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# ANALYSIS OF BODY DIFFICULTIES AT INDIVIDUAL 2016 OLYMPIC GAMES FINALS IN ELITE RHYTHMIC GYMNASTS

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## **Abstract**

The main aim of this study was to analyze the body difficulties in the compositions of individual elite rhythmic gymnasts at the Olympic Games 2016. In the final competition, ten gymnasts competed with four apparatus: hoop, ball, clubs, and ribbon. The research data have been collected using video recorded tape during the final competitions at the Olympic Games of 2016. Two independent analyst used form of notation to diverse the elements. Based on review and analysis of exercises, a total of 40 compositions were analyzed, based on which it was determined that 9 different jumps, 13 different rotations and 12 different balances have been performed, with total sum of 34 body difficulties. Compositions analysis gymnasts performed a total of 355 difficulties that consisted of 118 rotations, 125 jumps and 112 balances. Most frequent elements were Jete with a turn (n=44), Rotation in penché (n=29) and Back scale leg high up (n=28). Finalists of the Olympics 2016 used similar body difficulties with no diversity at the choice of body difficulties which were the part of their compositions.

Key words: **Rhythmic gymnastics, Code of Points, Individual exercises, Difficulty**

## **Introduction**

Rhythmic gymnastics as a conventional sport that contains aesthetically shaped and choreographed acyclic motion structures (Ibrahimbegović- Gafić, 2003.; Šebić, 2016) is a part of complex sports by the elements structure, i.e. by their biomechanical and functional analysis (Wolf-Cvitak, 2004). Eurhythmics and compatibility of moves of the whole body, as main expressive means, complemented by the work of the apparatus and in accordance with music (Šebić, 2016), shows the artistic dimension of rhythmic gymnastics (Bjelić & Radisavljević, 2011). The competition in the individual exercises was included in the program of the Olympics in 1984 (Schmid, 1984), whereas the competition in group exercises has been included in the Olympics program since 1996 (Hökelmann, Liviotti & Breitkreutz, 2013). Rhythmic gymnastics competition is held in individual and group exercises in accordance with the rules prescribed by Rhythmic Gymnastics Technical Committee of the International Gymnastics Federation, and which change every four years (Toledo & Antualpa, 2016) after the completion

of the Olympic Games. Reasons why these rules change commonly are: a) aspiration of the experts in this area towards finding a way to evaluate the success in performing technically very complex movement structures the most objectively (Šebić, 2016), b) to keep a great interest of fans of this sport and to prevent the monotony that can occur due to lack of diversity in the compositions, or performance of similar elements, where the originality and diversity cannot be shown (Agopyan, 2014). Five apparatus are used in rhythmic gymnastics: rope, hoop, ball, clubs, ribbon (Klentrou, 1998), while the program of the individual exercises includes four apparatus valid for an Olympic cycle based on prescribed rules. The program of individual competitions for senior in the 2013-2016 cycle included four exercises: hoop, ball, clubs, ribbon (FIG Code of Points 2013-2016).

The composition should be unique choreographic whole, with clear artistic expression, i.e. a product of distinct main idea, expressed through the different body and apparatus movements. The composition performance,

