaches, who had been invited by CBG, and not open to all interested Brazilian coaches.

Nunomura (2001), in his doctoral dissertation on the formation of gymnastics coaches, suggests that a certificate should be demanded, such as in other countries, and also approaches the subject of lack of specific preparation in Brazil:

Considering the problems faced with professional formation, to this moment there has been no initiative by the Gymnastics Confederation or Federations towards the creation of preparatory courses for our coaches. Part of this responsibility must also be assigned to these entities that must look after the quality of the services rendered in this area.

Importing coaches from several parts of the world also did not solve the problem, since there was no willingness to spread their knowledge and experience, being these restricted to entities that could afford to support their stay in the country (p.45). (Loose translation).

The same author highlights that “importing coaches solves momentary and private problems of the entities because they are not prepared to work in the formation of new coaches” (p.153). Additionally, often they are not open to new ideas and are unwilling to change the way they practice.

In this case, a strengthening of relations between research centers and sports organisations is suggested in order to combine their efforts towards gymnastics coach preparation in Brazil, gathering professionals for the preparation of new coaches.

Another important point raised in this study, and that has been studied by different authors since the beginning of the contemporary system of sports preparation, is the matter of traditions being part of the training with a power, sometimes greater than studies and scientific production. According to gymnasts’ interviews (Schiavon, 2009), it was possible to raise this discussion, since during the practice with the Ukrainian coaches, which follow the guidelines from their country of origin when it comes to athlete formation, some aspects were not considered based on scientific evidence, such as the prohibition of adequate water intake. This kind of procedure does not allow enough replacement of liquids in the body and may lead to kidney stones. This was the case with Caroline Molinari and Laís Souza. Currently there is enough scientific proof to condemn the practice of denying water intake, inexplicably adopted by the Ukrainian coaches, under the allegation that there would be an increase in the gymnasts body weight, as revealed during the testimonials.

It is interesting to observe that there is a commission of professionals from the health area, such as physicians, physiotherapists and nutritionists, who must guide the gymnasts according to scientific evidences. Nevertheless, tradition and the status of the coaches seem to make their will prevail, since these health professionals would certainly not prohibit adequate liquid replacement, as reported by several gymnasts.

Bortoleto (2004) also observes the predominance of traditions in Spanish gymnasts practices when he writes:

After several years of pure repetition, this formation style also blurs spontaneity and creative capacity from the part of the

gymnasts and their coaches, since the training dynamics does not undergo modifications. Most of the time, tradition seems to overpower innovation (p.390). (Loose translation).

Another point to be analyzed is the power and decision making always centralized in the same few people. Obviously, one or two people cannot deal with all the several levels of gymnastics in a country like Brazil, which makes the growth of gymnastics as a whole impossible. Grigoryants (2008) reports the same problem in Russia, where younger coaches, who were once great gymnasts, competent to take both technical and administrative positions, complain about few people in Russia accumulating several roles and about the Gymnastics development being centralized in only some regions of their country, where there is a concentration of athletes.

There are several studies completed and other ongoing studies in Brazilian universities on development of basic gymnastics, on certification of courses for coach preparation, among other subjects already discussed, pondered and compared with other countries but that cannot be put into practice due to the fact that the decisions always rely on the same people. Several projects are ready to be implemented, however, people waste time trying to reinvent what has already been studied at our universities. The gap between state federations and CBG, and universities does not contribute to the development of Brazilian Gymnastics.

Therefore, the approach of a relationship between research centers and sports entities is suggested in order to combine efforts towards the improvement of the Brazilian Gymnastics.

What can be noted after analyzing studies related to sports training, experiences published in other countries and testimonials of Brazilian gymnasts is that, regardless of what is proposed by science, several coaches work towards complying with demands imposed by the sports entities. Mainly when it comes to time for

recovery after practice because, if science was taken into account, there might be less injuries, however it is also possible that there would not be enough technical difficulties for the anticipated medals. What needs to be done in order to achieve their goals in terms of difficulty level, which is imposed by the scoring code prepared by FIG, is a tough training pace that has led to several injuries and overtraining faced inclusively by the great world powers in Gymnastics.

Former Soviet Union (URSS), China, Romania and the USA, in other words, countries that produced several champions in Gymnastics, have adopted training systems that generated several injuries but, since the number of gymnasts has always been high in these countries, some would "survive" the methods adopted. Currently, these systems were imported by countries that do not have the same number of athletes, such as Brazil, and thus facing problems with the excessive number of injuries in the few existing gymnasts, a fact that brings us back to the matter of the possibly inadequate balance between the training burden to which the gymnasts are submitted and the recovery period.

The Gymnastics own characteristic of having its movements based on alactic energy system does not match the number of repetitions and the number of continuous practicing hours. It is more difficult to reproduce the routines with maximal or with the necessary power after hours of exhausting training. According to Issurin (2007), since the 80s, several principles from the traditional periodization theory have been discussed, creating a new trend in worldwide sports. One of the main factors that affect such change is the increase in the number of competitions and sports performances, and the reduction of the total volume of training burden.

This reduction in the volume of training burden has been developed in different countries and in different sports. According to Bondarchuk (2007), mentioned by Issurin (2007), there is a similar trend observed in sports such as

hammer and discus throws, and weight-lifting, reduced from about 120 to 150 throws per session, to current 30 throws per session.

Gymnasts practice with landing forces (impact) and equipment routines every day, not having enough time to recover from the impact imposed to the body which, in medium term, produces injuries due to stress and other chronic injuries such as the ones mentioned in several testimonials given by the gymnasts

It is suggested that this aspect of the training be reviewed for assuring the physical integrity of the athletes.

It is necessary to ponder why science has sometimes been neglected. Maybe because it is not possible to have great gymnasts if we take into consideration the adequate theory about an athlete's good development? Maybe rules and demands imposed by FIG do not consider the studies published on incidence of injuries, for example. In this case, more in-depth studies are necessary in order to make the Gymnastics scoring code more adequate for solving this matter. In relation to this aspect, it seems that the media has had an important role on the development of Gymnastics, aiming at showbiz, and several times it gives more importance to this than to scientific information.

Currently, with knowledge spread throughout the world thanks to the coaches from the Soviet republic, there is the need to evolve stand out again, otherwise the medals will also be divided by the countries that acquired the knowledge on formation of champions.

It is interesting to note that even the great world Gymnastics powers are rethinking the developed methods (Grigoryants, 2004) that for years guaranteed their success, but that currently need updating, pondering and adapting, and that the home nation of these coaches (former URSS) has already been discussing.

After following and registering the formation process of the Brazilian athletes who participated in the Olympic Games, more specifically in Women Artistic

Gymnastics, and after achieving the specific goals set for the research, which was to analyze the sports history of these athletes, offering guidelines for reflections on the formation of Gymnasts, this article is concluded with the certainty that it has contributed, mainly due to its originality, to this sport in Brazil. It is expected that this will be the first of several studies to come, aiming at studying the formation of high level Brazilian gymnasts so that we can bring scientific production closer to the actual formation of gymnasts.

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THE EVOLUTION OF REAL DIFFICULTY VALUE OF UNEVEN BARS ROUTINES FROM ELITE GYMNASTS IN LAST 5 OLYMPIC CYCLES

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Abstract

Purpose of the present study was to characterize and analyse the evolution of real difficulty value of full routines, parts and specific kind of elements of Uneven Bars. Besides the full routine difficulty were analyzed the mount, dismount, flight elements, first and second half routines, bars changes, elements executed on low and high bar, number of elements of value D and higher, "in bar elements" and special connections. In total, 104 routines from world championships and Olympic Games finals of uneven bars were analysed between 1989 and 2008. As main results was observed significant increases in all studied variables. Real difficulty value of complete routines ranged from 3.15 to 5.80 points between first and last Olympic cycles analyzed. Special evolution of difficulty values was observed in number of elements D, E and F (from 2.80 to 8.05), total number of bonus connections (from 0.40 to 4.19) and in "in bar" elements (0.25 to 1.57). Based on results we may conclude that uneven bars routines suffered a significant evolution in difficulty and, in some specific kind of elements, just with last changes in Code of Points was possible to confirm the announced increases in quantity and difficulty such as the flight elements.

Keywords: *women artistic gymnastics, Uneven Bars, Difficulty.*

INTRODUCTION

Artistic Gymnastics (AG) is one of the most popular Olympic sports which practice is generally characterized as highly difficult and complex. Several authors carried out studies claiming the increase of the difficulty or complexity of routines and elements performed by high level gymnasts (Arkaev & Suchilin, 2004; Caine, DiFiori & Maffulli, 2006; Hadjiev, 1991; Hofmann, 1999; Irwin, Hanton & Kerwin, 2005; James, 1987; Jemni, Friemel & Delamarche, 2002; Radoulov, 1986; Sands,

Caine & Borms, 2003; Smolevsky & Gaverdovsky, 1996; Takei, Nohara & Kaminura, 1992), or the great acrobatic development that AG suffered in recent years (Daly, Bass & Finch, 2001; Hofmann, 1999; Kaneko, 1986; Smolevsky & Gaverdovsky, 1996). However, the training load in AG has been rarely defined and quantified or systematically reported (Caine, Bass & Daly, 2003; Claessens, Lefevre, Beunen & Malina, 2006). Jemni et. al (2003) state that the existence of many studies in morphological, behavioral and

biomechanical areas contrasts with the little information related with internal or physiological parameters of training load in gymnastics.

An exception are some reports from International Federation of Gymnastics (FIG) performed after each world cup and Olympic Games (FIG, 1994, 1997, 1999, 2000), which address some important aspects and consider the quantities and trends of some parameters of the routines composition in all apparatus but don't report to all factors of the external load which competition routines represent.

In order to determine the direction of the preparation for which should train the young gymnasts who start their practice today, it is important to know, with enough detail the current characteristics of the performances from the elite gymnasts, relating to its full competition routines, but also regarding specific parts or elements.

Since children and young gymnasts that start today their preparation should only reach its maximal performances within 6 to 9 years (Arkaev & Suchilin, 2004; Hofmann, 1999; Smolevsky, 1978; Touricheva, 1986), the references for their preparation should not be limited to the characteristics of the current elite athletes, being necessary to predict and characterize the requirements of the load for which they should prepare, through an analysis of development trends of Gymnastics in general and the load of the competition routines in particular.

In AG, the volume of the load is typically described as the number of elements or routines performed (Arkaev & Suchilin, 2004; Sands, 1999; Ukran, 1978). For the same authors intensity means the difficulty of the elements performed or the number of elements performed per unit of time. The concepts of difficulty and complexity of gymnastics exercises are close but not identical (Arkaev & Suchilin, 2004). For the authors, the complexity of AG routines has grown in structural and parametric directions, with three parameters which cover most of the increases in the complexity of the Gymnastics elements.

They distinguish the number of rotations around transverse and longitudinal axis and the body position of (tucked, picked, stretched and stretched with high arms). According Ukran (1978) the inclusion of longitudinal rotation in the elements is the most used way to make it more difficult

In competition, the references of difficulty presented by gymnasts in their competition routines are limited to regulatory, i.e., counting only the elements of difficulty required (in earlier versions of CP) or the 8 more valuable excluding for effect the repeated elements. Whereas all performed elements, counting or not to the final score of the gymnast, means external load, with a corresponding internal load, we propose in the present study the measurement of all load that the athletes are subject, by adding of all executed elements, multiplied by its coefficient of difficulty. We call to this indicator Real Difficulty Value.

In this context, the purpose of this study was to characterize the current status of the external load of Uneven Bars (UB) in Women's Artistic Gymnastics (WAG), searching some of its trends, based on analysis of the real difficulty value of their competition routines, through the observation of the finalists form World Championships and Olympic Games over the last five Olympic cycles.

METHODS

The studied sample comprised a group of world elite gymnasts in WAG. For that purpose, uneven bars routines from world championships and Olympic Games finals between 1989 and 2008 were analyzed. From a total of 120 finalists, 16 failed during their competition routine, which were excluded since they might have changed his routine for that reason, so were observed only 104 routines. The 15 competitions observed were framed in 5 Olympic cycles with 2 world championships and 1 Olympic Games each one.

Through observational methodology, an observation category was constructed

and validated, comprising fifteen indicators or variables:

1. real difficulty value of the routine,
2. difficulty of mount,
3. difficulty of dismount,
4. difficulty of flight elements,
5. difficulty of changes from high bar to low bar,
6. difficulty of changes from low bar to high bar,
7. difficulty of elements performed on low bar,
8. difficulty of elements performed on high bar,
9. difficulty of elements performed on 1^a middle of the routine,
10. difficulty of elements performed on 2^a middle of the routine,
11. difficulty of “in bar” elements,
12. total number of special combinations with bonus points,
13. number of combinations of 0.1 bonus points,
14. number of combinations of 0.2 bonus points,
15. number of elements of difficulty D, E and F.

For the registration of the difficulty presented in each of the above described variables, was considered all performed elements, regardless the regulatory issues or repeated elements. To determine the difficulty value of each element and combination was used the 2006 version of the CP (FIG, 2006).

The instrument validation was based on the authority judgement, through the overhaul of WAG experts, which were framed in three categories, coaches, judges and academics or researchers. For each category two individuals were selected.

To assess the internal validity, a first observation of 25 routines (5 of each studied cycle by random selection in 3 different moments) was performed. In the first two

moments of the evaluation (A and B) the leading researcher performed the observations with a month of interval. A third moment of evaluation (C) was performed by a team of 5 experts (international judges of AG) previously trained.

The intra and inter-observer agreement was calculated through the Spearman correlation coefficient. To assess the intra-observer agreement the encodings performed in the first 2 moments (A-B) were compared, a total of 25 routines, and the inter-observer agreement was assessed by comparisons between the first and second codifications with the third moment, separately (A-C and B-C).

