INFLUENCE OF DANCE ELEMENTS ON BALANCE BEAM RESULTS

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Abstract

According to the Code of Points (FIG, 2009) the balance beam difficulty value is determined by the sum of maximum 8 most difficult elements (including the dismount), fulfilling 5 composition requirements and by the values that exceed from the connections between the acrobatic elements, turns and acro-rhythmic elements. The aim of this study was to determine the frequency of performed dance elements on the balance beam and their influence on: difficulty value, execution value and final score. The sample consisted of 109 women top junior athletes, who participated in qualifications on the European Championships in Birmingham in 2010. The results obtained showed that the gymnasts in average perform 4.28 dance elements in their balance beam routines. The highest frequency was determined to a C difficulty jump ˝switch leap˝ (N=101), to two A difficulty jumps: "wolf hop or jump from cross or side position" (N=83) and to ˝Sissone˝ (leg separation 180°) take off from both legs (N=61); and to A difficulty turn: "1/1 turn (360°) on one leg – free leg optional below horizontal" (N=66). Regression analysis revealed a statistically significant influence of some dance elements on the difficulty value of the exercise (p <0.05) and on the final score. Statistically significant influence of different dance elements on the execution value was not found.

Keywords: women artistic gymnastics, juniors, difficulty, execution, code of points.

INTRODUCTION

From the publishing of the latest Code of Points (2009) many studies have been conducted over the gymnasts' final score. Some studies analyzed judges through their validity and reliability (Leskošek et al., 2010; Sands, 2010) while some analyzed equality between disciplines (Čuk & Atiković, 2009, Čuk & Forbes, 2010). Despite quite a number of studies, it is important to note that all results were carried out on male gymnasts' results, while the studies over results of the female gymnasts have not been found.

In artistic gymnastics women compete on four apparatus: vault, uneven bars, balance beam and floor. For every apparatus, specific rules (Composition Requirements and Connection Value) and tables of elements and their Difficulty Values are in the Code of Points (2009).

As it is mentioned before, balance beam is one of the four apparatus in Women Artistic Gymnastics (WAG) on which gymnasts perform elements from different groups during a routine, in a time that may not exceed 1.30 minutes (90 seconds). Every routine begins with a mount (taken-off from the board or the mat). During the routine on the balance beam, gymnasts perform gymnastic leaps, jumps and hops,

gymnastic turns, holds and acrobatic elements with or without flight phase and hand support. The evaluation of the routine begins with a mount and finishes with a landing of the dismount. After finishing the routine, whether with a dismount or with a fall that lasted more than 10 seconds, judges give two scores: difficulty value (DV) score and execution value (EV) score. DV score is calculated based on the sum of maximum 8 highest difficulties including the dismount (maximum 5 acrobatic and minimum 3 dance elements), fulfilling prescribed composition requirements (one connection of at least 2 different dance elements, 1 being a leap, jump or hop with 180° split (cross position only); 360° turn; one acrobatic series, minimum of 2 flight elements one being a salto; acrobatic elements in different directions (forward/sideways and backward); appropriate value of dismount and from values that gymnasts get for directly connecting acrobatic elements, turns and/or acrobatic-dance elements. EV score is given for the quality of the skills performed (Fédération Internationale de Gymnastique - FIG, 2009) and has an initial value of 10.00 points if the gymnast performs at least 7 elements. From the value of 10.00 points judges deduct errors that occur during the performance of a routine. Final score (FS) is calculated as the sum of DV and EV minus neutral deductions. According to Cuk et al. (2010) we can predict 84% of all-round final score with DV scores only.

All around world gymnastics competitions are held for the gymnasts of different ages, due to which different requirements apply for different categories. Competition requirements for younger gymnasts mostly differ in composition requirements and, sometimes, in required number of elements for scoring 10.00 points for EV. Competitions for juniors and seniors are held under the FIG organization. The only difference between these groups is a requirement for C dismount in junior category in relation to requirement for D dismount in senior category.

Although DV estimation is done by the sum of maximum 8 elements with the highest difficulty value (including dismount), the gymnasts usually perform much more than 8 elements during their balance beam routine. The question is how many elements gymnasts usually perform in order to achieve the highest possible DV. Also, it is not clear what type of dance elements do the gymnast choose or can perform in the balance beam routine, especially the juniors.