which shouldn't be only a plain sequence, such as a series of body difficulties or apparatus elements, but the transitions of logically connected moves without unnecessary interruptions, should completely correspond to the character, speed and rhythm of the music chosen (Viner, Terekhina, Guriev, 2012). Difficulties in individual exercises are consisted of four components: body difficulties, dance steps combination, dynamic elements with rotation and throw, apparatus mastery. The Code of Points for rhythmic gymnastics 2013-2016 included many variants of body difficulty (Leandro, Ávila-Carvalho, Sierra-Palmeiro, Bobo-Arce, 2016a), in total 151 difficulty, listed in the tables of the Code of Points, that include 48 balances, 45 rotations and 58 jumps, with a possibility according to the rules that to certain jumps can be added components which change the base value of the jump and its symbol. Difficulties from each group of body elements had to be represented in compositions (two minimal, four maximum): jumps, balances, rotations. The maximum number of body difficulties which can be performed in the exercise was nine, and the minimal number of body difficulties was six. Analysis the compositions of world/elite level individual gymnasts is a good indicator whether the new rules and their applications have achieved the efficiency and effects in making new compositions and whether they contributed to higher level of diversity and originality. Several studies (Trifunov & Dobrijević, 2013, Agopyan, 2014., Ávila-Carvalho, Sierra-Palmeiro, Bobo-Arce, 2016a, Leandro, Ávila-Carvalho, Sierra-Palmeiro, Bobo-Arce, 2016b, Batista, Garganta, Ávila-Carvalho, 2017, Leandro, Ávila-Carvalho, Sierra-Palmeiro, Bobo-Arce, 2017) describe the analysis of quality and quantity of technical content, and the components of compositions. Agopyan (2014) analyzed the type, value and final number of body difficulties performed in compositions with hoop, ball, clubs and ribbon by ten gymnasts who competed in the finals of the Olympic Games 2012 in London. The research data showed that in total 573 body difficulty repeats were performed, including 16 jump variations – performed 134 times, 14 balance variations – performed 178 times, 18 rotation variations – performed 153 times, 17 flexibility variations – performed 108 times. Therefore, the main aim of this study was to determine and analyze the number of body difficulties and their frequency in 40 compositions performed in the finals of the Olympic Games 2016.

## Methods

### Participants

The study was conducted on a sample of 10 gymnasts (mean ± SD: 21.60 ± 3.37 yrs.) who competed in the finals of the Olympic Games 2016. Each gymnast performed four exercises (hoop, ball, clubs, ribbon), which in total represents 40 compositions performed in the Olympics finale.

### Procedures

The research data was collected using video analysis during the competition finals in individual exercises at the Olympics 2016. Since it wasn't possible to access the official form-sheets of the gymnast's exercises (D-Form), the analysis was performed by viewing video recordings from the Olympics finals ([www.olympicchannel.com](http://www.olympicchannel.com)). The focus of the analysis was on one of the difficulty components, rather body difficulties. The analysis was performed by two national rhythmic gymnastics judges (National Level I and National level III) for 2013-2016 cycle. Variables obtained by the procedure are body difficulties divided in three groups. Groups of body difficulty elements by the Code of Points for rhythmic gymnastics 2013-2016 are jumps (J), balances (B) and rotations (R). According to the rules for cycle 2013.-2016., the gymnast in her composition could perform minimum two, and maximum four body difficulties from each group (jumps, balances, rotations).

### Criteria of body movements and difficulties

The type and number of body difficulties and their frequency in 40 compositions were analyzed. According to Code of Points 2013-2016, the lowest difficulty value was 0.10 points, and the highest was 0.50 points. Since in all three groups of body movements (jumps, balances, rotations), elements with body rotations and/or full body waves (which are not difficulties listed in the table) could be added before or after the difficulties and in that way raise their value. According to the Code of Points (FIG Code of Points 2013-2016), there are mixed difficulties that are consisted of two or more different difficulties, and their components counted as separate body difficulties, as prescribed by the rules. Multiple rotation difficulty, which involves two or more pivots with different shapes, according to the rules are counted as one difficulty, and on the same principle was calculated during the analysis (one difficulty). Fouetté Balance (that is consisted of three components) was calculated as one difficulty, that has its own value and symbol, which is in accordance with the rules prescribed. Rotations was not calculated by the number of the turns performed in the exercise, taking into the consideration that gymnasts make two or more turns, but by base rotation of 360°, i.e. they were calculated on the principle one pirouette = one base rotation (360°). Since the value of difficulties was not analyzed, balances that could be performed on the flat foot were calculated altogether with the same difficulties performed on the relevé, because, according to the rules, they represent same difficulties by the shape, but different by the value.

### Statistical analysis

Statistical data analyses were performed using SPSS 22.0 for Windows (SPSS Inc., Chicago, USA). Descriptive statistics which includes terms of mean, sum, maximum, minimum and frequencies for each body difficulties are expressed.