From the 165 correlations analyzed (11 comparisons x 15 variables) we found that for 13 studied variables, the correlation coefficient was equal to 1.00 ($p=0.000$) for all comparisons made (inter and intra-observer), ie, a perfect correlation showing full agreement between observations. For the remaining 2 variables (Difficulty of elements performed on 1^a and 2^a middles of the routine) were found 6 events with correlations values not equal to 1.00 but shows very high correlations ($0.895 \leq r_s \leq 0.975$), probably due to the different criteria to divide the elements in the 1^o and 2^o half routines by the observers. These results are highly satisfactory, showing a high correlation and agreement, both inter and intra-observer.

Data was analyzed with descriptive statistics (median and range, being also observed mean and standard deviation) and Kruskal Wallis (k-w) test was used to compare the values found over the five cycles studied with a significance level of 5% ($p \leq 0.05$). In order to analyse differences between cycles was used Mann-Whitney test with the *Bonferroni* correction, for a value of $p \leq 0.0125$.

RESULTS

Table 1. *Kruskal Wallis (k-w) test results for the indicators related to difficulty of Routines and Parts, in the five Olympic cycles considered (* $p \leq 0.05$).*

Indicator	Statistics	Cycle				
		1°	2°	3°	4°	5°
		1989-1992	1993-1996	1997-2000	2001-2004	2005-2008
Real Difficulty of Routine	Mean \pm sd	3.15 \pm 0.55	3.88 \pm 0.56	4.25 \pm 0.57	4.63 \pm 0.57	5.80 \pm 0.83
	Median/Range	3.00/2.00	3.90/2.40	4.20/2.20	4.60/2.10	6.00/2.70
	k-w	$X^2 = 67.979$ p = 0.000 *				
Mount Difficulty	Mean \pm sd	0.12 \pm 0.05	0.13 \pm 0.07	0.16 \pm 0.05	0.16 \pm 0.08	0.18 \pm 0.10
	Median/Range	0.10/0.20	0.10/0.30	0.20/0.10	0.15/0.30	0.20/0.30
	k-w	$X^2 = 15.558$ p = 0.004 *				
Dismount Difficulty	Mean \pm sd	0.30 \pm 0.10	0.41 \pm 0.04	0.40 \pm 0.02	0.41 \pm 0.05	0.41 \pm 0.03
	Median/Range	0.30/0.20	0.40/0.20	0.40/0.10	0.40/0.20	0.40/0.10
	k-w	$X^2 = 40.806$ p = 0.000 *				
Flight Elements Difficulty	Mean \pm sd	0.76 \pm 0.31	0.76 \pm 0.32	0.73 \pm 0.27	0.68 \pm 0.31	1.06 \pm 0.40
	Median/Range	0.80/1.00	0.80/0.80	0.80/0.90	0.65/0.80	0.90/1.50
	k-w	$X^2 = 14.018$ p = 0.007 *				
Changes Low to High Bar Difficulty	Mean \pm sd	0.23 \pm 0.14	0.35 \pm 0.18	0.41 \pm 0.12	0.43 \pm 0.12	0.55 \pm 0.23
	Median/Range	0.20/0.40	0.30/0.70	0.40/0.40	0.40/0.40	0.50/0.70
	k-w	$X^2 = 28.263$ p = 0.000 *				
Changes High to Low Bar Difficulty	Mean \pm sd	0.21 \pm 0.13	0.27 \pm 0.20	0.35 \pm 0.09	0.39 \pm 0.05	0.50 \pm 0.17
	Median/Range	0.20/0.40	0.20/0.80	0.40/0.20	0.40/0.20	0.40/0.40
	k-w	$X^2 = 43.693$ p = 0.000 *				
Low Bar Elements Difficulty	Mean \pm sd	0.50 \pm 0.37	0.62 \pm 0.43	0.70 \pm 0.28	0.83 \pm 0.35	1.00 \pm 0.39
	Median/Range	0.50/1.20	0.70/1.50	0.70/0.80	0.80/1.20	1.10/1.30
	k-w	$X^2 = 19.721$ p = 0.001 *				
High Bar Elements Difficulty	Mean \pm sd	2.65 \pm 0.49	3.26 \pm 0.44	3.39 \pm 0.80	3.80 \pm 0.68	4.80 \pm 0.91
	Median/Range	2.50/1.70	3.30/2.30	3.35/4.10	3.85/2.20	4.80/3.10
	k-w	$X^2 = 57.891$ p = 0.000 *				
1° Middle Routine Difficulty	Mean \pm sd	1.57 \pm 0.25	1.93 \pm 0.34	2.19 \pm 0.31	2.38 \pm 0.33	2.98 \pm 0.56
	Median/Range	1.55/1.00	1.85/1.20	2.30/1.25	2.30/1.10	2.75/1.85
	k-w	$X^2 = 65.274$ p = 0.000 *				
2° Middle Routine Difficulty	Mean \pm sd	1.58 \pm 0.35	1.95 \pm 0.28	2.10 \pm 0.31	2.26 \pm 0.30	2.82 \pm 0.41
	Median/Range	1.55/1.40	1.90/1.40	2.10/1.15	2.27/1.15	2.80/1.50
	k-w	$X^2 = 60.974$ p = 0.000 *				
“in bar” Elements Difficulty	Mean \pm sd	0.25 \pm 0.31	0.41 \pm 0.46	0.48 \pm 0.38	1.06 \pm 0.66	1.57 \pm 0.65
	Median/Range	0.15/1.00	0.30/1.50	0.30/1.20	1.25/1.80	1.70/2.00
	k-w	$X^2 = 46.787$ p = 0.000 *				
Total Number of Connections	Mean \pm sd	0.40 \pm 0.94	0.70 \pm 0.93	1.54 \pm 0.88	2.00 \pm 0.73	4.19 \pm 1.17
	Median/Range	0.00/3.00	0.00/3.00	1.00/3.00	2.00/2.00	4.00/4.00

		k-w	$X^2 = 66.103$		$p = \mathbf{0.000} *$	
Number of 0.1 Connections	Mean \pm sd	0.25 \pm 0.64	0.30 \pm 0.56	1.33 \pm 0.96	1.37 \pm 0.96	2.43 \pm 1.25
	Median/Range	0.00/2.00	0.00/2.00	1.00/3.00	1.00/3.00	2.00/5.00
		k-w	$X^2 = 49.650$		$p = \mathbf{0.000} *$	
Number of 0.2 Connections	Mean \pm sd	0.15 \pm 0.37	0.39 \pm 0.72	0.21 \pm 0.42	0.63 \pm 0.50	1.76 \pm 1.09
	Median/Range	0.00/1.00	0.00/2.00	0.00/1.00	1.00/1.00	1.00/4.00
		k-w	$X^2 = 45.139$		$p = \mathbf{0.000} *$	
Number of Elements D-E-F	Mean \pm sd	2.80 \pm 1.40	3.87 \pm 1.06	4.83 \pm 1.01	5.81 \pm 0.83	8.05 \pm 1.43
	Median/Range	3.00/5.00	4.00/4.00	5.00/4.00	6.00/3.00	8.00/5.00
		k-w	$X^2 = 70.915$		$p = \mathbf{0.000} *$	

The observation of the results presented in Table 1 shows statistically significant differences in all analyzed variables, with an evolution of the average values of the real difficulty of the routines from 3.15 to 5.80 points between the first and last studied cycle ($p = 0.000$).

Despite the significant differences found for all variables, it is possible to distinguish a group with relatively low amplitudes of their values from other one, whose differences showed high absolute

values. In the first group are the difficulty of mount, dismount, flight elements, both types of bar changes and the elements performed in low bar, all with variations not exceeding 0.50 points of difference between the first and last cycle. In the second are those indicators related to the increase in the number of elements in general, and the number of elements of high coefficient of difficulty or special combinations between them.

Table 2. Mann-Whitney test results for the indicators related to difficulty of Routines and Parts, in the fourth considered cycle changes ($* p \leq 0.0125$).

Indicator	Mann-Whitney	Cycle change			
		1° - 2°	2° - 3°	3° - 4°	4° - 5°
Real Difficulty of Routine	Z	-3.604	-2.111	-1.909	-3.928
	p	0.000 *	0.035	0.056	0.000*
Mount Difficulty	Z	-0.987	-2.589	-0.523	-0.356
	p	0.324	0.010 *	0.601	0.722
Dismount Difficulty	Z	-4.063	-0.061	-0.329	-0.291
	p	0.000 *	0.951	0.742	0.771
Flight Elements Difficulty	Z	-0.052	-0.316	-0.426	-2.894
	p	0.959	0.752	0.670	0.004*
Changes Low to High Bar Difficulty	Z	-2.400	-1.418	-0.328	-1.809
	p	0.016	0.156	0.743	0.070
Changes High to Low Bar Difficulty	Z	-0.685	-2.694	-1.728	-2.299
	p	0.494	0.007 *	0.084	0.022
Low Bar Elements Difficulty	Z	-1.131	-1.414	-1.030	-1.424
	p	0.258	0.157	0.303	0.154
High Bar Elements Difficulty	Z	-3.724	-1.230	-1.536	-3.040

	p	0.000 *	0.219	0.124	0.002*
1° Middle Routine	Z	-3.401	-2.700	-1.415	-3.363
Difficulty	p	0.001 *	0.007 *	0.157	0.001*
2° Middle Routine	Z	-3.608	-1.686	-1.554	-3.613
Difficulty	p	0.000 *	0.092	0.120	0.000*
“in bar” Elements	Z	-1.090	-1.115	-2.678	-2.183
Difficulty	p	0.276	0.265	0.007 *	0.029
Total Number of	Z	-1.468	-3.060	-1.700	-4.636
Connections	p	0.142	0.002 *	0.089	0.000*
Number of 0.1	Z	-0.721	-3.988	-0.120	-2.684
Connections	p	0.471	0.000 *	0.904	0.000*
Number of 0.2	Z	-1.030	-0.634	-2.633	-3.527
Connections	p	0.303	0.000 *	0.008 *	0.000*
Number of Elements	Z	-2.632	-2.959	-2.995	-4.098
D-E-F	p	0.008 *	0.003 *	0.003 *	0.000*

From Table 2 it is possible to establish more precisely some of the observed differences. While the evolution of the real difficulty of the routine was significantly ($*p \leq 0.01$) from 1° to 2° and from 4° to 5° cycle changes, the mount, dismount, flight elements, changes from high bar to low bar and the “in bar” elements only showed significant differences in a single cycle change. Other indicators related to the number of high difficulty elements and combinations between them, showed a progressive evolution, with several significant changes over the cycles.

DISCUSSION

Although the results presented denote a general evolution of the difficulty level of competition routines in UB, it is important more detailed analysis, trying to identify the most influential parameters in this development and explain or interpret the possible reasons for some changes.

First, the development of the real difficulty of full routines is associated with the increase in the number of elements performed, which evolved from 14.55 elements in the first cycle to 22.66 in the last one (Ferreirinha, 2007), thus about 8 more elements for the difficulty account.

Moreover, as the results show, the number of elements of high coefficient of difficulty (D, E and F) also presented a remarkable evolution.

Other studies may help to explain the dramatic evolution of difficulty observed. In a previous study (Ferreirinha, Silva & Marques, 2008b), was observed a significant increase in the number of rotations and the number of elements with the longitudinal rotation, which evolved from 3.35 to 8.05 and from 2.35 to 4.95, respectively, in the same period here observed. In accordance with the opinion of several authors who attribute to the longitudinal rotations an important role in the increase of the complexity and difficulty of elements, we believe that the enhanced of longitudinal rotations has a strong contribution to the increased difficulty of the routines. In another study (Ferreirinha, Silva & Marques, 2008a), was found that the number of "in bar" elements grew up between these same cycles, from 0.80 to 4.48 elements, which performed with longitudinal rotation or flight, allow the presentation of different elements and increased difficulty

The results for the difficulty of dismount are clear and indicate that the gymnasts only changed from a dismount of

difficulty "C" to "D", established just in the transition between the first and second cycle, coinciding with the new requirement from CP of 1993 (FIG, 1993) and suggesting a simple adjustment to regulatory requirements.

The difficulty of the flight elements, whose evolution showed a slight increase of 0.30 points between the first and last cycle analysis, remained without any significant changes until the last cycle, contrary to trends envisaged by several authors (Arkaev & Suchilin, 2004; Smolevsky & Gaverdovsky, 1996; Touricheva, 1986) for an evolution of this type of element, in quantity and difficulty. Only with the introduction of new rules that expanded the possibility of the gymnasts had higher number of difficulties (FIG, 2006), which ended with the mark of "10 points" for the final score of the athletes, was possible to observe a significant increase in the difficulty of this category of analysis.

The changes of bars evolved gradually, with small alterations, being a concern announced by the technical committee of the FIG (FIG, 1994, 1997) the absence of difficulty in this type of element.

Another kind of element that reflects the dependency of the structure of the routines from the CP, and the abuse in their excessive use are the "in bar" elements. First, because only after the CP of 2001 (FIG, 2001), requiring the inclusion of an element of this type of difficulty minimum "C", there was a significant increase, and second because after that date the athletes started to use it much more than the requirements of CP, through the introduction of longitudinal rotation, flight or executing with legs together or apart (Ferreirinha et al., 2008a).

The difficulty presented by the gymnasts in the different bars followed the general trend of difficulty of the routine, showing a preference for the execution of most elements of difficulty in the high bar. This is understandable by the greater freedom and consequently a bigger amplitude of the elements allowed by the high bar, but also by the type of elements

performed progressively more close to those presented by male gymnasts in High Bar (Arkaev & Suchilin, 2004; Cimnaghi & Marzolla, 1988; FIG, 1994, 1997; Smolevsky & Gaverdovsky, 1996; Witten & Witten, 1991).