Do they choose to perform elements with higher difficulty value, in which case performance is usually followed by an increased chance of falling and scoring deductions, or they perform elements with lower difficulty values which are usually performed with better technique? Does the huge number of elements from the Code of Points (2009) increase diversity among gymnasts' routines or they mostly choose to perform the same elements?

The main idea for the current research was based on the performance of dance elements on the balance beam and finding creativity and variety in performance of dance connections, as it can be found in the floor exercises (Johnson, 2011). In accordance with the above, the aim of the research was to determine the influence of performed dance elements on: (1) difficulty score (DV); (2) execution score (EV); and (3) final score (FS) in top junior artistic gymnasts.

METHODS

A total sample of 109 top junior gymnasts, competing at the qualifications of the European Championships in Birmingham in 2010 was investigated. From the official balance beam results 5 variables were extracted: difficulty value (DV), execution value (EV), final score (FS), total number of dance elements (DE) and total number of balance beam elements (TBE).

Data were analyzed using the Statistica for Windows 7.0 package. Statistical significance was set at $p < 0.05$. Graphic presentation was used to

demonstrate the prevalence of certain dance elements on the balance beam. Basic descriptive statistics were calculated for all variables: mean values (Mean), standard deviations (SD), minimum (Min) and maximum (Max) results, skewness (Skew) and kurtosis (Kurt). The Kolmogorov-Smirnov test (K-S) was used to confirm the normality of distributions. Finally, three multiple regression analyses investigated relationships between unique dance elements and (1) DV, (2) EV and (3) FS.

RESULTS

Basic descriptive statistics (Table 1) revealed a DV mean value of 4.82 while the EV mean value was 7.08. The mean final score was 11.90 points. According to K-S test and values of skewness and kurtosis, those variables had normal distributions. Among the total number of balance beam elements (mean 11.67), the gymnasts performed in average 4.28 dance elements. According to Kolmogorov-Smirnov test, in the number of DE differences were found between the observed and expected distributions ($p < 0.05$), since the boundary for the DE was 0.21. Values of skewness and kurtosis coefficients revealed minor leptokurtic distributions.

Table 1. *Basic descriptive statistics for all variables; the results of the Kolmogorov- Smirnov test for normality of distributions (d value for K-S test (N=109) is 0.15 with p<0.05)*

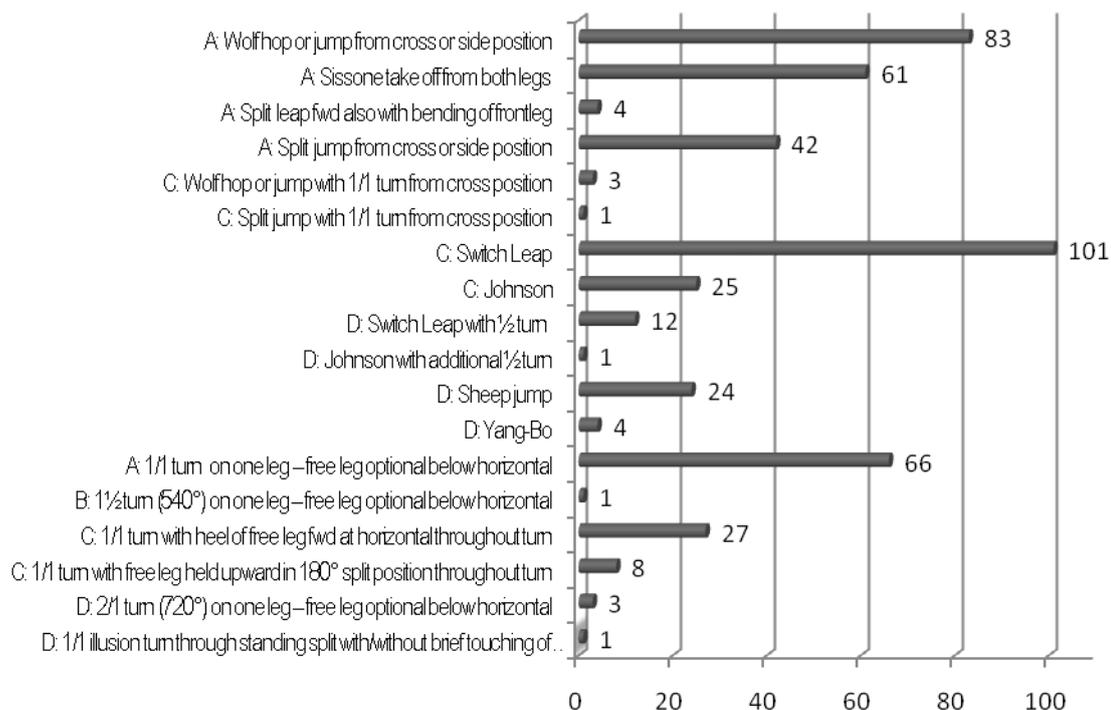|	Mean	Minimum	Maximum	SD	Skewness	Kurtosis	K-S (d)
DV	4.82	3.50	6.30	0.52	0.06	0.29	0.10
EV	7.09	4.55	8.83	0.87	-0.64	0.16	0.08
FS	11.91	8.65	14.75	1.18	-0.11	0.10	0.04
DE	4.28	1.00	8.00	1.02	0.26	1.57	0.21
TBE	11.61	7.00	16.00	1.66	0.36	0.46	0.14

