

Departure Difficulty Score Vs Final Difficulty Score. The Effect of Performance in Elite Rhythmic Gymnastics

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The aim of this study was to determine how the difference between the departure difficulty score, and the final difficulty score, in the different type of elements affects the performance success in elite rhythmic gymnastics. Two hundred eighty-eight individual routines performed at the World Championship 2013 were analysed. A non-parametric test- Kruskal-Wallis test, was applied to determine whether there were significant differences between different level groups. The results show significant differences between the departure difficulty score and final difficulty score, which increase as the level of performance decreases. Rotations, DER and Mastery are the main types of difficulty elements responsible for this difference. These results suggest that the judges and coaches do not have the same perception of the evaluation criteria of the difficulty elements. The findings can contribute to improve the definition criteria of the difficulty elements and to clarify the specific needs of the training program.

Keywords: *Difficulty score, coach, judge, rhythmic gymnastics.*

Introduction

The ability to control and monitor the technical content of competitive individual routines in Rhythmic Gymnastics (RG) accurately is an important factor of effective high performance in this sport. This knowledge can also contribute to preview and characterise the effort requirements allowing improvements in a gymnasts' preparation for elite competitions (Ferreirinha, 2011). A precise understanding of the technical content of individual RG routines, acknowledged by the judges' evaluation, can be beneficial to the International Gymnastics Federation (Cuk et al., 2012), as well as for coaches and gymnasts that can also be used as feedback to adapt the training structure in order to improve performance (Fernandez-Villarino, 2013).

Several studies (Caburrasi, 2003; Ávila-Carvalho, 2011; Ávila-Carvalho, 2012; Trifunov, 2013; Agopyan, 2014) analysed the number and the level of

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difficulty elements presented by the coach on the competition form. The number and the level of difficulty elements is the departure difficulty score (DDS). However, those studies did not emphasise information about the contribution of each type of element acknowledged by the judges, which leads to the final difficulty score (FDS).

The elements prescribed before the competition in the forms do not translate the real success in competition, which suggests that the use of these indicators may not be enough to understand the individual adaptations and to establish the optimised training models (Arkaev, 2004). Also as a consequence of the constant and quick evolution of this sport, a permanent upgrade of these kinds of studies is needed. (Caburrasi, 2003; Cuk, 2012; Massidda, 2012; Hokelmann et al., 2012; Bucar, 2013, Pelin, 2013).

An individual RG routine is composed of body and apparatus elements linked in a specific way, which are called difficulty elements. The code of points (CoP) holds a great variety of difficulty elements to be used in the routines. One important characteristic of the RG is to allow the gymnast to link it in her own way, with a clever configuration, and a stylish and perfect presentation (Wang, 2013). On the present Olympic cycle, the content of an individual RG routine should respect the specific requirements that are common to the routines of all 4 apparatus: Jumps/Leaps, Balances, Rotations, Apparatus Mastery, Dance Steps and Dynamic Elements with Rotation and throw (DER) (FIG, 2012). The value of each difficulty element is from 0.10 points to 1.50 points or more, which may be absolutely determinant in the final score obtained in the competition. The inclusion of complex abilities in the routines is essential to have a high score (Massida, 2012).

It is important to understand which groups of elements contribute the most for the difference between the DDS proposed by the coach on the difficulty form, and the FDS given by the judge in competition. Once the coaches know the cause of this difference, they may optimise the training process on these groups of elements, promoting an effective success in competition. Thus, before suggesting eventual future changes, it is important to find out what should be changed and what should be maintained and how.

The aim of this study is to determine the real performance success in elite rhythmic gymnastics through the analysis of the difference between the departure difficulty score and the final difficulty score. The analysis will be done (i) according to the final ranking of the gymnast in the competition in order to see if the technical level of the gymnasts has influence in the results, and (ii) according to the type of element, to determine if there are elements with more influence in the difference between the DDS and the FDS.

Material and Methods

Participants

One thousand and one hundred and fifty-two difficulty forms concerning 288 individual routines were analysed (4 forms per routine, 1 per judge). The routines were performed by gymnasts from 45 different countries competing at the Rhythmic Gymnastics World Championship in Kiev, Ukraine in 2013. The final scores were obtained from the official book of results of the qualification competition (FIG, 2013).