Finally, through the analysis of the difficulty in the 1st and 2nd middle of the routine we wanted to observe a possible preference for the execution of the higher difficulty in the 1st middle, due the advantage of greater energy availability, but the results showed that gymnasts equally divide its difficulty value on both half's routines.

CONCLUSIONS

Based on the results we can conclude that the Uneven Bars routines suffered significant increases in its difficulty value. If some indicators have evolved gradually as a result of natural and continuous increase of more difficult elements, others just increased the value of difficulty at specific times, usually associated with changes of CP. The latest update of CP dictated a significant evolution of difficulty for many indicators observed and in some specific kind of elements, only at this time it was possible to confirm the changes announced by many authors, in quantity and difficulty, as the case of the flight elements.

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A CASE STUDY ABOUT DIFFERENCES IN CHARACTERISTICS OF THE RUN-UP APPROACH ON THE VAULT BETWEEN TOP-CLASS AND MIDDLE-CLASS GYMNASTS

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Original research article

Abstract

The aim of this research was to determine the differences in run-up velocity of the last ten steps between top class athletes and middle class athletes. The examined sample consisted of four athletes participating in the finals of the World Championship in December 2002, and two participants of the World Cup in Maribor 2006. Run-up velocity was registered by the kinematic analysis system APAS and the OPTO-TRACK-Microgate system. Statistical significance of the difference in arithmetic means of run-up parameters was determined by t-test and U-test. Results showed a progressive increase in velocity in both examined groups and the fact that all gymnasts reach higher velocity on their last step (Top – 9.95m/s; Middle – 8.57m/s). Top class gymnasts have a significantly lower level of velocity at the initial part of the analysed run-up (3.2m/s related to 5.4 m/s), while at the end of the run-up they reach higher velocity values and bigger progression from step to step in comparison with middle class gymnasts, which is also statistically significant. In the top class gymnast group a velocity peak was observed on the 6th step with a slight decrease in velocity on the 7th step and increasing again for the last three steps before the vault board. Unlike the middle class gymnast group where a constant increase in velocity from the beginning to the end of the analysed run-up was observed. These results suggest that middle class gymnasts should try to change their run-up approach to the vault in a manner that follow as closely as possible the run-up of top class gymnasts.

Keywords: *men artistic gymnastics, vault, run-up, velocity, steps.*

INTRODUCTION

The vault is a apparatus characterised by a complex and very short movement (no longer than 7 seconds on average) which can be divided into several very important phases: run-up, preparation for the take-off and contact with the vault board, take-off, the first flight phase, hand take-off, second flight phase and landing. The basic task of gymnast's vault is to facilitate as much time as possible in the second flight, and enable gymnast's body ballistic curve movement with maximum high peak (distance is of no

significance) and angular momentum. For this purpose, the athlete uses kinetic energy, mostly generated during the run-up and the arms and legs take-off force.

The run-up is one of the basic preconditions for performance on the vault. The run-up enables the gymnast to achieve the necessary horizontal velocity, which is of outmost importance for proper development of the next phases. During the vault performance, the run-up is technically very similar to the run-up for long jump in athletics (Petrovic et al., 1995). The basic

difference between the long jump run-up and the vault run-up is that in the long jump run-up the jumper aims to generate his or her maximum velocity, while during the vault run-up velocity is always slightly lower than the athlete's abilities. However, both the jumper and the gymnast have the same goal - to generate the highest possible velocity in the take-off moment. Successful jumping on the vault board can only be enabled by optimal run-up velocity (Cuk & Karacsony, 2004). In this sense, the research project revealed the importance of reaching the highest possible, but controlled, velocity for the gymnast (Sands, 1984, Meeuwse & Magill, 1987; Krug et al., 1998). Krug and associates (1998) underlined the importance of run-up velocity and precision of the board take-off, and the latest research has emphasized the importance of optimal run-up velocity for the purpose of obtaining better visual perception of the vault board and vault during the I vault phase (Bradshaw 2004). The above mentioned authors insist upon additional trainings which should include improving the visual regulation of movement during the run-up. Krug and associates (1998) used a laser apparatus to determine the average run-up velocity for women gymnasts during the handspring type vault as 7.3 m/s, during the Yurchenko type vault as 6.98 m/s and during the Tsukahara vault as 7.28 m/s. The highest recorded velocity for a female gymnast was 7.9m/s. For men who perform medium vaults, the run-up velocity should be from 7.5 to 8.5 m/s, for heavy vaults from 8.5 to 9.5 m/s and for double salto vaults velocity should be over 10 m/s (Cuk and Karacsony, 2004). The maximum run-up velocity is not generated due to difficulties in the motor control of movements during the jump on the board (the location of the take-off is precisely defined as well as the location for the take-off during the preparation phase). A factor that prevents reaching the maximum velocity is a short run-up distance. In the 1950s Henry & Trafton (1951) proved that a sprinter reaches approximately 95% of maximum velocity over a 20m run.

A frequently researched problem is the connection between the run-up velocity and the final grade for a variety of vaults. Sands and Cheetham (1986) found there was a connection between the run-up velocity peak and the vault grade. On the other hand, Sands & McNeal (1995) measured the run-up velocity during gymnasts' vaults with a high precision apparatus (infrared interval timer) and recorded a weak connection between the maximum velocity and the vault grade. Additionally, when using the same parameters it turned out that on the female junior level, there was no statistically significant connection (Sands, 2000). Observations of vault mechanics showed that a higher run-up velocity is much more favourable for creating enough impulse to reach high and far in the second run-up phase. Takei thoroughly dealt with this problem and made a significant contribution in the analysis and modelling of the vault phases for both female and male gymnasts (Takei, 1988, 1989, 1990, 1991; Takei and Kim, 1990, Takei et al., 1990). One part of the research project focused on observations of the running technique which was found to be fairly bad. Thus, the conclusion of this part of the project was that gymnasts spend little time working on their running technique (Mann, 1985; Mero, Komi & Gregor, 1992; Sands & McNeal, 1999).

Two evolutionary changes in sports gymnastics have occurred in the last decade. One change refers to the change of rules and the grading system and the other one relates to the introduction of the new type of vault - the Pegaz (Knoll & Krug, 2002; Sands & McNeal, 2002). One of the basic reasons behind these changes is gymnast's safety. The latest research (Naundorf et al., 2008) analysing run-up velocity on vault (comparing two World Champions 1997 and 2007) points to the tendency to increase the analysed parameter for both women and men. The appearance of the new, much safer vault device largely contributes to this. Additionally, the same authors claim that there is no difference in running velocity

between men and women as far as Yurchenko vault is concerned.

This research is dealing with the difference in the run-up velocity of top class gymnasts (TCG) and middle class gymnasts (MCG). The aim of the research is to determine the differences in velocity in the last ten steps between top vault gymnasts, finalists of the World Championship 2002 in Debrecen (Hungary), and middle class gymnasts from the Republic of Serbia, the finalists of the World Cup in Maribor (Slovenia).

METHODS

The sample of examinees consisted of four top vault gymnasts, participants in the World Championship finals in Debrecen (2002), and two middle class gymnasts of the Serbian team, finalists of the World Cup in Maribor (2006). All gymnasts jumped their most difficult jumps and were able to maximise their scores. Only the direct vaults were taken into consideration (all analysed jumps were performed successfully, without falls). Differentiation of first class gymnasts was performed based on the difficulty of the vaults which were performed at the above mentioned competitions:

Top class gymnasts:

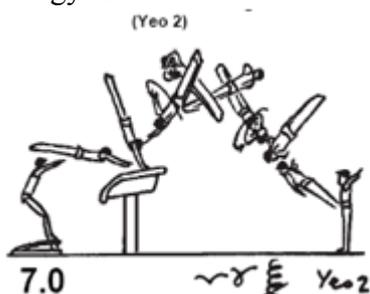


Figure 1. Li Xiao Pen CHN – WS Debrecen 2002. - Handspring fwd. and salto fwd.str. w. 5/2t. (num. vault- 336)(FIG, 2009).

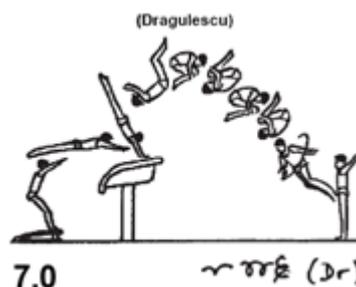


Figure 2. Marijan Dragulescu ROM - WS Debrecen 2002. - Roche with 1/2 turn (num. vault- 338) (FIG, 2009).

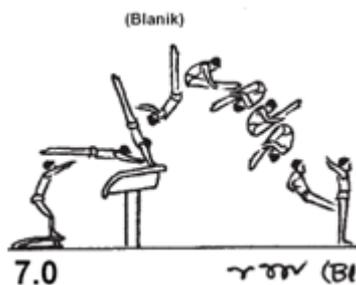


Figure 3. Blanik POL - WS Debrecen 2002. - Handspring fwd. and dbl. salto fwd. Piked (num. vault- 340) (FIG, 2009).

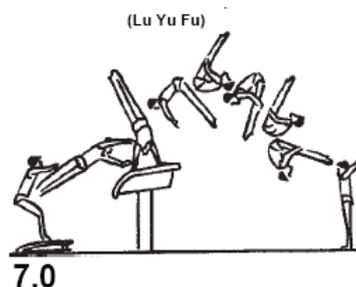


Figure 4. Evgenij Kryukov RUS - WS Debrecen 2002. - Tsukahara with salto bwd. piked (num. vault- 443) (FIG, 2009).

Middle class gymnasts:

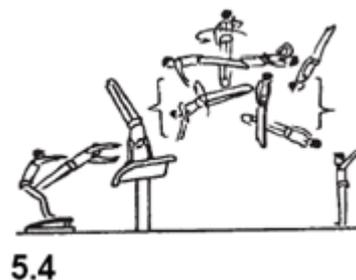


Figure 5. Miloš Paunović SRB - WC Maribor 2006. - Tsukahara str. w. 1/1 t. (num. vault- 427) (FIG, 2009).

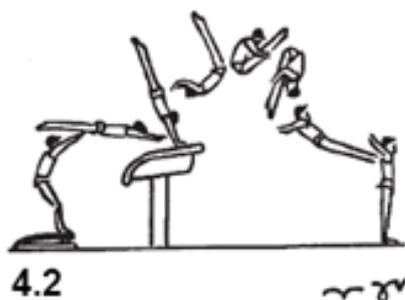


Figure 6. Miloš Paunović SRB - WC Maribor 2006. - Handspring fwd. and salto fwd. p.(num. vault – 319) (FIG, 2009).

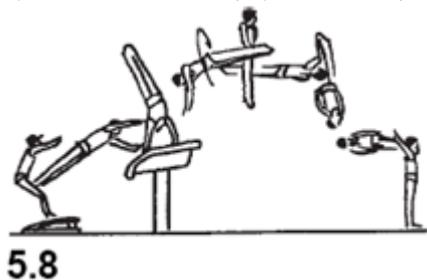


Figure 7. Aca Antić SRB - WC Maribor 2006. - Kasamatsu str. with $\frac{1}{2}$ t. (num. vault- 428) (FIG, 2009).

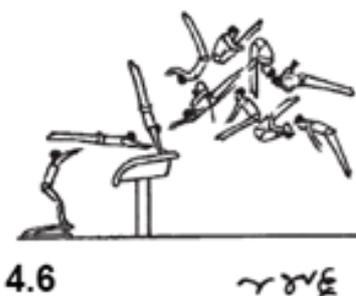


Figure 8. Aca Antić SRB - WC Maribor 2006. - Handspring fwd. and salto fwd. p.w.1/2 t. (num. vault – 320) (FIG, 2009).

The variable sample consisted of run-up velocity parameters (of each individual step) during the vault. Considering that the vault length varied for different gymnasts, the last 10 steps were chosen in order to obtain equal form for further analysis. Velocity parameters were measured by Laboratory for Biomechanics Analysis of the Faculty of Physical Education in Ljubljana (Slovenia) by applying well tested system and software for kinematic analysis (APAS - Ariel Performance Analysis

System 1995) and the OPTO-TRACK-Microgate system. By using the first system (APAS, two video cameras 50Hz) the standard procedure calculated velocity of each individual step at the World Championship 2002 in Debrecen: (a) data acquisition; b) data processing in six sub phases: 1) digitalization of video recording; 2) digitalization of comparative body parts; 3) transformation in three dimensional space; 4) filtering data; 5) calculating kinematic parameters; 6) data presentation). The other system detected velocity in each step at a World Cup Meeting in Maribor. The OPTO-TRACK-Microgate system is comprises optical sensors placed along the whole track (three centimetres apart, frequency 1000 Hz) and a computer for data storing and processing. The system enabled the measuring of: period of contact with the surface, period of flight, step length, step frequency, velocity in each step and acceleration. Only the velocity parameters in each step were used for this research (the last ten steps before jumping on the vault board).

Student t- test for determining statistical significance of difference between the top gymnasts group and the middle class gymnasts group was used for small independent samples. Having in mind that small number of samples is included; a non parameter procedure Man- Whitney U test was used for the purpose of examining the achieved results. SPSS 16 for Windows was used for statistical data processing.

RESULTS

Table 1 shows mean values and standard deviations of velocity indicators in each step for both groups.

Table 1. Means and Standard Deviation of velocity indicators in each individual step.