## Results

Based on exercises' review and the analysis, results were obtained on the number of body difficulties from each group of elements and their total frequency. Highest frequency of body difficulties was observed from the rota-

tions group (13), following the balances group (11), while the least frequency of difficulties was from the group of jumps (9). The highest frequency of body difficulties performed was scored by jumps (125 times), then rotations (118 times), and the smallest frequency was achieved by balances (112) (*Table 1*).

*Table 1* The number of performed body difficulties from each group and their total frequency

	n = 10				
	Frequency	Minimum	Maximum	Sum	Mean
Rotations	13	1	29	118	9.08
Jumps	9	1	44	125	13.89
Balances	12	1	28	112	9.33

Total number of body difficulties in all 40 compositions was 355. In addition to the total number of body weight repetitions in *Table 2*., the results of the minimum and maximum

number of performed difficulties in each composition and for all groups of body elements were presented.

*Table 2* Total number of body difficulties for 40 compositions

	n = 10			
	Balances	Jumps	Rotations	Total
N	40	40	40	40
Mean	2.80	3.13	2.95	8.88
Minimum	2	2	2	8
Maximum	4	4	4	9
Sum	112	125	118	355

Body difficulties performed in gymnastics compositions (jumps, rotations, balances), their labels and values are shown in *Table 3*. Results of the frequency for each body difficulty were obtained (*Table 4*). The highest frequency from the group of jumps achieved Jete with a turn (44 times), from the group of rotations it was the Rotation in penché (29 times), while from the group of balances the maximum frequency was achieved by the Back-scale leg high up (28 times).

## Discussion

The aim of the research was to determine and analyze the number of body difficulties and their frequency in 40 compositions performed in the 2016 Olympic Games finals. Based on the analysis and results given, it was established that 34 body difficulties were performed in the finals of the Olympic Games, which 13 of them were rotations, 12 balances and 9 jumps (*Table 1*). The obtained results show that, despite the huge diversity and number of body difficulties listed in the Code of Points 2013-2016, gymnasts performed similar difficulties, leading to the conclusion that a small number of variants of body difficulties were shown and, consequently, there was not enough diversity in the performed compositions. The results of this study

have shown similarities to the research Agopyan (2014) and Avila-Carvalho et al. (2012) where it was concluded that a limited variety in the choice of body difficulties for individual and group compositions makes them monotonous and compromises their artistic value.

According to the results, when the body difficulties were compared based on the number of performances, the rotations are performed the most (13), then the balances (12), and at least the jumps (9). When the body difficulties were compared based on the overall frequency, jumps are the group of difficulties that have achieved the highest frequency (125 times), then rotations (118 times), while the smallest number of repeated body difficulties was from the balances group (112). This research shows that the gymnasts performed jumps of higher values (Trifunov, Dobrijević, 2013), i.e. jumps performed with rotations (more than 180°), ring and back bending of the trunk (Agopyan, 2014). The performed jumps require a certain level of physical abilities, greater physical preparation (Avila-Carvalho, Klentrou, Palomero, Lebre, 2012) and quality performance, and the reason for quality performance can be found in the training process and work on the technique of their performance (Trifunović, Dobrijević, 2013). As a reason why the rotation difficulties were the preferred of the gymnasts and the balance difficulties the less used, it is possible to take the time needed to perform balances

Table 3 Body difficulties performed in compositions (rotations-R, jumps-J, balances-B)





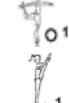
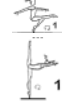




