Measures/ Procedure

All difficulty elements reported in the difficulty forms provided by the gymnasts at the competition were recorded. The evaluation of the each difficulty element was considered according to the average of the 2 intermediate scores done by the 4 judges on the form. The analysis was done considering the sample clustered into 3 groups according to the gymnasts' final ranking as follows: The top 24 gymnasts on the ranking (Group 1), the 24 middle gymnasts on the ranking (Group 2) and the 24 lower placed gymnasts on the ranking (Group 3). This division allowed the comparison of the routine difficulty value declared by the coach in the difficulty form (DDS) with the difficulty score given by the judges during the competition (FDS), for gymnasts with different technical levels. Then, we studied the sample according to the type of difficulty elements performed, listed according to the composition requirements of the Code of Points (FIG, 2012).

Full blinding of the judges and gymnasts involved was undertaken. That is, in order to protect the judges' and gymnasts' anonymity we blinded their names.

The forms were analysed by two international RG judges. The intraclass correlation coefficient (ICC) in the test-retest method (intra-examiner) was 0.99. The ICC between the observers (inter-examiner) was 0.98.

Statistical Analysis

The data were analysed using the Statistical Package for Social Sciences – version 20.0 (SPSS 20.0, Chicago, USA) and Microsoft Office Excel 2007. The level of significance was set at $\alpha = 0.05$ (confidence interval of 95%). Descriptive statistics were calculated using the mean values as a measure of central tendency, standard deviation (SD) as a measure of dispersion. After checking the normalities in the data distribution ($p < 0.05$) using the Kolmogorov-Smirnov normality test, we resorted to a non-parametric test-Kruskal-Wallis test, to determine whether there were significant differences between the three groups in the Rhythmic Gymnastics World Championship ranking. A multiple regression was used to analyse the influence of each difficulty element in the gymnasts' final difficulty score.

Results

Comparing the routine difficulty value declared by the coach in the difficulty form (DDS) with the difficulty score given by the judges during the competition (FDS) we get the results summarized in Table 1 where we present the average values for DDS and FDS (mean \pm sd) and the difference (Δ) between these values in the 3 groups of the gymnasts' final ranking.

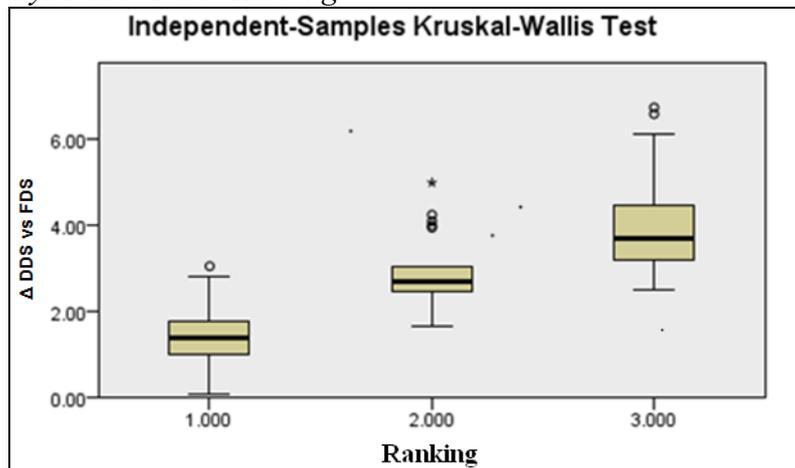
Table 1. Descriptive Values of Departure Difficulty Score and Final Difficulty Score

Routine Difficulty Score	Group 1 (n=96)	Group 2 (n=96)	Group 3 (n=96)
	Mean \pm sd	Mean \pm sd	Mean \pm sd
DDS	9,83 \pm 0,22	9,59 \pm 0,26	8,50 \pm 0,98
FDS	8,42 \pm 0,64	6,81 \pm 0,62	4,61 \pm 1,37
Δ DDS vs FDS	1,41 \pm 0,58*	2,78 \pm 0,57*	3,88 \pm 0,94*

* $p < 0.05$ Kruskal-wallis test; DDS: Departure Difficulty Score; FDS: Final Difficulty score;
 Δ DDS vs FDS: differences between DDS and FDS
 Source: Authors' estimations.