	TOP			MIDDLE		
	N	Mean	SD	N	Mean	SD
STEP 1	4	3.223	2.044	4	5.434	0.167
STEP 2	4	4.495	1.675	4	5.806	0.271
STEP 3	4	5.243	0.784	4	6.150	0.527
STEP 4	4	6.215	0.862	4	6.797	0.223
STEP 5	4	7.043	1.024	4	7.104	0.227
STEP 6	4	7.665	1.220	4	7.384	0.228
STEP 7	4	7.223	0.392	4	7.564	0.347
STEP 8	4	7.713	0.607	4	7.901	0.259
STEP 9	4	8.578	0.178	4	7.996	0.430
STEP 10	4	9.950	0.743	4	8.573	0.234

Insight into numerical values of arithmetic means (Table 1) as well as the graphic review (Figure 9), indicate the following:

- 1) There is a progressive increase of velocity in both groups and all gymnasts achieve the highest velocity values in the last step (Top – 9.95m/s; Middle – 8.57m/s);
- 2) Top class gymnasts have significantly lower velocity level at the beginning of the analysed part of the run-up (3.2m/s as opposed to 5.4 m/s), while at the end of the run-up they reach higher values in comparison with middle class gymnasts;
- 3) Top class gymnasts show velocity peak in the sixth step, velocity is then reduced in the seventh step and again rapidly increased in the last three steps in front of the board. Middle class gymnasts, however, show a constant velocity increase from the beginning to the end of the analysed run-up (Figure 9).

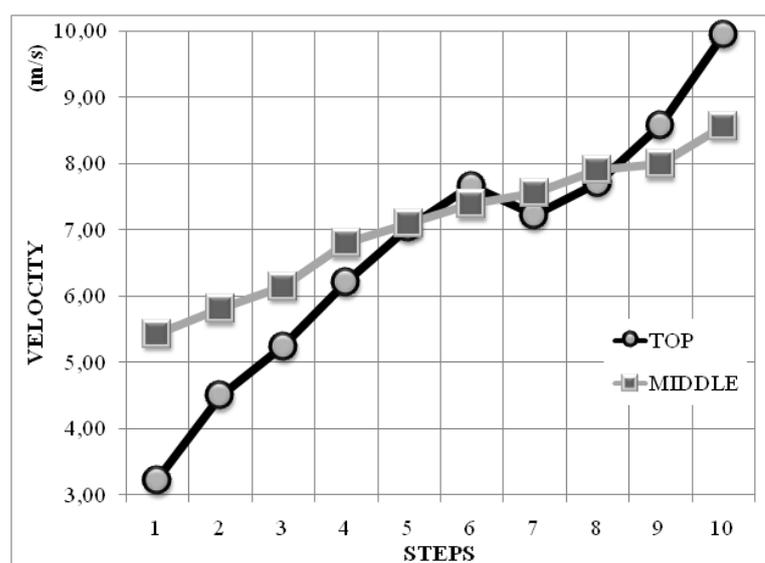


Figure 9. Mean values of individual step velocity for top class and middle class gymnasts.

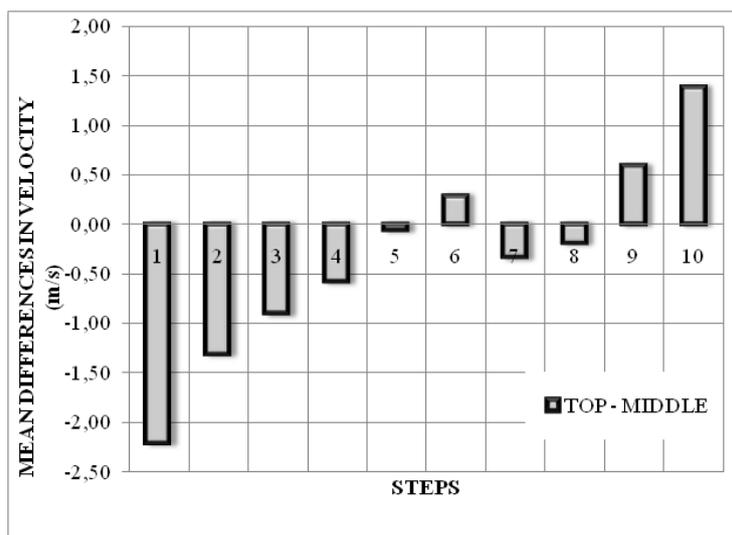


Figure 10. Absolute differences in each step velocity between TCG and MCG.

The following has been noted:

- 1) The differences in run-up velocity show for the initial part of the analysed run-up a significantly high level (above 2m/s) and are in favour of higher step for MCG;
- 2) As the gymnast approaches the vault board, the numeric differences of arithmetic means gradually decrease up to the fifth step, at which point the differences are minimal.
- 3) In the sixth step (take-off leg step) a difference was observed in favour of a higher average velocity level for TCG.

4) The run-up velocities in the seventh and the eighth step are again higher for MCG;

5) In last two steps velocities significantly increase and are in favour of TCG.

Results of T-test and U-test which help to determine statistic significance of differences in arithmetic means (Figure 10) are presented in Table 2.

Table 2. Results of testing statistic significance of differences in arithmetic means (Student T-test and Mann-Whitney test).

	TOP – MIDDLE				
	Independent Samples Test		Mann-Whitney U (U-test)		
	t	p	U	Z	p
STEP 1	-2.16	0.11	11	-1.44	0.18
STEP 2	-1.56	0.26	12	-1.31	0.23
STEP 3	-2.61	0.02	5	-2.22	0.03
STEP 4	-1.34	0.27	11	-1.44	0.18
STEP 5	-0.12	0.91	20.5	-0.20	0.85
STEP 6	0.46	0.68	18	-0.52	0.66
STEP 7	-1.63	0.13	10	-1.57	0.14
STEP 8	-0.60	0.59	19	-0.39	0.75
STEP 9	2.58	0.02	5	-2.22	0.03
STEP 10	5.73	0.00	0	-2.89	0.01

A statistically relevant difference between arithmetic means was noted in the third step in favour of higher velocity for MCG (Table 2 and Figure 10). A statistically relevant difference was also noted between the penultimate and the last step; it goes in favour of higher velocity for TCG.

Using the available values, it was also possible to calculate differences in velocity of two adjacent steps (Figure 11) and to determine the progression of the run-up velocity which provided more essential information for this research.

In TCG the run-up velocity progression of two adjacent steps increases, and has tendency to gradually reduce the velocity differences up to the seventh step when a decrease occurs. The velocity is reduced by 0.44 m/s in the seventh step compared to the sixth step (Figure 11).

Immediately after the seventh step, the velocity level increases progressively and this trend is maintained to the last step (step prior to jumping on the vault board).

In MCG, the velocity increment is significantly different from the velocity increment for TCG. Velocity in adjacent steps increases constantly (by around 0.30 m/s) and there is no decrease (constantly accelerating). Major differences have been identified between the third and the fourth step (0.65 m/s), and the ninth and the tenth step (0.58 m/s) – (Figure 11). The increase and decrease of velocity curve (triangles) is similar to the TCG performance curve, but with smaller fluctuations. The key difference is the difference in velocity between the eighth and the ninth step which significantly increases (large positive rate) for TCG and decreases (negative rate) for MCG.

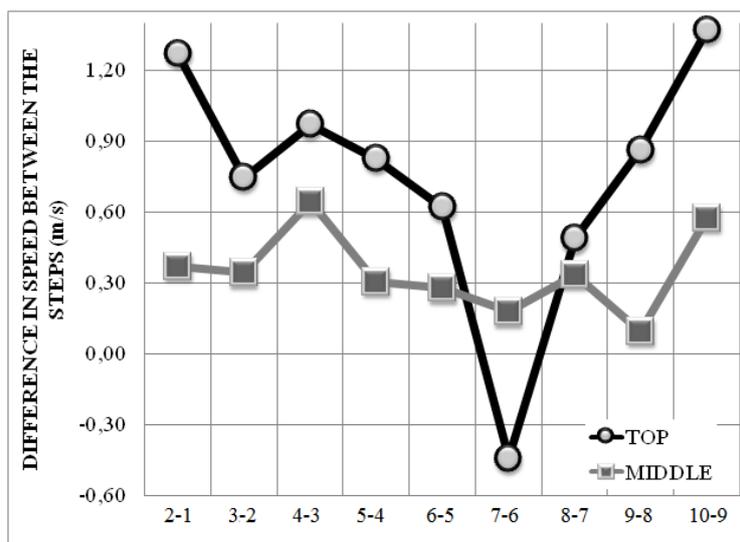


Figure 11. Average values of differences in velocity of adjacent steps for TCG and MCG.

More specifically, TCG significantly increases velocity in the transition from the eighth to the ninth step, while MCG increases velocity (positive rate) but the increase tendency reduces with the following steps. These differences are statistically relevant at levels 0.01 and 0.02 (Table 3). Statistically relevant is also the velocity increment in the transition from the

ninth to the tenth step, i.e. greater acceleration for TCG.

Table 3. Results of testing the statistical significance of differences in arithmetic means of velocity increments in adjacent steps (Student T-test and Mann-Whitney test).

TOP – MIDDLE A					
	Independent Samples Test		Mann-Whitney U		
	t	p	U	Z	p
STEPS 2-1	1.93	.140	7.5	-1.90	.056
STEPS 3-2	1.11	.285	18.0	-.52	.661
STEPS 4-3	.96	.354	14.0	-1.04	.343
STEPS 5-4	.87	.447	20.0	-.26	.851
STEPS 6-5	1.42	.181	15.0	-.91	.412
STEPS 7-6	-1.12	.341	15.5	-.85	.412
STEPS 8-7	.41	.702	18.0	-.52	.661
STEPS 9-8	2.98	.011	4.0	-2.35	.018
STEPS 10-9	3.06	.009	5.5	-2.16	.026

DISCUSSION

Our results show a clear difference in the run-up tactics the two groups. TCG has a significantly lower level of velocity in the initial part of the analysed run-up and a significant increase in velocity at the end of the run-up, i.e. in the moment when it is essential to reach the highest velocity which is immediately prior to jumping on the vault board (Cuk & Karacsony, 2004). The differences in this part of the run-up are especially statistically relevant (Table 2). Apart from the statistically relevant high level of velocity at the end of the run-up, a significant increase of velocity at the end of the run-up for TCG was also found. Why is this relevant when it comes to vaults of various coordination complexity (Sands & Cheetham, 1986)? A higher level in the run-up velocity, immediately prior to jumping onto the board, provides a greater potential for a strong jump onto the board and the vault. And when a strong jump and a strong hand take-off are performed after the first flight phase, a greater potential, i.e., greater kinetic energy, is generated which facilitates a higher second flight phase (Krug et al., 1998). A high second flight phase provides more time and a greater potential for a more complex rotation around the vertical and transversal axis. MCGs have lower run-up

velocity prior to jumping on the vault board and therefore a lesser potential for more complex vaults. Nevertheless, the level of velocity in MCG was sufficient for a successful performance of simple vaults (difficulty range from 4.2 to 5.6). But the question is whether such momentum could generate a sufficient amount of kinetic energy for mastering more complex vaults. It appears that this specific run-up mode is one of the essential arguments that differentiates top class gymnasts from middle class gymnasts.

Furthermore, TCGs better prepare for a good - that is, rapid, strong and precise - jump. They start the initial part of the analysed run-up with a lower level of velocity than MCGs and rapidly increase and then gradually decrease it up to the fifth step; after that a steady decrement of velocity is noted (compared to MCGs who increase the velocity level gradually throughout the analysed run-up – Figure 11). In this part of the run-up a statistically relevant difference is noted in the third step (Table 2). This again raises the question of the run-up strategy for TCG. The answer is presumably in the complexity of the vault they perform. Namely, complex vaults (vaults of the highest difficulty – 7.0) require not only a strong hand and leg take-off, but also a precise take-off. Precision

requires a specific invasion angle for legs on the vault board and for hands on the vault, as well as a precisely found contact point on the vault board and on the vault. This is only possible by performing an optimal, controlled and carefully planned run-up. It can be concluded that TCGs assess the distance from the vault board and the vault in the initial part of the analysed run-up, that is, in the transition from the sixth to the seventh step, since velocity in this part of the run-up slightly decreases (the first velocity peak). It can be assumed that gymnasts slightly decrease velocity in order to assess the vault, aiming to jump onto the board as precisely as possible and to successfully perform further phases of the vault (Krug et al. 1998; Bradshaw, 2004). After the evaluation of the distance from the vault board and the vault, TCGs can direct all their energy in the last three steps into creating the maximum hand and leg take-off as a vital part of vault performance with movements of very high coordination complexity.

MCGs have nearly constant progression and increment of velocity for the better part of the analysed run-up and this seems to be a disadvantage for a successful preparation to the jumping onto the board. A careful analysis of Figure 11 shows a bigger decrement in velocity between the eighth and the ninth step (two steps prior to jumping onto the board). This can indicate that MCGs acquire the information about the distance from the board and the vault in eighth and the ninth step, which is significantly later than TCGs. This could therefore be one of the arguments why they can perform only vaults of lower complexity.

An anomaly is noted in the last ten steps of the run-up. The leg which performs the take-off dominates velocity increments. A broken curve in Figure 11 shows in the first, third, fifth, seventh, and ninth boxes (progression of the leg which performs the take-off) mostly higher values than in adjacent boxes (Figure 11). This can indicate an opposite leg injury for MCGs

(causing a slower increment) or a poor running technique.

CONCLUSION

These results suggest that MCGs should try to change their run-up to the vault follow as much as possible the pattern set by TCGs. During the training process, it is necessary to focus not only on maximum velocity but also on the proper progression to the vault, as there is a high correlation with the vault progression for TCGs. If this does not result in a higher second flight phase, the error is in other vault phases, more specifically, in the jumping onto the board and a hand take-off which beside the run-up contribute to increases in the amount of kinetic energy.