Figure 1. *The prevalence of certain dance elements on the balance balance beam*

Table 2. *Regression analysis of difficulty value; execution value; final score and types of dance balance beam elements (difficulty from A to D)*

	DV		EV		FS	
	Beta	p	Beta	p	Beta	p
A:*Wolf hop or jump from cross or side position*	-0.02	0.79	-0.02	0.84	-0.03	0.79
A: *Sissone (leg separation 180°) take off from both legs*	-0.07	0.47	-0.12	0.33	-0.12	0.29
A: *Split leap fwd (leg separation 180°)*	-0.05	0.55	-0.07	0.58	-0.07	0.51
A:*Split jump (leg separation 180°) from cross or side position*	0.00	0.99	0.00	0.99	0.00	0.99
C:*Wolf hop or jump with 1/1 turn (360°) from cross position*	-0.04	0.58	0.04	0.70	0.01	0.91
C:*Split jump with 1/1 turn (360°) from cross position*	-0.13	0.07	0.04	0.69	-0.03	0.73
C:*Switch Leap*	0.00	0.99	0.08	0.45	0.06	0.54
C:*Johnson*	0.20*	0.01*	-0.02	0.87	0.07	0.42
D:*Switch Leap with ½ turn (180°)*	0.32*	0.00*	0.07	0.47	0.19*	0.04*
D:*Johnson with additional ½ turn (180°)*	0.26*	0.00*	0.14	0.17	0.21*	0.02*
D:*Sheep jump*	0.32*	0.00*	0.12	0.24	0.23*	0.02*
D:*Yang-Bo*	0.15*	0.05*	0.18	0.08	0.20*	0.03*
A:*1/1 turn (360°) on one leg – free leg optional below horizontal*	0.03	0.82	0.01	0.94	0.02	0.89
B:*1 ½ turn (540°) on one leg – free leg optional below horizontal*	0.11	0.23	-0.18	0.13	-0.09	0.43
C:*1/1 turn (360°) with heel of free leg fwd at horizontal throughout turn*	0.22	0.09	-0.01	0.96	0.09	0.55
C:*1/1 turn (360°) with free leg held upward in 180° split position*	0.23*	0.02*	0.00	0.98	0.10	0.38
D:*2/1 turn (720°) on one leg – free leg optional below horizontal*	0.14	0.08	0.05	0.63	0.10	0.30
D:*1/1 illusion turn (360°) through standing split with/without brief*	0.23*	0.00*	0.18	0.06	0.24*	0.01*
R	0.72		0.44		0.57	
R²	0.53		0.20		0.32	
p	0.00*		0.25		0.00*	

* p<0.05

The highest prevalence of dance elements was observed in the C difficulty ″Swich leap″ jump (N=101), in the A difficulty ″*Wolf hop or jump from cross or side position*″ (N=83) and in the A difficulty "*1/1 turn (360°) on one leg – free leg optional below horizontal*" (Figure 1).