We could see, by only observing the numbers, that there is a considerable difference between the DDS and the FDS, even in the 24 best gymnasts (1.41 \pm 0.58 points). This difference is almost twice as high in group 2, the 24 middle gymnasts (2.78 \pm 0.57 points) and for group 3, it achieves an average of 3.88 \pm 0.94 points. We found statistically significant differences between these results, visible in Figure 1.

Figure 1. Boxplot for Difference between DDS and FDS for the 3 Parts of the Gymnasts' Final Ranking



* $p < 0.05$ Kruskal-wallis test; DDS: Departure Difficulty Score; FDS: Final Difficulty score;
 Δ DDS vs FDS: differences between DDS and FDS

After getting these results we analysed the differences between the DDS and FDS, considering the different types of difficulty elements, trying to find out if the differences are mainly connected to some type of difficulty elements, and if the type of elements with a higher difference are the same for the 3 groups of the gymnasts ranking. In Table 2 we can observe the DDS and FDS for each type of difficulty element for the gymnast in the different groups.

Table 2. Descriptive values of the different types of the difficulty elements of the Departure Difficulty Score and Final Difficulty Score

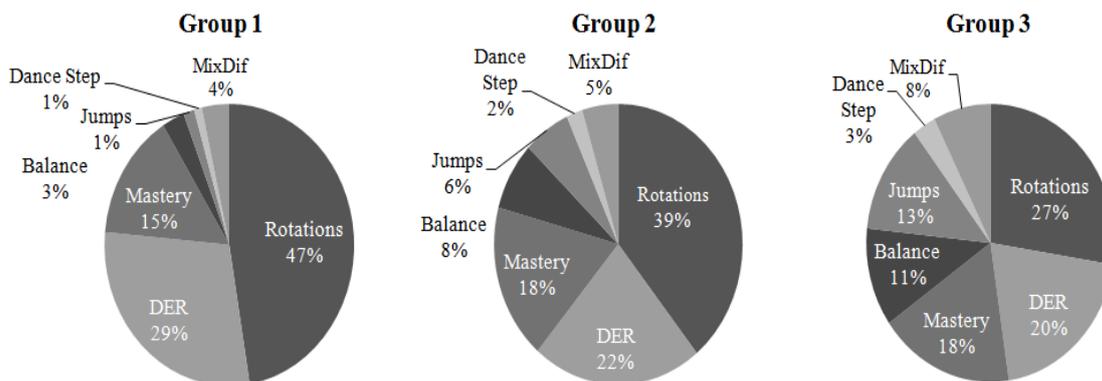
Elements		Group 1	Group 2	Group 3
Difficulty Score		Mean±sd	Mean±sd	Mean±sd
Jumps	DDS	1,54±0,44	1,40±0,45	1,25±0,33
	FDS	1,52±0,44	1,23±0,48	0,72±0,49
	Δ DDS vs FDS	0,01±0,07*	0,16±0,25*	0,52±0,43*
Balance	DDS	1,09±0,51	1,18±0,45	1,16±0,40
	FDS	1,05±0,52	0,96±0,46	0,69±0,38
	Δ DDS vs FDS	0,04±0,11*	0,21±0,28*	0,47±0,40*
Rotations	DDS	3,00±0,88	2,89±0,66	2,22±0,71
	FDS	2,32±0,77	1,80±0,47	1,08±0,52
	Δ DDS vs FDS	0,67±0,37*	1,08±0,42*	1,13±0,48*
DER	DDS	2,05±0,30	2,01±0,27	1,83±0,35
	FDS	1,64±0,42	1,40±0,38	1,00±0,51
	Δ DDS vs FDS	0,41±0,37*	0,61±0,33*	0,83±0,44*
Mastery	DDS	0,77±0,40	0,82±0,45	0,96±0,71
	FDS	0,56±0,40	0,32±0,27	0,24±0,27
	Δ DDS vs FDS	0,20±0,18*	0,50±0,31*	0,72±0,59*
MixDif	DDS	0,98±0,20	0,90±0,10	0,88±0,05
	FDS	0,93±0,27	0,76±0,25	0,57±0,28
	Δ DDS vs FDS	0,05±0,13*	0,13±0,24*	0,31±0,30*
Dance Steps	DDS	0,81±0,26	0,76±0,23	0,81±0,30
	FDS	0,79±0,26	0,70±0,23	0,69±0,30
	Δ DDS vs FDS	0,01±0,07*	0,05±0,12*	0,12±0,18*

*p<0.05 Kruskal-wallis test; DDS: Departure Difficulty Score; FDS: Final Difficulty score; Δ DDS vs FDS: differences between DDS and FDS
Source: Authors' estimations.