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THE TEACHING-LEARNING-TRAINING PROCESS IN RHYTHMIC GYMNASTICS SUPPORTED BY THE ECOLOGICAL THEORY

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Abstract

This study aimed to analyze and compare the structure of the teaching-learning-training process in children's Rhythmic Gymnastics. Seventeen girls, aged 10 to 12 years, who were members of the Rhythmic Gymnastics initiation classes for athletes in the cities of Florianópolis-SC (n = 11) and Maringá-PR (n = 6) participated in this study. A systematic observation method was used for data collection during the typical weeks of training. Chi-square and, when necessary, the Fisher Exact Test were used for statistical analysis. Using aspects of the Ecological Theory, the results showed a similarity between the structure of teaching-learning-training process, as the activity identification, the tasks progression, and coaches' and athletes' conduct. It is possible to conclude that the evidence seems to confirm the use of a methodological approach in teaching RG founded on notions of progressions of exercises through the refinement and application of the technique. On the other hand, it has also become evident that interpersonal relationships that go through the training programs need to be re-evaluated.

Keywords: *rhythmic gymnastics, teaching, learning, training, ecological theory.*

INTRODUCTION

Considering that Rhythmic Gymnastics (RG) has become more visible, mainly in athlete training centers, schools, and particularly in the media, it is expected that many studies related to RG would have been carried out. However, there is a lack of academic work in this area, and studies that have been conducted have mainly focused on high performance aspects of the sport. There are few studies related to RG that have focused on the different levels and methods of teaching and learning, as well as studies that consider the training environment or classroom.

Among the few academic papers in Brazil, the ones which stand out were written by Crause (1985), Freire (2003), Freire & Scaglia (2003), Nista-Piccolo (1999), Oliveira (2002), and Paes (1996).

These have indicated the necessity to adapt models of teaching and learning to children's characteristics and interests. Relevant studies were also carried out by Marques (1997 and 2001), which traced the proximity of training models between schools and clubs, in addition to similarities regarding RG teaching for different age groups and levels.

Another problem with RG is the emphasis given to technical teaching. RG is one of the modalities that requires a certain level of technical expertise from its practitioners due to the complexity of its rules and movements. However, it also involves creativity, beauty, feelings, sensations, behaviors, and actions. This diversity of elements favors different forms of education and raises questions about the

organization and systems of practice, and consequently, on the methods that are used by coaches.

In this context, it is essential to better understand how RG has been taught in athlete training centers. Therefore, we attempted to conduct a study that identified the structure of activities and tasks of the RG teaching-learning-training process, from the perspective of the practice environment and of the relationships between the people involved. The theory underpinning this study is the Bronfenbrenner Ecological Theory.

The ecological approach developed by Bronfenbrenner (1979, 1992), was previously used in studies carried out by Haddad (1997), Krebs (1993, 1995), Stefanello (1999), and Vieira (1999). It states that human development results from the dynamic relationship between humans and the environmental context. For the author, the relevance of this approach relates to the quality of contexts and on understanding the extent to which these contexts facilitate or inhibit the developmental processes of the individual. Thus, there is a dynamic relationship between human development and its constant interactions with the environment. This process, in turn, is composed of elements that mutually interact with each other and simultaneously affect development.

Bronfenbrenner's ecological approach to human development is organized in sequential structures or systems known as the macro system, mesosystem, exosystem, and microsystem. The person being developed can be influenced by these systems. The ecological environment also includes the interconnections between the environment and external influences from the contexts in question.

The structure analyzed in this study was the micro system, which is characterized by a more immediate and more contextualized dimension of development. By Krebs (1995) this provides an initial outline for understanding the development of an individual; the

microsystem is defined as a dimension that allows face-to-face interaction between the developing person and his/her values and beliefs.

According to Martins & Szymanski (2004), the microsystem includes environments such as the home, daycare center, or school. These can be viewed as locations where behaviour change and personal development occur. In addition, the microsystem is comprised of three theoretical aspects: (1) molar activities that provoke development with a certain temporal persistence and a meaning or intention behavior (Krebs, 1995); (2) the interpersonal structures that are formed by the dyads and are established by the relationships between two people (a bi-directional relationship); and (3) the roles, which, according to Nascimento (2003), involve the integration of activity and relationship elements in terms of social expectations.

In addition to Bronfenbrenner's ecological theory, for this investigation, the theoretical field research model was used. This model goes beyond the description of causal processes, that are concerned with specifying and analyzing particular processes that take place in the RG context, since it directly affects the development of children who engage it actively (Stefanello, 1999).

Given the above, the aim of investigating the microsystem in RG was to unravel the inter-personal relationships, the acquisition of new skills, and the proximal processes that sports provide. This will allow, according to Alonso (2004), new possibilities so that the teaching-learning-training process is better structured and developed.

In this sense, the objective of this study was to analyze the structure of the teaching-learning-training process in children's Rhythmic Gymnastics, trying to identify whether there are differences in the complexity of the activities, tasks and teams in the ecological field that was investigated.

METHODS

Among the models of theoretical research identified by Bronfenbrenner (1992), this research is characterized by the person-process-context paradigm, which provides information on the characteristics of people (athletes and coaches), on the processes by which development occurs (teaching-learning-training process), and on systematic information about the context involved (microsystem). This model allows us to analyze variations in the developmental process and outcome in a conjoint function of environmental and person's characteristics performance (Vieira, 1999).

Moreover, according to the classification adopted by Carreiro da Costa (1986), this research also constitutes an educational investigation, conducted in the natural environment of teaching, through the paradigm of Presage-Process-Product. The variables relevant to the presage step are those intentions and actions that teachers have while they are in a teaching situation. In this research these variables are represented by the characteristics of coaches that influence the Teaching-Learning-Training process. The process is comprised of the behaviors adopted by athletes and coaches, and the product refers to the effects on athletes' learning and development.

The benefits of this approach include the possibility to highlight the importance of the decisions and behaviours in learning activities, to identify the nature of the teaching behaviors of coaches, and to highlight the importance of studies in a natural educational environment.

Participants were from two teams, totaling 17 female child rhythmic gymnasts (aged 10 to 12 years). 11 girls were from the State Institute of Education (Instituto Estadual de Educação) in Florianópolis, Santa Catarina, and 6 girls were from the CIAGYM (Integrated Centre for Care Generator Movement for Citizenship - Centro Integrado de Assistência Gerador de Movimento para Cidadania) from Maringá, Paraná. The final sample was determined by

the number of signed ICES (Informed Consent and Explanation of Subjects) (TCLE - Termo de Consentimento Livre e Esclarecimento dos Sujeitos) from parents or guardians. The research protocol was approved by the Ethics Committee of Human Research of Santa Catarina Federal University (Universidade Federal de Santa Catarina - UFSC) (Case 066/07).

Analysis of the structure of the teaching-learning-training process was performed during typical weeks of training in the child category of RG, and was meant to examine the micro sports of each team. In the data collection direct and systematic observation of training was used, together with the use of a camera, and later transcribing the data onto observation forms. We filmed four training sessions each month, amounting to twelve sessions for each team, over three months.

The observation system was adapted from procedures used in studies by Stefanello (1999), Nascimento & Barbosa (2000), Saad & Nascimento (2003) and Silva (2004) to include a detailed analysis of the exercises performed. The analysis of the training sessions used three broad spheres: complexity of activities, complexity of tasks, and complexity of ecological field.

In analyzing the structural complexity of the activities the aim was to describe in detail the activities that were part of the training sessions, the duration of each activity, and their spatial characteristics.

In analyzing the structural complexity of the tasks, we sought to identify: (a) the function of the tasks as a global acquisition of technique (which aims to obtain information on movement and motor development); (b) technique fixing/diversification (focuses on aspects of technical execution, referred to the critical points of its achievement); (c) application of the technique (trying to apply technical skills in a sequence of movements), and (d) competition (which identifies the application of technical skills in situations that portray the requirements of official competition).

Subsequently, we ranked the tasks conditions as an individual foundation (learning basic movements of RG exercise slowly and methodically), a combination of fundamentals (two or more basic foundations of RG, without musical accompaniment), and range of movements (sequence of motions with musical accompaniment).

The task success criteria aimed to rank the criteria as to focus on the achievement of the correct movements (efficiency), on the result of the movement (effectiveness) and the application form of each situation (adaptation in the series of movements).

In analyzing the complexity of the ecological field, we classified the involvement or conduct of the coaches in relation to: initiation by the coach (coach sets the activity to be performed), centered on the coach (coach controls the specific movements to each athlete), and feedback (trainer provides information after the athlete's movement, movement velocity, correcting, modeling, or refocusing). Finally, we sought to characterize the involvement or athletes' conduct as congruent (athlete's conduct corresponds to the task posed by the trainer), modifying (athlete's conduct changes letting the task easier or more difficult), supportive (athlete's conduct to assist in performing other's task), and standby (athlete's conduct to wait, pause, and take a while to accomplish task).

For statistical analysis and description of the data, Microsoft Excel and SPSS (version 13.0) were used. Chi-square, and when the assumptions of this test were violated, Fisher's exact test were used. Significance was set at $p \leq 0.05$.

RESULTS

Structural Complexity of Activities (identification of activities, duration, and spatial boundaries)

In the training sessions of the two teams seven molar activities were identified: stretching, flexibility training, physical preparation, materials handling, and assembly of sets, no music training series, training series provided with music and ballet using bar and/or ground training. Almost all the activities were part of most of the training sessions and there was little variation in the content of the daily training sessions. The similarities between the training sessions of both teams shows that RG training generally follows a routine that is repetitive, monotonous and disciplinarian.

When characterizing RG sportive microsystem, Stefanello (1999) found that, throughout the research process, the same activities were carried out in every training day, both during warm-up, and during the technical preparation phase. Stefanello explains that there was little variation in the sequence of exercises and in the content of sessions, which agrees with the results in this research.

The first features identified in the RG training sessions were the long duration of the sessions and the restricted content. Usually, sessions take around two to five hours daily, in a frequency of 3 to 6 days per week, depending on the skill level of practitioners and the category. In the analyzed teams there were four training sessions per week of around four hours per day. Thus, during the three months of this investigation, three weeks were observed, meaning 12 training sessions for each team, total 2,588 minutes of training for team A, and 2,057 minutes for team B. Table 1 shows the temporal persistence of the main activities carried out by RG teams that were investigated.

Table 1. *Temporal persistence of activities structuring in the GR teams.*

TEAM A	Time	TEAM B	Time
1. Training series with music	710 ‘	1. Training series with music	785 ‘
2. Stretching	525 ‘	2. Training series with music	354 ‘
3. Training of the series without music	383 ‘	3. Stretching	342 ‘
4. Ballet Bar/Ground	330 ‘	4. Training flexibility	200 ‘
5. Physical preparation	292 ‘	5. Physical preparation	166 ‘
6. Materials handling and setting series	253 ‘	6. Materials handling and setting series	108 ‘
7. Training flexibility	95 ‘	7. Ballet Bar/Ground	102 ‘
Total	2588‘	Total	2057‘

Training with music was the activity used most frequently by both teams, which comprised 710 minutes for team A and 785 minutes for team B. In team A, training session activities included stretching, training series without music, bar-ground ballet, physical preparation (materials handling and setting the series), and flexibility training. Activities used in team B sessions included stretching, flexibility training, physical preparation (materials handling and setting the series), and bar/ground ballet.

Overall, it was noted that the analyzed teams presented similarities regarding the structuring of activities in the observed training sessions, since the three activities most frequently used were the same for both teams. Afterwards, it was possible to realize that there was only one inversion in the presence of ballet activities in team A, and the presence of flexibility training activities in team B. The activities carried out comprised three segments of training: physical preparation, technical preparation, and ballet. The physical preparation segment, often carried out at the beginning of sessions, included activities such as stretching, flexibility training, and physical preparation exercises (abdominal, vertical jump, and strength). The technical preparation segment featured activities of handling/setting series, training series without music training, and training series with music. Finally, the ballet segment was

constituted by ballet activities performed on the bar and/or on the floor.

Sessions always started with physical preparation followed by technical preparation, with ballet interspersed. During practice, athletes often had a 15 minute break for eating and recovery. However, it was possible to notice that the training sessions of the two teams were more focused on technical training (training series with music, the series without music training, and handling/setting series, consecutively), showing a greater concern for the correct completion of exercises. In this respect, during almost all the sessions, the athletes focused on the difficulty of the series, i.e., isolated or combined movements that correspond with the rules set out in the 2007 Code of Points (Código de Pontos de 2007).

The analysis of spatial delimitation for team B focused on one main court of the gymnasium, which was divided into two RG sub-blocks. One of these areas was demarcated by a carpet and the other was not. A ballet room was also used for their training. However, on several occasions this team faced problems with the availability of these spaces. Unavailability was caused by structural problems and other forms of training modalities happening at the same time. As a consequence, the team had to use other available spaces, such as the gymnasium stairwell, the lobby, etc., which were limited and inadequate for practicing

RG. In these alternative spaces there were often no adequate materials, which negatively affected the training sessions. Even the safety fence that surrounded the courts was used as a ballet bars.

Another problem faced by team B was the extra presentations that were not programmed in the structuring of the trainings. These unexpected situations had the following effect: first, they negatively affected the work of technical training, however they gave a new positive meaning to the athletes' action, in which they were the ones who planned the routines (without the necessity of meeting the rules of the Code of Points), developing creativity, self-confidence, teamwork and autonomy.

Team A had one main court for RG where the athletes stretched and practiced their series individually with music. There was also an area booked for the practice of gymnastics, where the athletes practiced their routines individually and together with the whole group. This court also had a ballet bar. During this study no unexpected use of this group's space was noted.

Structural Complexity of Tasks (function, classification, and success in tasks criteria)

The detailed analysis of the task allowed a precise description of the gradual shift of progressions, refinement, and application of exercises in the RG teaching-learning-training process.

According to Mesquita (1997), progress includes the interference in the degree of the tasks complexity so that without taking away the essence of the learned behavior, the acquisition is gradual, with a progressive increase in the levels of demand. In this respect, the training contents must be organized by establishing constant links between what was acquired and what will be the acquisition focus, in an increasing evolution perspective, always referring to before and after periods. Furthermore, the progressions must be adjusted to the characteristics of the training factors (complexity, intensity, and volume), and to the athletes' characteristics. In RG, three progressive elements add up to the function of the tasks: technique acquisition, fixation and technique diversification, and technique application and competition.

