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Choreography Strategies in Women's Artistic Gymnastics Floor Routines across Five Olympic Games

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Abstract

Routine compositions are an indicator of an exercising trend in a particular Olympic cycle in artistic gymnastics. The primary aim of the current study was to identify which acrobatic and dance elements significantly influence specific scores throughout five different Olympic Games (OG) in elite female artistic gymnasts: finalists of OG 2000-2016. A total of 40 female competitors, participants of floor apparatus finals competitions, were subjects of this study. The results identified the following: 1) at OG 2000, an under-sensitive scoring system did not allow the extraction of individual elements that significantly contributed to a specific score; 2) the performance of acrobatic elements from the highest difficulty groups had a significant impact in OG 2004; 3) At OG 2008, exercises comprising slightly easier elements, performed technically and aesthetically correctly, scored better than exercises comprising elements of higher difficulty values performed with specific technical and/or aesthetic errors; 4) at OG 2012, the performance of the most difficult acrobatic elements without technical errors was the key to a better result; 5) quality performance of the greatest difficulty acrobatic elements, as well as the performance of the highest bonuses between the acrobatic and dance elements was the key to success at OG 2016. The results of this research are possible indicators of future floor compositions in OG 2020 and provide guidance to everyone involved in the long-term planning and programming process of future floor finalists.

Keywords: *exercise trend, difficulty score, execution score, apparatus finals*

Introduction

While artistic gymnastics is a sport in which gymnasts perform short routines on all types of apparatus, except for the vault, floor exercises have remained the most attractive ones, both for the audience and judges. After the abandonment of compulsory exercises in 1996, many successful gymnastics federations were against this decision. However, following that, athletes had to start performing their optional routines according to the rules prescribed by the valid International Gymnastics Federation's Code of Points (CoP). The period between 2000 and 2016 was dramatic in artistic gymnastics and was full of changes, most notably in the judging system. The year 2006 brought the most relevant changes by introducing the open-ended system of scoring and by allowing the evaluation of the judge's perfor-

mances through video analysis. The open-ended system was argued for by researchers, praising the improvement in judging difficulty but questioning the judging of artistry (Kerr & Obel, 2015). It was after the introduction of the open-ended system that Artistic Gymnastics became an individual technical sport with a highly tactical character. The selection of appropriate tactics is also crucial in extending the relatively short career of elite artistic gymnasts (Delaš Kalinski, Atiković, Jelaska, & Milić, 2016). The tactical character became obvious in choreographing floor exercises in which coaches had to start balancing the difficulty of the routine and the accuracy of the execution. Coaches continue to struggle in deciding whether to pick more difficult elements and increase the difficulty score, or to "play safe" and choose easier but clean execution. The International



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Gymnastics Federation Woman's Technical Committee makes the choice even more difficult by amending the CoP after each Olympic Cycle, and rules influence the composition of the routines and therefore performance (Massidda & Calo, 2012). The border between the difficulty of the exercise and the accuracy of the performance is represented by the level of the athlete's technical skills (Corlaci, 2018).

The majority of researches on this topic focus on male artistic gymnastics (Atiković, Delaš Kalinski, Bijelić, & Avdibašić Vukadinović, 2009; Čuk, Fink, & Leskošek, 2012; Čuk & Forbes, 2010; Leskošek, Čuk, & Bučar Pajek, 2013; Yu-jian, 2007) and are primarily focused on a single competition, such as World Championships or Olympic Games (Xiao-bo, 2007). Trends in choreographing male floor routines have already been debated (Rohleder & Vogt, 2019). The authors are in favour of the highest D score and state that current compositional trends in men's floor exercise encourages including difficult forward jumps and multiple twisting connections concerning the gymnasts' abilities and the decisive influence of stick landings. In contrast, women's artistic gymnastics (WAG) has been less researched (Delaš Kalinski, Božanić & Atiković, 2011), especially floor exercises (O. Donti, A. Donti, & Theodorakou, 2014). The most research reveals the tendency of doing high-risk acrobatic skills and difficult gymnastics elements, mainly by the leading athletes who are adequately prepared. As well as Donti et al. (2014), other researchers also report the continuous drive towards more difficult exercises while execution remained one step behind (Čuk et al., 2012). There is an obvious lack of scientific consensus on which strategy is better; however, regarding floor exercises, scientists agree that performing exercises with minimum errors is a better path.