Label	Body difficulty	Value	Label	Body difficulty	Value	Label	Body difficulty	Value
R1		0.30 (360°)	R2		0.40 (360°)	R3		0.30 (360°)
R4		0.10 (360°)	R5		0.50 (0.30+0.20) (360°+360°)	R6		0.60 (0.10+0.50) (360°+360°)
R7		0.30 (360°)	R8		0.20 (360°)	R9		0.20 (360°)
R10		0.50 (360°)	R11		0.30 (360°)	R12		0.40 (180°)
R13		0.10 (360°)	J1		0.70	J2		0.50
J3		0.50	J4		0.60	J5		0.40
J6		0.30	J7		0.80	J8		0.40
J9		0.40	B1		0.50	B2		0.50
B3		0.50	B4		0.50	B5		0.50
B6		0.30	B7		0.30	B8		0.30
B9		0.40	B10		0.50	B11		0.40
B12		0.30						

Table 4 Frequencies for all performed body difficulties

	N	Minimum	Maximum	Sum	Mean		N	Minimum	Maximum	Sum	Mean
J3	4	10	13	44	11.00	B5	4	1	1	4	1.00
J1	4	6	12	36	9.00	R10	4	1	1	4	1.00
R2	4	6	8	29	7.25	R9	4	1	1	4	1.00
B2	4	7	7	28	7.00	R8	4	1	1	4	1.00
B4	4	5	8	26	6.50	B8	4	0	1	3	0.75
R4	4	6	7	26	6.50	R11	4	0	1	3	0.75
R3	4	4	6	20	5.00	R6	4	0	1	3	0.75
B3	4	4	7	19	4.75	B10	4	0	1	2	0.50
B1	4	4	6	19	4.75	B9	4	0	1	2	0.50
J2	4	2	5	13	3.25	B7	4	0	1	2	0.50
J4	4	2	4	12	3.00	B12	4	0	1	1	0.25
R1	4	3	3	12	3.00	B11	4	0	1	1	0.25
R7	4	2	3	10	2.50	J9	4	0	1	1	0.25
J7	4	1	3	7	1.75	J5	4	0	1	1	0.25
J8	4	0	2	6	1.50	R13	4	0	1	1	0.25
B6	4	0	2	5	1.25	R12	4	0	1	1	0.25
J6	4	1	2	5	1.25	R5	4	0	1	1	0.25

See Table 3 for abbreviations

(Leandro, Ávila-Carvalho, Sierra-Palmerio, Bobo-Arce, 2016a), because they are static elements and their value, which, according to the prescribed rules, is not greater than 0.50 points, while in the case of rotations it is possible to achieve a higher value of difficulty, since every additional rotation of 360° on the relevé increases the value of difficulty for the full value of the base, while in rotations on flat foot or other part of the body, each additional rotation of 360° increases the base value of the difficulty by 0.20. A similar study carried out by Agopyan (2014) showed that in the finals of the Olympic Games in 2012, the gymnasts performed the most body difficulties from the group of rotations, then from the group of flexibility, jumps and balances, while in terms of the total number of repetitions achieved by body difficulties from the group of balances, then from the group of rotations, jumps and the smallest number of repetitions was performed in flexibility. It is evident that according to the Code of Points 2009-2012, four groups of body elements were defined (jumps, balances, rotations and flexibility) which were divided as compulsory and non-compulsory body movement groups for each apparatus separately (FIG Code of Point, 2009-2012). However, the Code of Points 2013-2016 brings new changes: the jury composition is changed (it returns to two groups of judges), the evaluation of the artistic components (unity of composition, music and movements, expression of the body and the use of space) became the responsibility of the Execution judges, the final score is changed (instead of the previous 30.00 to 20.00 points), it is allowed to use

music with words in only one exercise, the components of the difficulties of the composition are defined, the requirements for the body difficulties are changed. Another change is the elimination of flexibility and the redistribution of certain elements from this body group into balance and rotation groups (Avila-Carvalho, Klentrou, Palomero, Lebre 2012), because extreme flexibility was the cause of an increasing number of injuries in gymnastics.