Regarding the function of the task (Table 2), the results reveal that technique acquisition was less frequent in the tasks performed by the investigated teams (team A 23.3%, and team B 17.4%). These percentages can be justified by the short time devoted to ballet - the segment of training that most emphasized technique acquisition (the technique acquisition depends directly on the degree of complexity of a motor task, the number of elements necessary to be coordinated and the network of relationships established between these elements).

Tabela 2. Frequency and percentage of the function of the tasks of the teams.

Function of the task	Team A		Team B		Total		P
	f	%	f	%	f	%	
Technique acquisition	10	71.4% ^a 23.3% ^b	4	28.6% ^a 17.4% ^b	14	100.0% ^a	0.162
Fixation/technique diversification	19	76.0% ^a 44.2% ^b	6	24.0% ^a 26.1% ^b	25	100.0% ^a	
Technique Appliance/ Competition	14	51.9% ^a 32.6% ^b	13	48.1% ^a 56.5% ^b	27	100.0% ^a	
Total	43	100.0% ^b	23	100.0% ^b	66	100.0% ^{a/} ^b	

Legend: a=line; b=column

The most frequent exercises in team A were: fixing and technique diversification (44.2%). This function is characterized mainly by technique refinement, focused on the most difficult aspects of accomplishment. In the RG training sessions fixation and diversification were made up of constant repetitions and variations of isolated movements and combinations, with or without the use of appliances.

Similar to RG, in the team sports categories it was possible to conclude that the repetition of technical gestures is also the most widely used method of learning. This method disregards the process of construction and comparison of existing knowledge with the knowledge that is acquired (Moreira, 2005).

In team B the most frequently used functions were technique and competition application exercises (56.5%). In RG, the technique application exercises in RG competition are used in situations that contain the characteristics of a series, being a whole sequence or only a part of movements organized according to the difficulty required in the Code of Points. The competition exercises are evidenced when performed with musical accompaniment in a complete sequence of movements, from the beginning (initial pose) to the end (final pose).

However, during the technical preparation of team B there was no concern regarding the execution of movements, since most of the tasks were aimed at training the series as a whole. On this topic Mesquita (1997) warns that athletes need, above all, to learn how to execute correct technique in order to proceed with further actions. Thus, insofar as certain technical errors occur, they become increasingly more difficult correct, which in turn may compromise the correct movement execution. Therefore, for the author, teaching technical skills should be done in isolation, which can minimize the occurrence of erroneous automatisms and difficulties that need to be correct.

The ratings of the task, presented in Table 3, revealed that team A has focused its learning process on a combination of fundamentals (46.5%). These data demonstrate the importance this team attributed to training and to the repetition of the difficulties that composed the series. This team used to direct most of the segment to technical preparation for the refinement and improvement of technique. However, the practice in team B was directed mainly at the foundation series (47.8%), which characterizes the teaching-learning-training process in a more general, broad and global way.

Table 3. Frequency and percentage frequency of the classification of the tasks of the teams.

Task classification	Team A		Team B		Total	P
	f	%	f	%	f	
Individual fundament	8	66.7% ^a 18.6% ^b	4	33.3% ^a 17.4% ^b	12	100.0% ^a
Combination of fundamentals	20	71.4% ^a 46.5% ^b	8	28.6% ^a 34.8% ^b	28	100.0% ^a
Series of fundamentals	15	57.7% ^a 34.9% ^b	11	42.3% ^a 47.8% ^b	26	100.0% ^a
Total	43	100.0% ^b	23	100.0% ^b	66	100.0% ^{a/b}

Legend: a=line; b=column

The results found point to several different methodological trends in the teams investigated. While the process of teaching and learning of team A stood mainly on refining techniques with characteristics of the analytical method, and team B focused the process in practicing the movement in a more globalized way, with characteristics of a global method.

On the issue of RG teaching methods, there is no consensus in the literature. For Pereira (1999), the movements should be taught in isolation, with the elaboration of a pedagogical sequence before associating them, gradually increasing the degree of difficulty to raise the level of learning. In return, Caçola (2005) asserts that by teaching through a global method better results can be obtained. However, Mesquita's (1997) seems to have a more coherent approach, which proposes that the methodology used by the coach, when teaching skills, should not be standardized, but must meet the predetermined criteria in accordance with the selected objectives and contents.

Thus, the use of only one methodology becomes a reductionist action. Therefore, we must understand that during the teaching-learning process there may be different possibilities of education.

Another important aspect in structuring the complexity of the task is the criteria for success (Table 4). The success criteria are based on three key elements: efficiency, effectiveness and application on the situation. However, in the RG context, it became necessary to group the efficiency and effectiveness elements as a fourth element, due to variations of the sport in the use of materials (rope, ball, bow, ribbon and/or apples).

The results in Table 4 showed that the criterion application in the situation was the most frequent in both teams (32.6% of Team A, and 56.5% Team B). However, more than half of the percentage of team B was focused on this criterion, showing that the training sessions of this team were basically applied in the execution of the series, being the adaptation of tasks the priority in the movement series.

Table 4. Frequency and percentage frequency of the criteria for task success of the teams.

Success criteria	Team A		Team B		Total		P
	f	%	f	%	f	%	
Efficiency	12	80.0% ^a 27.9% ^b	3	20.0% ^a 13.0% ^b	15	100.0% ^a	
Effectiveness	10	66.7% ^a 23.3% ^b	5	33.3% ^a 21.7% ^b	15	100.0% ^a	0.24
Efficiency e effectiveness	7	77.8% ^a 16.3% ^b	2	22.2% ^a 8.7% ^b	9	100.0% ^a	0
Application in the situation	14	51.9% ^a 32.6% ^b	13	48.1% ^a 56.5% ^b	27	100.0% ^a	
Total	43	100.0% ^b	23	100.0% ^b	66	100.0% ^{a/b}	

Legend: a=line; b=column

Another important fact was that, in the two teams, the criterion that appeared least often was efficiency and effectiveness (team A 16.3% and team B 8.7%), something described as contradictory, facing the requirements of the modality, because concerning RG it is as necessary for the athlete to perform the movements correctly

as it is necessary for her to obtain satisfactory results, especially when executed with materials. When launching a ball, jumping, and recovering a ball consecutively, the athlete should not be concerned only in making the jump right, but also in obtaining a good result when recovering the ball.

The criteria of efficiency and effectiveness analyzed separately, had better distribution in Team A, differently than in Team B that presented a much higher percentage to obtain results (21.7%) compared to the correct performance of movements (13.0%).

Ecological Field Complexity (conduct among coaches and athletes)

The last sphere to be analyzed was the Ecological Field, which refers to established patterns of behaviors among coaches and athletes and their established relationships in the sports microsystem.

The term 'conduct' refers to the individual conscientious behavior and is directly influenced by the expectations of others. Facing this, the ecological perspective identifies the emergence of social roles that directly interfere with the performance of activities and conduct relationships among coaches and athletes. According to Bronfenbrenner (1996), social roles represent the way each person should act and the way others act towards him/her. Moreover, the role expectations may determine how the person participates in a given context and the relationships that are created among her and the others.

Two lines marked the RG teaching-learning-training process, initiated by the coach and the athletes' congruent behavior. These procedures show the characteristic command style of the instruction and practice directly controlled by the coaches

and followed and enforced by the athletes. As in the study carried out by Stefanello (1999), artistic gymnastics coaches took, virtually, all the decisions about what and how things should be done, overseeing the development in all of the activities.

In this study, similar data to that of the Stefanello (1999) study was obtained. It became evident in both investigated teams that the roles identified obeyed a relation of hierarchy. The coaches held total control of the training sessions, especially in the activities to be performed, while all the athletes performed consistently from the beginning to the end of the practice with no objection, in a fairly automated way.

In the interpersonal relationships among female athletes, the social role established during practice was determined by the technical level of each of them. The athletes who were more advanced, or had a better technical level, attracted the attention of others, especially during the training series with music.

Regarding the results presented in Table 5, it was possible to notice that in both teams the behavior initiated by the coach was the most frequent one (Team A 45.7% and Team B 63.5%). But in team A the behavior initiated by the coach with feedback was also evident (44.3%). However, there were no significant differences in the approaches adopted by the coaches.

Table 5. Frequency and frequency percentage of the teams' coaches' behavior.

Coaches behavior	Team A		Team B		Total		P
	f	%	f	%	f	%	
Initiated by the coach	32	49.2% ^a 45.7% ^b	33	50.8% ^a 63.5% ^b	65	100.0% ^a	0.148
Initiated by the coach /Feedback	31	67.4% ^a 44.3% ^b	15	32.6% ^a 28.8% ^b	46	100.0% ^a	
Centered on the coach	7	63.6% ^a 10.0% ^b	4	36.4% ^a 7.7% ^b	11	100.0% ^a	
Total	70	100.0% ^b	52	100.0% ^b	122	100.0% ^{a/} b	

Legend: a=line; b=column

Regarding team B, it was possible to notice that the behaviors that were focused on the coach and initiated by the coach with some level of feedback presented low frequencies (7.7% and 28.8%), suggesting that the coach played a little active role during trainings in two aspects: in not controlling the activities and not providing information regarding the corrections of movements.

Opposing the action of the coach of team B, Cooke et al (2005) stresses that there must be a feedback in any teaching-learning process, because it contributes, at least, with four possible roles: motivation, reinforcement, information, and guidance. In this context, one must understand that feedback can be used as a favorable instrument for learning process of skills if provided in an appropriate and positive way (p. 128).

Adams (1971) in Chiviacosky & Godinho (1997) also emphasizes that, in most cases, during their training, individuals are not able to trigger the mechanism of

detecting and correcting errors. The author adds that when individuals are still developing the standard reference on the correct movement, it is crucial that additional information be provided to adjust and correct the next response, and to always come closer to the correct standard. Without this information, the individual can establish that a wrong standard is becoming more consistent.

According to Table 6, the results indicated that there are significant differences in the behaviors adopted by the athletes ($p = 0.002$). Thus, it was possible to notice that the congruent behavior was the most frequent in both teams (51.4% on team A and 36.5% in team B). On the other hand, less frequent behaviors differed between the teams. In team A, the least frequent behavior was the congruent one and the modifier one (11.4%), while in the B team it was the consistent and supportive behavior (3.8%).

Table 6. Frequency and percentage frequency of athlete' teams' behaviors.

Athlete's behavior	Team A		Team B		Total	P
	f	%	f	%		
Congruent	36	65.5% ^a 51.4% ^b	19	34.5% ^a 36.5% ^b	55	100.0% ^a
Congruent/ Modifier	8	36.4% ^a 11.4% ^b	14	63.6% ^a 26.9% ^b	22	100.0% ^a
Congruent/ Supportive	14	87.5% ^a 20.0% ^b	2	12.5% ^a 3.8% ^b	16	100.0% ^a
Congruent/ Waiting	12	41.4% ^a 17.1% ^b	17	58.6% ^a 32.7% ^b	29	100.0% ^a
Total	70	100.0% ^b	52	100.0% ^b	122	100.0% ^{a/b}

Although team A has shown a low percentage (20%) in the congruent and supportive behavior during the course of physical preparation (strength training, abdominals and jumps), it was established that there was interdependence among the athletes in some activities (activities done in pairs and with the help of more than one athlete). Similarly, Stefanello (1999) showed that in RG activities that

requisitioned the interdependence among the actions of the athletes were also scarce.

Still in relation to the consistent and supportive behaviors, we must clarify that in RG there are two possibilities for exercise series, the individual and the group ones. In this investigation, although the group training of the series of movements presented collaboration among the gymnasts, they were not considered

supportive behaviors. This is because those procedures were not performed by the athletes as a free endeavor, but these were the requirements of the regulations imposed by the Code of Points.

In this sense, the main roles played by athletes in most of their training activities were only done by active and observing participants. The roles of the observers were seen in various situations, especially in the B team, both in the physical preparation (activities organized in rows) and in the technical preparation, during the series training.

By relating the behavior of the coaches with the conduct of athletes, regardless of the team investigated (Table 7), it was possible to identify the existence of a significant association between these variables ($p < 0.001$). This fact is evidenced by the behavior initiated by the coaches (44.6%), initiated by coaches with feedback (44.7%) and centered on the coaches (54.5%) when combined with congruent behavior of athletes.

Table 7. Frequency and percentage frequency of the behavior of athletes in relation to the behavior of coaches.

Coaches' behavior	Athletes' Behavior								Total	
	Congruent		Congruent/ modifier		Congruent/ Supportive		Congruent/ Waiting			
	f	%	f	%	f	%	f	%	f	%
Initiated by the coach	29	44.6%	17	26.2%	13	20%	6	9.2%	65	100
Initiated by the coach/ Feedback	21	44.7%	3	6.4%	2	4.3%	21	44.7%	47	100
Centered on the coach	6	54.5%	2	18.2%	1	9.1%	2	18.2%	11	100

p<0.001

Overall, the results of this analysis show that there is a strong relationship established in social roles between coaches and athletes in RG. On this aspect, Mesquita (1997) assumes that there is a relationship of complicity between those who teach (coach) and the learners (athlete), which is embodied in matter of training (content of practice).

However, what really makes it crucial to the development process, according to Bronfenbrenner (1996), is not only the type of interpersonal relationship formed, but the quality of inter-relationships. That is, the degree of reciprocity established among the participants of the molar activities, the power dynamics established between elements of the interactions and the type of emotional relationship between them.

From this perspective, it is essential that professionals from this area understand and reflect on the relationships established in this context, between coaches and athletes, since the activities, roles, and interpersonal relationships experienced in an environment contribute significantly to the development of individuals. Bronfenbrenner (1992) also warns that extreme disorganization or stiffness in the structure and functioning of these relationships represent danger signals for psychological growth of the developing person, whereas intermediate degrees of flexibility are the optimal conditions for human development. This study shows that the training teams analyzed, in most cases, involve a high degree of stiffness, perhaps affecting the development of those involved.