Due to the constant rule changes between the Olympic Cycles and on an every-day coach's dilemma of whether to "play hard or play safe", a few essential questions arise 1) What influences different scores in a routine? 2) Which elements are crucial to get the best possible score? 3) Which strategy was the best in a specific Olympic Cycle? To answer these questions,

the main aim of the current study was to identify which acrobatic and dance elements significantly influence specific scores throughout five different Olympic Games in elite women's artistic gymnasts: finalists of Olympic Games from 2000 to 2016.

Methods

The subject sample included a total of 40 female gymnasts, participants of floor Apparatus Finals Competitions that were held at the Olympic Games from 2000 to 2016. Data about gymnasts' official scores have been retrieved from a website (<https://gymnasticsresults.com/>). Their floor routines, performed on the analysed competitions, have been reviewed on the official Olympic YouTube channel and noted with gymnastics symbols by two expert gymnastics coaches and one Croatian (national) WAG judge. Accordingly, information and frequencies of performed elements have been obtained, together with the difficulty score (DS), execution score (ES), and final score (FS).

All data were presented using mean±standard deviation, minimal and maximal results together with skewness and kurtosis. One-way between subject's ANOVA together with Bonferroni correction was used to identify the differences in different scores between all analysed OG. Partial eta squared (partial η^2) was used for effect size assessment. Furthermore, series of multiple regression analyses were applied to determine the impact of a specific element on different scores in each OG. For all statistical analysis, type one error was set at $\alpha=5\%$. All calculations were performed by using the Statistica v.13 data analysis software system (TIBCO Software Inc., USA).

Results

According to the results of the descriptive statistics of different scores through the entire analysed period, the values of DS experienced a decrease from OG 2000 up to OG 2012 and then a slight increase at the OG 2016 (Table 1). Secondly, the values of ES and FS experienced a continuous decrease from OG 2000 up to OG 2016. The majority of skewness values

Table 1. Descriptive Statistical Parameters of Different Scores in Floor Routines in the Apparatus Finals at the OG Held from 2000 to 2016; Results of One-Way ANOVA with Bonferroni correction

OG		Mean±SD	Min	Max	Skew	Kurt
2000	DS ^{08,12,16}	9.98±0.07	9.80	10.00	-2.83	8.00
	ES ^{08,12,16}	9.57±0.29	9.01	9.85	-1.23	0.78
	FS ^{08,12,16}	19.52±0.34	18.81	19.85	-1.40	1.94
2004	DS ^{08,12,16}	9.86±0.18	9.50	10.00	-1.52	1.79
	ES ¹⁶	9.34±0.37	8.50	9.75	-1.92	4.85
	FS ^{08,12,16}	19.15±0.56	17.90	19.75	-1.85	4.36
2008	DS ^{00,04}	6.25±0.22	5.80	6.50	-1.28	1.85
	ES ⁰⁰	8.85±0.37	8.25	9.23	-0.94	-0.72
	FS ^{00,04}	15.08±0.52	14.13	15.65	-0.91	0.00
2012	DS ^{00,04}	6.13±0.28	5.60	6.50	-0.70	0.78
	ES ⁰⁰	8.68±0.36	8.03	9.10	-0.62	-0.03
	FS ^{00,04}	14.73±0.66	13.33	15.60	-1.28	2.95
2016	DS ^{00,04}	6.29±0.43	5.40	6.90	-1.05	2.67
	ES ^{00,04}	8.34±0.72	6.70	9.07	-1.97	4.89
	FS ^{00,04}	14.59±1.23	11.80	15.97	-1.85	4.65

Legend: ^{00, 04, 08, 12, 16} - significant differences between the specified year and the year in superscript

indicate a shift in the distribution of the results towards the results that are higher than the average result. According to kurtosis values, larger groupings of results were found at distributions of the results of different scores.