In the Table 2 are shown the results for the total number of body difficulties performed in 40 compositions, the minimum or maximum number of difficulties performed in one composition, and the minimum and maximum number of body difficulties from each group to be performed. In all the compositions, at least two and maximum four body difficulties from each group of elements were performed, and it is evident that the gymnasts and coaches complied with the rules. When it comes to maximal number of body difficulties that can be performed in one composition, most gymnasts and their coaches chose the maximum number of difficulties, while a few gymnasts chose a performance of eight difficulties, from which it is possible to conclude that the gymnasts were selecting the performance with more body difficulties, so that they could achieve the highest possible scores for difficulties (Leandro, Ávila-Carvalho, Sierra-Palmeiro, Bobo-Arce, 2015, Leandro, Ávila-Carvalho, Sierra-Palmerio, Bobo-Arce, 2016a) and contribute to a better final score, which in essence, apart from the execution (which include the artistic and technical faults) determines the final order. The total number of

body difficulties performed in all 40 compositions is 355. When we look at the results of the total frequency for all the difficulties in all 40 compositions, the Jete with a turn was performed the most, 44 times as a difficulty having a value of 0.50 and a difficulty that can be successfully performed isolated, in a series or combined with other jumps in exercise (Agopyan, 2014). Rotation in penché was the most used rotations, 29 times. One of the possible reasons for the highest frequency of Rotation in penché is that it does not require much effort in performance (Agopyan, 2014) and compared to other difficulties of the same level it is easier to perform and since gymnasts perform two or more turns, it is possible to achieve high difficulty value. Gymnasts used the balances that mostly require to bend the body (Torso) forward, side or back with a wide leg amplitude (open the legs 180° degree). Back scale leg high up is performed 28 times, and it requires bending the torso back to the horizontal position, the amplitude of the legs of 180° and it is possible to be performed isolated but also combined with other balances. This study shows that, apart from the difficulties with a large number of repetitions, several difficulties were performed only once (*Table 4.*), and as a reason it is possible to indicate that some gymnasts decided to perform these difficulties in accordance with the consistence and the idea of composition, trying to achieve originality and diversity in compositions, then according to their abilities, while other gymnasts do not prefer the same body difficulties and have not decided on their performance, which is also evident in the results obtained. Increasing body difficulties and apparatus level helps gymnasts to achieve as high initial value of the composition (Agopyan, 2014). When considering the analysis and the results for all 40 compositions, it is obvious that gymnasts and their coaches, respecting the rules, unity and style of their gymnasts, have chosen the difficulties of the higher value and the complexity. The evaluation criterion in rhythmic gymnastics requires the optimal use of the total body potential combined with apparatus, and therefore the gymnasts, with the intention of getting the highest points from the judges, aim to prepare and present a composition of superior quality (Agopyan, 2014).

## Conclusion

As a result of the analysis, it can be concluded that the finalists of the Olympic Games used similar body difficulties and, accordingly, there was not enough diversity in the selection of body difficulties which are an integral part of their compositions, but since the compositions are represented by other difficulties' components (Batista, Garganta, Ávila-Carvalho, 2017), according to the author, the compositions were overall interesting, original and attractive. The gymnasts surely prefer the difficulty that corresponds to their structural features, which aesthetically correspond to the idea of the composition, which is performed with greater certainty and for which there is less probability of performance error. Coaches, respecting the rules, style, capabilities and abilities of their gymnasts, choose the difficulty

that is by value, but also by performance more complex and attractive, to make a composition as good as possible. The performance of individual compositions in rhythmic gymnastics is characterized by qualitative factors that include the artistic value of exercise, musical accompaniment, body difficulties and apparatus selection, as well as the quantitative factors that involve the number of body difficulties and apparatus, including original elements, so as the use of space (Hökermann, Livioti, Breitreutz, 2013). Since the rules in rhythmic gymnastics change every four years, it is very important that professional staff, coaches constantly follow the current changes in the world of rhythmic gymnastics in order to prepare their gymnasts in the best possible way and achieve better results. The results of this research can certainly help judges, coaches and gymnasts in Bosnia and Herzegovina to have a better insight into the top of the world rhythmic gymnastics, which can ultimately be a guideline to achieve better results on the international scene, because there are young talented gymnasts who, with better conditions, competent and educated staff could achieve notable results.

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