CONCLUSIONS

From the characterization of the RG's sports microsystem it was possible to conclude that the structure of the teaching-learning-training process seems to be solidified regarding to its activities, to the organization of daily training sessions, as well as in interpersonal relations, and in social roles between coaches and athletes. The evidence confirms that the teams investigated presented almost the same structure, and differed only in their teaching methods.

As to the Structural Complexity of Activities, it was concluded that the molar activities developed in the training sessions of RG are similar in identification, but differ as to the duration. It was also found that the RG practice sessions were generally long, homogeneous, and repetitive.

The analysis of the Tasks Structural Complexity made it easy to identify some differences between the teams. While team A prioritized the development of fixation and diversification tasks of individual basic techniques, team B provided technical application tasks performed by systematized repetition of combinations and basic series. In RG practice there is a concern both with the refinement and improvement of technique, and with the factor of physical performance and motor performance of athletes. The evidence confirms the preference for the overall teaching method in team B, while in team A was most used of the analytical method or part of it.

Concerning the criteria of success, both teams concentrated on the application situation, i.e., adapting the movements in situations of series so that the athletes could develop a large repertoire in motor quick solution of problems found in situations of series. The study highlights the emphasis of team A on the efficiency of movements, correct execution of movements in a progressive and individualized way.

Concerning the Ecological Field Complexity, interpersonal relationships were homogeneous in both teams, since the coaches' behavior was almost always to start

the situations, and the athletes' behavior was always congruent. These data confirm the hierarchical roles that are developed in the RG context, where the coaches tried to take control over all situations in the teaching-learning-training process.

Despite the coaches demonstrating full control of training sessions, in the A team there was also a constant concern with the feedback provided by the athletes. Moreover, very few times such an action was noted team B, except in the training activities of the series with music, which demonstrated negative feedback in the learning process. The athletes trained their staff in this series without the accompaniment of the coach, resulting in the execution and automation of incorrect movements, which invalidated the effects of feedback.

Regarding the conduct of athletes, it can be seen that, although they always shared the same space, as it occurs in team sports training, the activities developed are highly individualized, because few activities that establish interaction between them were noticed.

In summary, with respect to the teaching-learning-training process, the evidence seems to confirm the use of a methodological approach in RG teaching founded on notions of exercise progression, through the refinement and application of the technique. On the other hand, it has also become evident that interpersonal relationships that go through the training programs need to be re-evaluated, especially regarding the rigidity of the sessions and the lack of communication between coaches and athletes.

Finally, it is necessary to conduct more studies of this nature in other RG categories, in order to demonstrate more fully the various ways of structuring the teaching-learning-training process of the modality, and to assist in the performance of teachers/coaches, as well as in the initial and ongoing training of these professionals.

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THE SPREAD OF GYMNASTICS IN EUROPE AND AMERICA BY PEDAGOGUE-GYMNASTS DURING THE FIRST HALF OF THE 19TH CENTURY

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Abstract

At the beginning of the 19th century, a general gymnastics movement was created by the Philanthropists' movement of the 18th century. Its main representatives were the great gymnastic systems (German, Swedish, English, and Slavic). In addition to the founders of the above gymnastic systems, there were also some other pioneer pedagogue – gymnasts. These people promoted physical education and more specifically gymnastics (Artistic Gymnastics: AG), and developed various gymnastic methods in several countries. The main components of these gymnastic methods were the various forms of AG, which spread and developed mainly through the gymnastic associations of the German gymnastic system. The aim of this study was to research and describe the gymnastic systems and the instructive and written works of the first pedagogue – gymnasts in the first half of the 19th century, who spread physical education and AG across Europe and America.

Keywords: *history, gymnastic movement, gymnastic systems, gymnastic apparatuses.*

INTRODUCTION

The Philanthropists' gymnastic movement began in Europe and America during the first decade of the 19th century. Specifically, Guts Muts's and Vieht's books constituted the base of this gymnastic movement and so many other books were written by other pedagogue- gymnasts. Then, the three main gymnastic systems were developed in this favorable environment (German, Swedish, and English) (Krüger, 1993; Pahnche, 1983). After Jahn, many pedagogue-gymnasts appeared in Germany. Their instruction and written work contributed to the rise of physical education and AG. Eiselen was one of these pedagogue-gymnasts (Jahn's student, collaborator, and best friend). Massmann was Jahn's student and the

founder of Bavarian physical education, and another man named Spiess was Guts Muts's and Jahn's admirer and the founder of the German and Swiss school of physical education. Spiess organized, separated, and grouped the German gymnastic system. (Borrmann, 1978; Chrisafis, 1965; Pahnche, 1983). This study was about pedagogue – gymnasts, who spread physical education and AG across Europe and America, with their books, their instruction and their gymnastic methods. This study was also about countries and pedagogue – gymnasts who cultivated and spread this system, either in its original form or a modified version. All these gymnasts had studied the Philanthropists, who devoted part of their books in forms of AG (Guts Muts, 1793; Vieht, 1794). They had studied and

translated Jahn's book that constituted the base of the German gymnastic system and specifically of AG (Jahn & Eiselen; 1816). Some of these gymnasts showed their own philosophy in a different way and with a different content in physical education and AG, something that history has not recognized until now. Some other gymnasts tried to convince people in their country, who were fond of gymnastics, that they were introducers of a new and original gymnastic system, but, in fact, it was a misleading modification, mainly of the German and Swedish system or some other gymnastic method. However, it did not constitute a completely new gymnastic system.

Doctors, who used gymnastics and AG for medical reasons, also contributed a lot to the gymnastic movement during that period. From 1820 onwards, various private institutes were founded by doctors and gymnasts mainly in Germany and England. Their aim was the healing and recovery of disabled girls, with myoskeletal problems. At the same time these doctors and some gymnasts published special books concerned with women's gymnastics and the healing of girls with myoskeletal problems with the help of gymnastics. (Hagelin 1985; Kaimakamis 2003; Pahncke, 1983).

Throughout the 1850's, there was a hostile attitude towards certain gymnastic apparatuses of the German gymnastic system, particularly the parallel bars. The reasons seemed to be political and ideological and appeared in Prussia, the country of the above system (Krüger; 1993). The world famous doctors (professors of physiology) Raymond & Virkov reinstated these apparatuses, and specifically the parallel bars, with their scientifically presumed intervention; Raymond's proposal finishes with the following phrases: "AG is useful and effective for muscles and nerves". "... and if the parallel bars had not been invented, the human beings should anyhow have to invent them in the name of physical education". (Gasch; 1920). Also, during that time period there was rivalry

between the two sovereign gymnastic systems (Swedish and German), not because of the real difference and the supremacy of one or the other, but due to political, national, and racist motives (Kaimakamis; 2001). The main characteristics of the German gymnastic system were the acrobatics, the steady gymnastic apparatuses (horizontal bar and parallel bars), and the foundation of gymnastic associations. The main characteristics of the Swedish gymnastic system were the gymnastic exercises, the absence of the horizontal bar, the parallel bars, and of course the distinction of gymnastics in school, military, medical, and aesthetical gymnastics. This system was recognized, and spread throughout Europe and to America from the beginning of the 20th century onwards. Its first great success was the impressive appearance of the Scandinavian countries in the Mesolympic Games in 1906 in Athens. (Kaimakamis et al., 2001). Finally, three basic points must be clarified and explained in this introductory section:

Firstly, during the 19th century, AG did not mean a separate and specialized sport, with specialized regulations, common dimensions and functional specifications in the apparatuses, but constituted various gymnastic apparatus included in a general, mixed gymnastic system.

Secondly, AG (specifically for women) and Rhythmic Gymnastics (RG), in their current form, were created later, by the combination of these two gymnastic systems.

Thirdly, up to the end of the 19th century, the German gymnastic system was supreme and was the base of the European and world AG (especially for men).

The introduction of the German gymnastic system in England and role of Clias.

The German gymnastic system had spread to England (home of the English gymnastic system) from around 1825, due to Jahn's various students, such as Karl Föller, and the Swiss pedagogue-gymnast Fokion Heinrich. Clias (1782-1854)

introduced military gymnastics in this country (Mouratidis, 2000; Prestidge, 1988). In England AG was at its peak from the middle of the 19th century until the beginning of the 20th century. Many associations and gyms, with thousands of members, were founded. Clias contributed to the spread of AG and specifically of military gymnastics. Clias was born in America and lived in America, Switzerland, France, and England. "He used to train, to be trained, to teach, to write" (Chrisafis, 1930). His most important book, published in Bern in 1816, was titled "The basic principles of gymnastics and AG" (Hagelin, 1985). Among the various sports and games that Clias taught and included in this book, there were also exercises for the gymnastic horse, climbing, swinging, and exercises on the swinging "triangle", which Clias claims he invented. A commentator on Clias' work describes this apparatus and the way of his practice on this: "This apparatus consists of a strong bar four feet in length, supported in its edges by two ropes, fifteen feet in length, which are linked on a transversal beam. On this triangle, Clias demonstrates his maximum strength, hung either by the legs from the bar or the ropes, or with his head downwards. I have seen him staying in this position for a long time with his hands kept behind his back..." (Chrisafis, 1965). Clias' gymnastic method was oriented to apparatuses and exercises, which were really useful and not just impressive and spectacular.

Amoros's presence in French and Spanish gymnastics and his contribution to the general gymnastic movement in Europe

Francisco Odeano Amoros (1770-1848) was the founder of French and Spanish gymnastics. He lived during the first half of the 19th century. After he excelled in the Spanish army and Spanish gymnastics, he fled to France for political reasons, because he participated in the Battle of Waterloo in 1815 with Napoleon's troops, which were defeated by the allied forces. In his gymnastic methods and books (1819, 1821, 1830) he included a number of steady gymnastic apparatuses, like balance

beams (parallel bars and inclined), balance bars, swinging and climbing apparatuses, gymnastic horses, swinging horizontal bar etc. (Amoros, 1830). The last of these was invented by Amoros himself. He narrated that a Prussian traveler described it to him in Madrid, in 1806 (Chrisafis, 1956). So, Amoros is thought to be the inventor of this apparatus.

Nachtegal, the founder of Danish gymnastics, was one of the most important pedagogic-gymnasts of the first half of the 19th century.

Denmark has a great gymnastics tradition. A daily training programme for girls and boys was introduced in its schools in 1814 (Chrisafis, 1965). Denmark preceded even Prussia and many other European countries by 26 years in this regard. The great Greek gymnast J. Chrisafis praises this avant-garde Dane, as well as Guts Muts in his important book "Gymnastik für die Jugend" (gymnastics for young persons) (Guts Muts, 1804). Franz Nachtegal is considered to be the founder of Danish gymnastics (1777-1845). He was an educated person, who knew all Guts Muts's books on gymnastics (Chrisafis, 1930). Nachtegal left a great gymnastic work to Denmark and the entire world. His work had two focuses: pedagogic or school gymnastics, and military gymnastics. He used the following steady apparatus that had a direct relation to the later discipline of unmixed AG: balance beams, swinging and climbing apparatus, gymnastic horses, and various rolling exercises on the floor, which later became a special tradition in Denmark (Chrisafis, 1965). Nachtegal used these apparatus for the development of physical abilities and not for impressive acrobatics. One student, who attended his lectures for the education of gymnasts in Copenhagen, was Pier Ling, who was the founder of the Swedish gymnastic system.

Tyrs, the founder of the gymnastic movement in the Slavic countries

Miroslav Tyrs (1832-1884) is considered to be a great personality, particularly for the Slavic nations. He was an intellectual and he founded the gymnastic association "Sokol" (Falcon) in 1862. His aim was to promote gymnastics and improve the cultural and national level of the Slavic nations (Blecking, 1987). Later, similar associations were founded in all the Slavic nations, while at the same time a gymnastic, cultural, national, and liberation movement was created through them. The result of this movement was the organization of Slavic gymnastic and cultural meetings called Slets (as of 1953 these games were replaced by the "Spartakiades"), (Huguenin, 1911). Tyrs was a professor of history and art and an expert of ancient Greek gymnastics. He created a new gymnastic movement, in which he added elements from various other gymnastic systems (mainly from the German system) mixed with national, cultural, and folklore elements of the Czech nations. Tyrs work is great and except for his gymnastic method, he establishes the gymnastic terminology of the Czech (Blecking, 1987). The main characteristics of Tyrs's method were the gymnastic apparatus of the German gymnastic system, as well as the spectacular gymnastic performances by hundreds of athletes who were performing simultaneously (Huguenin, 1991). Countries like the Czech Republic, Slovenia, Slovakia and Poland had a developed level of AG in the beginning of the 20th century. During the first decades of the 20th century Czech (later Czechoslovakia and nowadays Czech Republic) was a world champion six times, from a total of nine championships (Kaimakamis, 2001).

The spread of various variations of the German gymnastic system in Italy, the Netherlands, and in other states of Europe

Italy did not present any gymnastics movement during the beginning of the 19th century. The Swiss Obermann and Baumann promoted the German gymnastic system in

this country, but in the distinctive style of Spiess', Jahn's, and Guts Muts' method (Gasch, 1920). In 1865, Obermann published a book with many pictures and references to Gymnastics (Obermann, 1865). At the end of the 19th century and at the beginning of the 20th century, Italy was one of the most important gymnastic forces with a high level of AG. Italy participated in all the Olympic Games in the first three decades of the 20th century and held a leading position in AG. The greatest athlete of that period Alberto Braglia was a member of the Italian team (Götze & Herholz, 1992; Götze & Zeume, 1989).