The analysis of variance revealed significant differences between years for DS ($F_{35,4}=468.01$; $p<0.001$; $\eta^2=0.371$); ES ($F_{35,4}=9.89$; $p<0.001$; $\eta^2=0.092$) and FS ($F_{35,4}=93.52$; $p<0.001$; $\eta^2=0.238$) together with large effect size. Bonferroni correction revealed a significant difference between 1) DS and FS from OG 2000 and the same scores from OG 2008/2012/2016; 2) DS and FS from OG 2004 and the same scores from OG 2008/2012/2016; 3) ES from OG 2000 and the same score from OG 2008/2012/2016; 4) ES from OG 2004 and the same score

from the OG 2016.

Examining the numerical values, primarily the elements with the highest difficulty values that comprise the DS of the exercise, we can see that the most difficult acrobatic element “double salto bwd tucked with 2/1 twist” (difficulty value H) experienced the largest numerical increase from OG2000 (when performed by one gymnast) to OG2016 (when performed by seven gymnasts) (Table 2). The opposite trend was observed in two elements during the analysed period 1) “bwd stretched salto with 3 twists” (difficulty value E) performed by 7 gymnasts in OG2000, and only one gymnast in OG2016; 2) “bwd stretched salto with 2 1/2 twist” (difficulty value D) performed by 6 gymnasts at OG2000 and only two gymnasts at OG2016.

Table 2. Frequencies of certain acrobatic and dance elements performed in floor routines at the OGs held from 2000 to 2016

Acrobatic elements	00	04	08	12	16	Dance elements	00	04	08	12	16
H: double salto bwd tucked with 2/1 twist	1	1	2	2	7	D: split jump with 1 1/2 turn	0	0	0	0	1
H: double salto bwd stretched with 1/1 twist	0	0	1	0	3	D: straddle pike or side split jump with 1 1/2 turn	0	0	1	0	0
H: Arabian double salto stretched	0	1	1	0	0	D: 2/1 turn with heel of free leg fwd at horizontal	0	2	1	2	1
G: double salto bwd stretched with 1/2 twist	0	0	0	0	1	D: 2/1 turn in back attitude	0	0	0	1	0
F: double salto bwd stretched	2	3	2	2	4	D: 2/1 turn with free leg held upward in 180° split position	0	0	0	1	2
F: Arabian double salto piked	0	1	0	1	1	D: 2/1 turn in tuck stand on one leg-free leg straight throughout turn	0	0	0	1	2
F: salto bwd stretched with 3 1/2 twist	0	1	0	0	0	C: 3/1 turn on one leg-free leg optional below horizontal	1	4	3	1	0
E: salto bwd stretched with 3 twist	7	4	6	6	1	C: split leap with 1/1 turn	3	1	6	1	2
E: double salto bwd tucked with 1/1 twist	2	2	4	2	3	C: switch leap with 1/2 turn	0	0	5	2	0
E: double salto bwd piked with 1/1 twist	0	3	2	3	0	C: switch leap to ring position	3	1	5	4	3
E: Arabian double salto tucked	1	0	0	3	1	C: johnson with 1/2 turn	1	0	2	2	0
E: double salto fwd tucked	0	1	1	0	0	C: straddle pike or side split jump with 1/1 turn	3	5	0	0	4
D: double salto bwd piked	5	5	4	6	6	C: split jump with 1/1 turn	0	0	1	0	0
D: double salto bwd tucked	0	0	0	1	1	C: cat leap with 2/1 turn	1	6	1	0	0
D: salto bwd stretched with 2 1/2 twist	6	5	5	4	2	C: tuck hop with 2/1 turn	2	6	0	0	0
D: salto fwd stretched with 2 twist	1	1	1	0	0	B: johnson	3	0	0	0	0
C: salto fwd stretched with 1/1 twist	0	0	4	3	1	B: switch leap	2	1	3	2	4
C: salto fwd stretched with 1 1/2 twist	0	0	3	0	0	B: hop with 1 1/2 turn in horizontal plane to lay in front lying support	1	0	0	0	0
C: salto bwd stretched with 2 twist	3	0	2	0	0	B: straddle pike or side split jump with 1/1 turn landing in front lying support	1	0	1	0	0
C: salto bwd stretched with 1 1/2 twist	1	0	5	4	3	B: stag ring jump	1	1	0	0	0
B: salto fwd with 1/2 or 1/1 twist	0	1	0	0	0	B: cat leap with 1/1 or 1 1/2 turn	1	6	0	0	0
B: salto fwd stretched	0	3	0	3	1	B: tuck hop with 1/1 turn	0	0	0	0	0
B: salto fwd stretched with 1/2 twist	0	0	3	0	1	B: wolf jump with 1/1 turn	4	0	0	0	0