Finally, for the three multiple regression analyses with different types of dance elements as the predictors, the criterions were DV in the first analysis, EV in the second and FS in the third. The first analysis showed high value of the multiple correlation coefficient (0.72) which indicates strong linear connections between the predictor variables and the criterion variable. Also, predictor variables explain 53% of the total variance. All statistically

significant predictors (dance elements) have a positive influence on the criterion. The second regression analysis revealed that the dance elements are not good predictors of EV, while the third analysis showed medium linear connections between the predictor variables and the criterion variable (R=0.57) and the predictors explain 32% of the total variance.

DICSUSION

Code of Points (COP) defines that DV value is composed from top 8 high scoring elements (maximum 5 acrobatic and minimum 3 dance elements). Results of the study determined that the junior gymnasts in average performed 4.28 dance elements in their balance beam routines. The results of skewness values revealed the existence of a larger group of gymnasts performing less than 4 dance elements what, very likely, indicates a current trend in exercising on the balance beam, in order to achieve good performance and better final score.

According to COP the first composition requirement on the balance beam is one direct connection of at least 2 different dance elements, 1 being a leap, jump or hop with 180° split (cross position only). Based on determined frequencies of jumps, performed on the balance beam by juniors (Figure1), it is possible to conclude that gymnasts often use dance elements of lower difficulty value to meet this requirement. Confirmation of this can be seen in frequency of the three A difficulty value jumps: *Sissone take off from both legs (N=61), Split jump from cross or side position (N=42)* and *Wolf hop or jump from cross or side position* (*N=83*). Obtained result for these jumps also indicates tactic of some gymnast when composing a routine, which is the usage of these jumps in fulfilling first composition requirement. Because of their high frequency and their A value difficulty, statistically significant impact of these jumps on DV, EV and FS was not determined.

When performing a dance element on the balance beam, in order to recognize their DV, specific Technical expectations, prescribed in article 7 of Code of Points, are required. For dance elements on the balance beam they imply (1) completing turns exactly, (2) split requirement when performing Leaps, Jumps, Hops and Turns and (3) some special requirements for some selected dance elements. If these requirements are not fulfilled performance of dance elements is considered as bad and leads to deductions or to devaluation of DV to dance element. This possibility is perhaps one of reasons why gymnasts mostly choose to perform dance element with lower DV.

Statistically significant influence on DV and FS was determined in the jumps of C and D difficulty (C difficulty value: *Johnson* (N=25); D difficulty value: *Switch Leap with ½ turn* (N=12), *Johnson with additional ½ turn* (N=1), *Sheep jump* (N=24) and *Yang-Bo* (N=4)), whose frequencies were much smaller than the A difficulty jumps. Unlike values of the A difficulty jumps, difficulty values of these jumps were part of the initial DV, according to E judge sheets (where devaluation of dance elements wasn't marked), while the performance of these jumps was confirmed as statistically significant on DV. Concurrently with the above mentioned, because the smaller group of gymnast performed jumps with higher difficulty values, it was expected that the same will make statistically significant distinction between the gymnasts in the FS. Statistically significant influence of jumps with higher difficulty value on EV was not determined, probably as a result of "tactic" in the balance beam exercise composing, that is, using only technically correct and safe jumps. With the all previously mentioned results and facts, it is important to point out that gymnasts, probably, performed the higher difficulty value jumps separately, in order to perform them as best as they can.