The German gymnastic system spread to the Netherlands (Holland, Belgium, Luxemburg), where a lot of gymnastic associations and gyms, with thousands of members, were founded. The International Federation of Gymnastics (FIG) was founded in Belgium in 1881, by the President of the Belgian Gymnastic Federation, Niclaus Cuperus (Huguenin, 1981).

Jahn's students, tradesmen, and political fugitives promote the German gymnastic system in the USA and in South America

AG and the German gymnastic system began to be spread in the USA from the beginning of the third decade of the 19th century when some of Jahn's students (like Follen, Beck, and Lieber) arrived and settled there (Gasch, 1920). Follen introduced Jahn's gymnastics to the University of Harvard in 1826, and Beck translated Jahn's book "Die Deutsche Turnkunst" (Mouratidis, 2000). Many political fugitives arrived in the USA at the end of 1840, after the revolution against the feudal lords failed in Germany. Therefore a lot of German communities were created (mainly in Philadelphia and Saint Louis), which consisted of several former gymnastic-revolutionists. In 1860 these Germans founded the first gymnastic association in America, called "Cincinnati Turngemeinde". In 1850 13 German-American gymnastic associations were organized in leagues, and later a federation

was formed called "Socialist Gymnastic Federation of North America". Turners also had their own organisation. Up to 1860, 70 associations with 7,000 athletes were founded and ten years before the end of the century, in the USA, there were 312 German associations, with 41,000 members, which produced a high level of AG (Binz, 1985).

The organization of gymnastic events of the Olympic Games in 1904, in Saint Louis, shows the American people's love for high level AG. At that time, 17 German associations with many members existed in Saint Louis. The Americans had a complete programme with four team all around events and an individual all around event, according to the German gymnastic system (Götze & Herholz, 1992).

In Latin America and mainly in Chile, Argentina, and Brazil the German gymnastic system and AG began to be spread from the middle of the 19th century onwards (Temme, 2000). European (mainly German) tradesmen, pedagogues, politicians, and economic refugees, who had settled in these countries, brought Jahn's gymnastic methods with them. In Chile, the German political fugitive Karl Anvander, who arrived in the country in 1850, introduced the German gymnastics. In 1853 he and other Germans founded a gymnastic association and a school in the city of Valdivia (Temme, 2000). Later, gymnastic associations that taught the German gymnastic system multiplied. So, the German community created a powerful gymnastic, social, and commercial movement in Chile and other parts of South America. The German emigrants, in keeping with the habits of their homeland, began to organize annual gymnastic and cultural events in their new home-countries. These events were called Turnfeste (Temme, 2000).

The German gymnastic system spreads to Russia and Ukraine, where a general gymnastic movement is created

Jahn's gymnastic movement began to spread early but slowly, in various regions of Russia and Ukraine. In 1825, Holander,

who had studied in Prussia and was Jahn's student, established the first gym using the German model, in Riga. In 1837 the German Lange founded the first gymnastic association in Odessa. In the early 1860's, a number of similar associations were founded in Moscow and in Saint Petersburg (Gasch, 1920). Later, these German associations had multiplied and began to organize annual athletic and cultural events in the model of the German "Turnfeste". In 1881, the first original Russian gymnastic association was founded in Moscow. The famous writer Giliarofski was the president of this association. In 1897, the first pan-Russian gymnastic events were held in Saint Petersburg (Arkayev, 1997). In 1900, in Saint Petersburg, another gymnastic movement appeared, which was based on Jahn's movement, but catered for the Slavic nations. The Czech gymnast and pedagogue Wichra founded the first Czech gymnastic and cultural association in the model of the Slavic "Sokol" (Gasch, 1920). Later, in 1913, after these associations had multiplied, the federation of "Sokol" was founded (Arkayev, 1997). The German gymnastic system and AG were in ascendance in Russia, however the October Revolution of 1917 suppressed this athletic movement, because it was considered to be the "sport of Bourgeoisie" (Gasch, 1920). Contrary to the view of gymnastics being the "sport of Bourgeoisie", it was found to be very useful for the soviet army. After a decade, unmixed AG began to be spread in all Soviet Union nations and across all social classes. Later, these countries became the greatest gymnastic forces in the world.

The German gymnastic system in Greece

In Greece the German gymnastic system began to spread after the establishment of the Modern Greek state. G. Pagontas was the founder of this system. He had studied in Munich beside Massmann (Jahn's student). Also, many Germans and thousands of Bavarians promoted this system when they came to Greece during that period. Othon was the first king of Greece. Othon's father was fond of ancient

Greece and gymnastics. When Othon came to Greece, many Bavarian consultants and 3500 soldiers followed him (Kaimakamis & Mouratidis, 2003; Seitzl, 1965).

In 1837 G. Pagontas wrote his first book about gymnastics, based on books by Guts Muts and Jahn (Pagontas, 1837). In his book he describes how to manufacture several gymnastics apparatuses, and also some of the exercises that could be performed on them. At the end of his book, there is a special table with pictures of these apparatuses. The writer states that some of these pictures were taken from Amoros' book, and some from Guts Muts' and Jahn's books (Pagontas, 1837).

Jahn's gymnastic movement, and later the mixed German gymnastic system, spread across the developed world. The gymnastic associations were founded one after the other, in the following countries and cities: Australia (Melbourne 1861, Adelaide 1864, Sidney 1862), Congo (1863), Istanbul (1874), Stockholm (1864), Copenhagen (1878), and in some large African cities (Gasch, 1920).

CONCLUSION

The Philanthropists' instructive and written work created a general gymnastic movement, from which all the main gymnastic systems emerged.

Jahn was the founder of the German gymnastic system. His students promoted this system and AG in Germany, and across almost the entire developed world. Additionally, many natives of these countries, who had known and adopted this system, contributed to its promotion.

Many of these great pedagogue-gymnasts modified the German gymnastic system to develop new gymnastic methods. Others did not do anything more than a simple translation or a slight modification of the work of other important gymnasts.

AG spread all over the world, through gymnastic associations (the main characteristic of the German gymnastic system). These associations were

institutions of an athletic, political, social, and national movement.

In the Slavic nations, Jahn's gymnastic movement was modified, promoted, and organized in a way that reflected the character of these nations and to accommodate their particular national and cultural needs.

In Greece, the main representatives of the German gymnastic system and AG were the Greek gymnast Pagontas (with his instructive and written work), some German gymnasts, thousands of Bavarian soldiers, and king Othon's consultants.

From the middle of the 19th century onwards the German gymnastic system, after its rapid development, was considered to be the sovereign gymnastic system.

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Slovenski izvlečki / Slovene Abstracts

Laurita Marconi Schiavon in Roberto Rodrigues Paes

RAZVOJ BRAZILSKE ŽENSKÉ ŠPORTNE GIMNASTIKE OD OLIMPIJSKIH IGER 1980 DO LETA 2004

Rezultati brazilskih telovadk v športni gimnastiki so se na mednarodnih tekmovanjih zelo izboljšali v zadnjih desetih letih. V iskanju odgovorov zakaj so telovadke bile tako uspešne smo izvedli primerjalno analizo zgodovinskih dejstev življenjepisov telovadk, ki so tekmovali na olimpijskih igrah od leta 1980 do leta 2004. V intervjujih desetih najuspešnejših telovadk omenjenega obdobja smo jih spraševali o: pričetku vadbe gimnastike, udeleževanju v ostalih športih, športnih idolih, pogojih vadbe, prehrani, psiholoških vidikih vadbe, poškodbah, udeležbi na OI, odnos med trenerjem in telovadko, podpori staršev, ekonomskih vidikih, pomembnih drugih vplivih na njihovo življenje etr načinu končanja tekmovalne kariere. Rezultati analize so nasveti za dolgoročni razvoj telovadk v športni gimnastiki.

Ključne besede: ženska športna gimnastika, Brazilija, zgodovina, dolgoročni razvoj.

José Ferreirinha, Joana Carvalho, Cristina Côrte-Real in António Silva

RAZVOJ TEŽAVNOSTI PRVIN NA DVOVIŠINSKI BRADLJI VRHUNSKIH TELOVADK V ZADNJIH PETIH OLIMPIJSKIH OBDOBJIH

Namen raziskave je bil ugotoviti značilnosti in razvoj prave težavnosti prvin v sestavah, njihovih delov, povezav in posebnih prvin na dvovišinski bradlji. Upoštevani so bili tudi naskoki, seskoki, spusti, prvi in drugi del sestave, število prehodov na lestvinah, število prvin na nižji letvini, število prvin na višji lestvini, število prvin z D težavnostno stopnjo in višjo, prvine skozi veso vzosno in njihove povezave. Skupaj je bilo analiziranih 104 sestave z olimpijskih iger in svetovnih prvenstev med letoma 1989 in 2008. V tem obdobju se je povečala težavnost vseh upoštevanih dejavnikov. Prava težavnost celotnih sestav je narasla od 3.15 do 5.80 med prvim in zadnjim analiziranim olimpijskim obdobjem. Poseben razvoj je bil opžen pri D, E in F težavnostih (od 2,80 do 8,05) in dodatne točke za povezave (od 0,40 do 4,19) ter prvine skozi veso vzosno (od 0,25 do 1,57). Na osnovi rezultatov lahko ugotovimo, da so sestave na dvovišinski bradlji izjemno napredovale v težavnosti in pri nekaterih posameznih vrstah prvin kot so spusti.

Ključne besede: ženska športna gimnastika, dvovišinska bradlja, težavnost.

Saša Veličković, Dragoljub Petković, Emilija Petković

RAZLIKE V ZNAČILNOSTIH ZALETA NA PRESKOKU MED VRHUNSKIMI TELOVADCI IN TELOVADCI SREDNJE KAKOVOSTI

Namen raziskave je bil ugotoviti razlike v značilnostih zaleta zadnjih desetih korakov med vrhunskimi telovadci in telovadci srednje kakovosti. Vzorec merjencev so predstavljali štirje vrhunski telovadci, ki so sodelovali v finalu na preskoku na svetovnem prvenstvu v Debrecnu leta 2002 in dva tekmovalca, ki sta tekmovala na tekmi svetovnega pokala v Mariboru leta 2006. Zaletna hitrost je bila merjena s kinematičnim systemom APAS in OPTO-TRACK-Microgate merilno napravo. Statistično značilne so bile razlike v spremenljivkah zaleta (tako pri t-testu kot U-testu). Pri obeh skupinah telovadcev hitrost zaleta narašča, prav tako vsi telovadci dosežejo vrh hitrosti pri zadnjem koraku (vrhunski – 9.95m/s; srednji – 8.57m/s). Vrhunski telovadci imajo nižje hitrosti na začetku zaleta (3.2m/s v primerjavi z 5.4 m/s), medtem ko imajo na koncu zaleta višje hitrosti zaradi hitrejšega pospeševanja iz koraka v korak v primerjavi s srednje kakovostnimi telovadci. Pri vrhunskih telovadcih je bilo zaslediti v 7 koraku manjšo izgubo hitrosti, nato pa zopet povečanje, za razliko od srednje kakovostnih telovadcev, ki neprenehoma povečujejo hitrost od začetka do konca zaleta. Rezultati nakazujejo potrebo po spremembi strategije zaleta pri srednje kakovostnih telovadcih.

Ključne besede: moška športna gimnastika, preskok, zalet, hitrost, koraki.

Marise Botti, Juarez Vieira do Nascimento

POUČEVANJE-UČENJE-VADBA V RITMIČNI GIMNASTIKI V LUČI EKOLOŠKE TEORIJE

Namen raziskave je bil primerjati strukturo procesa poučevanja, učenja in vadbe pri deklicah ritmične gimnastike. Vzorec merjenk je predstavljalo sedemnajst deklic starih 10 do 12 let, ki so bile začetnice iz mest Florianópolis-SC (n = 11) in Maringá-PR (n = 6). Z načrtnim opazovanjem in merjenjem smo zbirali podatke v običajnih tednih vadbe. Razlike med skupinama smo izčunali s hi kvadrat testom in Fisherjevim testom. Z uporabo vidikov ekološke teorije, rezultati kažejo na podobnost structure procesa poučevanja, učenja in vadbe glede na vrsto dejavnosti, napredovnju v gibalnih znanjih in odnosu trener-ritmičarka. Poudarjen je proces metodičnega postopka pri poučevanju ritmične gimnastike osnovanem na sestavi in izboljšanju tehnike izvedbe njenih delov. Ugotovljeno je bilo tudi da bi bilo potrebnmo na novo oceniti medsebojne odnose sodelujočih v procesu vadbe.

Ključne besede: ritmična gimnastika, poučevanje, učenje, vadba, ekološka teorija.

Vasilis Kaimakamis, George Dallas, Panagiotis Stefanidis, George Papadopoulos

VPLIV PEDAGOGOVS TELOVADCEV NA RAZŠIRITEV GIMNASTIKE V EVROPI IN AMERIKI V PRVI POLOVICI DEVETNAJSTEGA STOLETJA

Na začetku devetnajstega stoletja so se pričela razvijati gimnastično gibanja, ki so bila posledica delovanja filantropistov v osemnajstem stoletju. Največja gimnastična gibanja so bila pri Nemcih, Švedih, Angležih in Slovanih. Ob ustanoviteljih gimnastičnih gibanj, so bili predvsem pomembni pionirji pedagogi gimnasti. Pionirji so vzpodbujali telesno vzgojo in gimnastiko in so razvili različne gimnastične metode v svojih državah. Glavna sestavina gimnastičnih sistemov so bile razne oblike gimnastike, ki se je v osnovi razvila na nemškem gimnastičnem sistemu. Analizirani so bili različni gimnastični sistemi ter ideje in zapisi prvih pedagogov gimnastov v prvi polovici devetnajstega stoletja, ki so razširili gimnastiko v Evropi in Ameriki.

Ključne besede: zgodovina, gimnastično gibanje, gimnastični sistemi, gimnastična orodja.