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Acrobatic elements	00	04	08	12	16	Dance elements	00	04	08	12	16
A: walkover bwd from stand or extended tuck sit to hstd	0	0	1	0	0	B: 2/1 turn on one leg	4	3	3	0	0
A: salto fwd tuck or piked	4	1	2	0	0	B: 1/1 turn in back attitude	0	0	1	0	0
A: free walkover fwd	0	0	0	2	3	B: 1/1 illusion turn	1	0	0	0	1
A: whip salto	5	4	1	3	0	A: stag jump	0	0	0	4	0
A: free ariel	0	0	0	0	1	B: stag jump with 1/1 turn	0	0	0	0	0
A: salto bwd tucked	0	0	0	2	0	B: 1/1 turn in back attitude	0	0	0	0	0
						A: split leap fwd	1	1	0	2	0
						A: straddle pike or side split jump landing in front lying support (also 1/2)	5	0	0	0	0
E: 4/1 turn on one leg	0	1	0	1	1	A: split jump	0	0	0	1	4
D: switch leap with 1/1 turn	0	0	0	4	7	A: sissone	0	0	0	0	0
D: split leap with 1 1/2 turn	0	4	0	7	6	A: 1/1 turn	0	0	0	1	2
D: split leap to ring position with 1/1 turn	0	0	0	1	2						

Regarding the dance elements, the “switch leap with 1/1 turn” (difficulty value D) had the largest increase over the years. While it was not performed at all in OG2000, OG2004 and OG2008, as many as seven competitors performed it at OG2016. In contrast, high frequency jumps at the beginning of the analysed period (OG2000), whose appearance was not noted at OG2016, include the following: “straddle pike or side split jump landing in front lying support ½” (difficulty value A), “wolf jump with 1/1 turn” and “johnson jump” (difficulty value B).

According to the results of the regression analyses (Table 3), only a few of all the derived elements had a significant influence on a particular score on certain OGs. No significant influence of any element was identified at OG 2000, while at

other OGs elements were found to have significant impacts of different scores, characterized by a) high difficulty values; b) double rotations around the transverse axis of the body (“double salto bwd tucked/piked/stretched”); c) multiple rotations around the longitudinal axis of the body (“salto bwd stretched with 2½ or 3 twists”); d) double rotations around the transverse and simultaneous rotations around the longitudinal axis of the body (“double salto bwd stretched with ½, 1/1 and 2/1 twists”). From OG2008 to OG2016, from the area of dance elements, significant influences on different scores were determined by the “switch leap” and its more difficult derivatives (“switch leap with 1/2 turn and 1/1 turn”) and also, the jumps “johnson with 1/2 turn” (OG2012) and “split jump with 1 1/2 turn” (OG2016).

Table 3. Results of regression analyses between specific elements and difficulty (DS), execution (ES) and final scores (FS) at OG 2000-2016