C difficulty value *Switch Leap jump* was found in almost every junior balance beam exercise (N=101). Statistically significant influence of this jump was not determined on DV, EV or FS. However,

importance of learning this jump on the highest possible level is inevitable for more reasons. The first reason can be seen through the high frequency of this jump in juniors' exercise, on what basis it can be concluded that this jump probably is not very hard to learn or to perform. Another reason lies in difficulty value of this jump (C difficulty value) and its contribution to a total DV value. The third reason is its structure of performance, or 180° leg split, because of what this jump can fulfill the composition requirement (connection of 2 dance elements). The fourth reason is the fact that the jump can be used in connection of dance and acrobatic elements in order to get 0,10 point bonus award. It is known that DV is not possible to increase with difficulty value of more than 8 most difficult elements. In that case, getting bonus awards presents a very important part of the total DV score, primarily because of the fact that they are unlimited. Bonuses on the balance beam are given if connections are performed between acrobatic elements (C/D+D (or more), C+C, B+E, B+B+D, C+B+C for 0,10 point; C with rebounding effect/D+D (or more), B+F, B+B+E, C+C+C, B+C+D for 0,20 point), turns (A+C or more turn (or reverse) for 0,10 point) and between acrobatic and dance elements (mix: C+C or more and D – salto to 1 foot + A- scale for 0,10 point).

The second composition requirement on the balance beam (COP, 2009) is performing turn from Group 3. Accordingly, it was expected that turns could be performed in various forms and rotation degrees. The *1/1 turn on one leg – free leg optional below horizontal (N=66)* had the highest prevalence, but statistically significant influence of this turn on DV, EV and FS was not determined. From the group of turns statistically significant influence on the DV was determined for the *1/1 turn with heel of free leg fwd at horizontal throughout turn (C difficulty value; N=27)* and for the *1/1 illusion turn through standing split with/without brief touching of balance beam (D difficulty value; N=1)*. With respect to the difficulty value of this turns it is possible

to assume that they had a part in determining the total DV of exercise and because of what their influence on DV and FS was determined as statistically significant. If we observe the possibility of bonus award for connecting turns (A+C) through the number of all turns (N=106) in relation to the number of gymnasts (N=109) it can be assumed that (1) there were no gymnasts that performed more than a single turn, so there were no connections between the turns or (2) that the D judges devaluated the turns or (3) didn't recognize them occurring the fall. The absence of significant influence of all types of turns on the EV is probably the result of the accurate technique for performed turns which led to fewer deductions.

Summarizing the results, it is obvious that, although COP consists of a huge number of dance elements, junior gymnasts mostly performed the same elements. This result is consistent with Minusa (2000) and his opinion that performances in gymnastics have become increasingly similar and that virtuosity in performing isn't priority to most gymnast. The highest prevalence was determined to one C difficulty value dance element (*Switch Leap jump*) what is explained through its simplicity of performance and usability in fulfilling first composition requirement, in getting bonus for "mix" and in determination of total DV. Beside *Switch Leap jump*, very high prevalence was determined to four A difficulty value dance elements: *Sissone take off from both legs, Split jump from cross or side position, Wolf hop or jump from cross or side position* and *360° turn*. Although these elements have the lowest difficulty value, it is possible that they were a part of total DV scores of most routines. This especially counts for *360°turn* which is minimum turn, but inevitable part for fulfilling second composition requirement. Because most of the gymnasts chose to perform only this turn in exercise, expectedly, its statistically significant influence on DV, EV and FS wasn't determined.

Although COP defines minimum, but not maximum of dance elements in balance beam routine, only a few gymnasts choose to perform greater number of dance elements in their routines to achieve higher DV and accordingly higher FS. One of the reasons of this result probably lies in the article 7 which explains devaluation of dance elements if their performance is bad.

For routines with greater number of dance elements it can be assumed that they were composed from the elements with lower difficulty value, which fulfill composition requirements and from the elements with higher difficulty value (performed correctly) whose aim was to increase total DV. This assumption was confirmed with statistically significant influence of a dance elements with lower prevalence but higher DV score (*Johnson*, *Switch Leap with ½ turn*, *Johnson with additional ½ turn*, *Sheep jump* and *Yang-Bo*) on total DV and ultimately on a better FS.

Based on this result it can be concluded that, although implementing high difficulty dance elements on the balance beam is very risky, it is clear that the highest scoring dance elements are the best predictors of success in junior gymnastics competition. Nevertheless, this result needs to be perceived through the fact that information from this study came from E judge sheet, where devaluation of these jumps has not been marked. If the D judge sheets were used, it is possible that the results of this study would have been slightly different.

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