		Element	β	SE(β)	b	SE(b)	p
DS	R=0.95 R2=0.90 F(5.2)=3.63 p=0.22	D: salto bwd stretched with 2 1/2 twist	0.97	0.30	0.15	0.05	0.09
		D: double salto bwd piked	-0.06	0.37	-0.01	0.05	0.88
		C: salto bwd stretched with 2 twist	0.51	0.24	0.07	0.03	0.17
		A: salto fwd tuck or piked	0.66	0.43	0.09	0.06	0.26
		B: wolf jump with 1/1 turn	-0.39	0.35	-0.05	0.05	0.37
00	R=0.89 R2=0.79 F(3.4)=4.99 p=0.08	A: whip salto	0.44	0.29	0.25	0.16	0.20
		D: double salto bwd piked	-0.53	0.23	-0.30	0.13	0.08
		C: salto bwd stretched with 2 twist	0.34	0.29	0.19	0.16	0.30
ES	R=0.84 R2=0.71 F(3.4)=3.332 p=0.14	A: whip salto	0.31	0.34	0.21	0.22	0.41
		D: double salto bwd piked	-0.50	0.27	-0.33	0.18	0.14
		C: salto bwd stretched with 2 twist	0.45	0.34	0.30	0.22	0.25
DS	R=0.87 R2=0.76 F(3.4)=4.13 p=0.10	C: tuck hop with 2/1 turn	0.96	0.35	0.37	0.13	0.05
		E: salto bwd stretched with 3 twist	1.21	0.49	0.40	0.16	0.07
		B: salto fwd stretched	-0.88	0.55	-0.30	0.19	0.19
04	R=0.96 R2=0.93 F(2.5)=33.71 p=0.00	E: salto bwd stretched with 3 twist	1.53	0.19	1.05	0.13	0.00
		F: double salto bwd stretched	1.17	0.19	0.83	0.13	0.00
FS	R=0.96 R2=0.92 F(2.5)=27.63 p=0.00	E: salto bwd stretched with 3 twist	1.51	0.20	1.58	0.21	0.00
		F: double salto bwd stretched	1.15	0.20	1.23	0.22	0.00

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			Element	β	SE(β)	b	SE(b)	p			
08	DS	R=0.88 R2=0.78 F(3.6)=6.97 p=0.02	C: split leap with 1/1 turn	-0.61	0.20	-0.35	0.11	0.02			
			E: salto bwd stretched with 3 twist	-0.53	0.21	-0.30	0.12	0.05			
			F: double salto bwd stretched	-0.33	0.21	-0.20	0.13	0.17			
			E: double salto bwd tucked with 1/1 twist	0.89	0.14	0.57	0.09	0.00			
	ES	R=0.96 R2=0.92 F(4.5)=13.91 p=0.01	E: salto bwd stretched with 3 twist	-0.82	0.15	-0.54	0.10	0.00			
			B: switch leap	-0.48	0.14	-0.31	0.09	0.02			
			H: double salto bwd tucked with 2/1 twist	-0.37	0.13	-0.26	0.09	0.04			
			C: split leap with 1/1 turn	-0.92	0.08	-0.97	0.09	0.00			
	FS	R=0.99 R2=0.99 F(6.3)=63.91 p=0.00	C: switch leap with 1/2 turn	0.33	0.07	0.34	0.08	0.02			
			E: salto bwd stretched with 3 twist	-0.58	0.07	-0.62	0.07	0.00			
			F: double salto bwd stretched	-0.70	0.09	-0.80	0.10	0.00			
			D: double salto bwd piked	0.40	0.09	0.41	0.10	0.02			
12	DS	R=0.99 R2=0.99 F(4.3)=124.13 p=0.00	C: switch leap to ring position	0.19	0.08	0.20	0.08	0.09			
			D: double salto bwd piked	0.82	0.06	0.50	0.03	0.00			
			E: Arabian double salto tucked	0.61	0.05	0.33	0.03	0.00			
			A: salto bwd tucked	0.11	0.06	0.07	0.04	0.16			
	ES	R=0.71 R2=0.51 F(1.6)=6.19 p=0.05	D: salto bwd stretched with 2 1/2 twist	-0.10	0.06	-0.05	0.03	0.23			
			C: johnson with 1/2 turn	-0.71	0.29	-0.55	0.22	0.05			
			FS	R=0.76 R2=0.57 F(1.6)=8.02 p=0.00	C: johnson with 1/2 turn	-0.76	0.27	-1.08	0.38	0.03	
					D: split jump with 1 1/2 turn	-0.76	0.14	-0.93	0.18	0.00	
	16	DS	R=0.95 R2=0.90 F(2.5)=22.04 p=0.00	G: double salto bwd stretched with 1/2 twist	0.46	0.14	0.57	0.18	0.02		
				D: split jump with 1 1/2 turn	-1.13	0.06	-2.28	0.13	0.00		
				ES	R=0.99 R2=0.99 F(3.4)=103.90 p=0.00	B: switch leap	0.45	0.07	0.61	0.09	0.00
						D: double salto bwd tucked	-0.22	0.06	-0.45	0.13	0.03
FS		R=0.99 R2=0.99 F(3.4)=95.37 p=0.00	D: split jump with 1 1/2 turn	-1.13	0.07	-3.93	0.23	0.00			
			B: switch leap	0.48	0.07	1.11	0.17	0.00			
			D: double salto bwd tucked			-0.23	0.07	-0.80	0.23	0.03	

Discussion

In the CoP that were valid for a specific analysed period, new difficulty groups of elements appeared, and an increasing number of elements of the highest difficulty groups were derived. Such floor exercise trends, in addition to being partly a consequence of the improvement of the construction of the apparatus, indicate an improvement in the methodology of teaching structurally more complex dance and acrobatic elements, but also an improvement in the preparation of the organism itself to perform these elements. In contrast, a constant decrease in the average values of all scores (DS, ES, and FS) was found. One can conclude that the efforts of the trainees to perform such elements generally led to lower technical and aesthetic quality of the floor compositions. However, it is evident from the examination of the routines that such a conclusion is completely incorrect and that the reduced values of the scores are not due to the lower quality of performance of the elements in the final floor exercises, but to the constant tightening of the evaluation criteria in the analysed period.

The lack of significant influences of elements on any score at OG2000 is an indication of an inadequate and in-

sensitive way of judging at the highest levels of competition (where the quality and uniformity of competitors is higher than in other competitions), confirms the findings of Leskošek et al. (2013) who found excess judges' variability in vault and floor exercises. They attempted to explain these results as a result of the shortage of time available to assess the specific vault and by the need for highly subjective judging of artistry and music in floor routines. However, it seems that by the introduction of videotaping and the possibility of re-watching the execution, the reliability and sensitivity of judging has increased.

Considering the extraction of two acrobatic elements from the higher difficulty groups at OG2004 (E: "salto bwd stretched with 3 twists" and F: "double salto bwd stretched") as significantly positive for ES and consequently for FS, it can be concluded that "heavy" acrobatics was a good choice in the floor routines in these OGs. The positive influence of these elements on the ES leads to the conclusion that their performance was free from technical and/or aesthetic errors. However, this conclusion should be taken with caution since these are technically extremely demanding elements, espe-

cially in the landing stages. It is more likely that deductions for technical and aesthetic errors that arose from the performance of these elements were not prescribed in that CoP, but this remains to be verified by further research. As the ES determines the final ranking in the Vault Finals for female gymnasts (Delaš Kalinski, Jelaska, & Atiković, 2017) even with heavy acrobatic elements, it is presumed that similar situation occurs in floor exercises as well, probably because of the need for a higher number of accurately performed landings.

According to the results of the regression analyses for OG2008, two variables were extracted that significantly and negatively affected DS: the dance element C: "split leap with 1/1 turn" and the acrobatic element E: "salto bwd stretched with 3 twists". Although these are elements of high difficulty values that almost certainly became part of the DS, since each of these two elements was performed by six competitors, the performances of these elements did not contribute to their differentiation, and the impact on the DS was found to be negative. Of the four variables (three acrobatic and one dance element), only "double salto bwd tucked with 1/1 twist", had a positive effect on the ES. One can assume that the performance of this element was not characterized by specific technical and/or aesthetic errors, thus contributing to higher ES values. For acrobatic elements belonging to high-value difficulty groups (E: "salto bwd tucked with 3 twists", H: "double salto bwd tucked with 2/1 twist") and whose performances without technical and/or aesthetic errors are very rare, the negative impact on ES is a logical result.

In contrast to these complex elements, the finding of a negative impact of the structurally non-complex jump B: "switch leap" performed by three competitors, whose difficulty value almost certainly did not form part of the DS, is probably due to the "role" of this jump in the routines of these competitors. Namely, this element is most often used to fulfil a special requirement related to the connection of two jumps, at least one of which must be a jump with a "switch", so the errors in the performance of this jump may be directly the result of a connection with another dance element. Determining the positive impact of some other, slightly easier elements ("switch leap with 1/2 turn", "double salto bwd piked", and "switch leap to ring position") on FS indicates that, according to CoP 2005-2008, to achieve higher FS values in the final floor competition, it was more desirable to have routines composed of slightly easier elements, performed technically and aesthetically correctly, than routines composed of higher difficulty elements performed with certain technical and/or aesthetic errors. Confirmation that the performances of high difficulty acrobatic elements at OG2012 (D: "double salto bwd piked" and E: "Arabian double salto tucked") were technically and aesthetically good and contributed to higher DS, is the determination of their positive effect on DS, and the absence of a negative effect on ES. In contrast to these variables, a negative impact on ES, and probably consequently on FS, was determined by C: "johnson with 1/2 turn". However, the premise that this was a performance characterized by certain technical and/or aesthetic errors should be researched given the lower determination values of these criterion variables by a set of predictor variables.

The importance of the quality performance of the highest difficulty acrobatic elements is again emphasized in the results at OG2016. The significant positive influence of the element G: "double salto bwd stretched with 1/2 twist" on DS

was found. Since this is an element whose DS contribution is extremely high (0.7 points), this result is logical. Unlike this acrobatic element, which was performed for the first time at OG2016 and immediately had a (positive) effect on DS, the inverse effect was determined for element D: "double salto bwd tucked" on ES and, consequently, FS. Although it is an element whose difficulty is likely to be part of the DS, the additional judge's review of the performance of the only female athlete who performed this element on these OGs found that the element was performed with a classic error related to the same: the gymnast did not sufficiently rotate the element. The deduction for this element is not expected at this level of competition, but given that it was performed within the connection and a shortened run-in, it is not unexpected. The aforementioned leads to the conclusion that the performance of this and similar acrobatic connections, which due to the shortened run-in for the performance of the second element, often have specific errors in the performance of that (second) element, are probably not "useful" for the final result. However, because of the extremely low dispersion of DS at this level of competition, we believe that it is precisely the connections, along with the better performance of other elements, that play a role in the creation of DS, and consequently the FS.

The negative impact of D: "split jump with 1 1/2 turn" on DS and ES is probably because it was a part of the routine of only one (i.e., the worst placed) finalist in the OG2016. Considering that this is the highest-level competitor, this result can be seen through stricter evaluation criteria, which were defined in WAG CoP 2013-2016. In contrast to this complex dance element, a positive influence on the ES and, in particular, on the FS, was found for B: "switch leap". Therefore, the positive influence should be looked especially through the performance of this leap, but also through the fact that by linking this leap with higher difficulty leaps adds bonuses to the final scores, which further emphasizes the importance of the links and/or value of the bonuses of those links in the final result.

The best gymnasts' routines at the highest-level competitions best illustrate what kind of routines gymnasts aspired to, to make the most out of the prescribed rules. Introspection of the frequencies of acrobatic elements in the analysed period generally indicates a decrease in the frequencies of elements with multiple rotations around the longitudinal axis of the body and an increase in the frequencies of elements that requires simultaneous multiple rotations around the transverse and longitudinal axis. For dance elements, jumps with small amplitudes disappeared, frequencies of jumps characterized by only large amplitudes decreased, and an increase in the frequencies of jumps with high amplitudes and rotations around the longitudinal axis of the body was observed.

According to the established results, despite the continuous decrease in the values of DS, ES, and FS, and due to the emergence of new difficulty groups of elements and increasing frequencies of elements from such groups, visible progress in the structural complexity of floor routines during the analysed period was observed. Moreover, the quality of performance is the most important aspect and, according to also the results from OG2016, the connections between acrobatic and dance elements. If the results from OG2016 are seen as a springboard for the results at OG2020, it is to be expected that the routines will consist of a large number of connections of elements of the highest difficulty values.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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