As we can see in Table 2, the difference between the DDS and FDS is highly correlated with the final ranking of the gymnasts in each difficulty element. The lowest is the position of the gymnast in the ranking and the highest is the difference between the departure and the final score in all types of difficulty elements. We can distinctively see the difference between the DDS and FDS behaviours according to the different types of difficulty elements. For the Jumps, Balances, MixDif and Dance Steps the difference between the DDS and the FDS is very low for the best gymnasts and increases a lot as we go down in the gymnasts' ranking. For the Rotations, DER and Mastery the difference between the DDS and the FDS is very high in the 3 groups.

Figure 3 shows the contribution of each type of element (in percentage) to the difference between the DDS and the FDS according to the final ranking of the gymnast.

Figure 3. Contribution of Each Type of Element (in percentage) to the Difference between the DDS and the FDS, for the 3 Parts of the Gymnasts' Final Ranking



We can see that the Rotations clearly contribute, in the 3 groups of the ranking (47%, 39% and 27%) to the difference between DDS and FDS. It is worth highlighting that the Rotations together with the DER group are responsible for more than half of the difference between the DDS and FDS for the gymnasts in group 1 and group 2 of the ranking (76% and 61% respectively). The Dance Steps is the element that clearly shows smaller differences between the DDS and FDS for the gymnasts placed in the 3 groups of the ranking.

Discussion

According to the results we can see that there are large differences between the scores proposed by the coaches in the competition forms and the difficulties that judges could identify, which increase as the gymnasts go lower in the ranking, going from almost more than 1 point in the gymnasts placed in group 1 of the ranking, to almost 4 points for the gymnasts placed in group 3 of the ranking, with a statistically significant difference between the 3 levels of gymnasts. Analysing these results we can remark that if we could expect differences between the DDS and FDS in the weaker gymnasts due to the faults in execution which cancel the value of the difficulty (FIG, 2012), the same result would not be expected in the very good gymnasts (the first 24 in the ranking), since these gymnasts get higher scores in execution (Leviotti, 2012).

The average of the DDS presented in the competition was 9.3 points, close to the maximum grade of 10 points. This average suggests a high global stage of world excellence, but truthfully, as we can see in Table 1, not even the best-ranked gymnasts in the group one of the ranking can reach this score.

Therefore, we can state that the difficulty value of the proposed routine by the coach in the competition form (DDS) is ambitious and does not reflect the performance capacity of the gymnast.

These results could be seen in two ways: on the one hand, perhaps all coaches “overwrite” the competition forms knowing that the judges “feel” the need to cut some difficulties (Ávila- Carvalho, 2011), or, on the other hand, we can also speculate that the lower we go in the gymnasts ranking, the more difficult it is for the judge to identify the difficulty elements, probably due to an execution problem. We propose this point of view because the other possibility is to consider that the judges were not able to identify the difficulties performed by the gymnasts. But, as we know, in Rhythmic Gymnastics World Championship competitions only highly prepared judges can evaluate. Studies such as St. Marie et al., 2001; Plessener et al, 2005; Johansson, 2010; Dallas, 2010; Heinen, 2012; Fernandez-Villarino, 2013 and more recently (Flessas et al., 2015 have shown that the experience of the judge and her capacity to use other cognitive strategies in perceiving error may be an asset in gymnastics judging. Thus, the non-recognition of the difficulties seems to be inappropriate.

To help explain these results, we tried to understand if these differences between the DDS and FDS could be identified in the different types of difficulty elements. We found out that they exist in all difficulty elements, being significantly higher in the difficulty elements Rotations, DER and Mastery and almost residual in the difficulty elements Dance Steps for the gymnasts in the three groups of the ranking. Analysing the elements first mentioned, these results may suggest the coaches and the judges understand the CoP rules differently. In the difficulty elements with higher differences between the DDS and FDS they may have some problems in the definition of the criteria that characterises them and/or in the comprehension of the technical faults, which cancel the value of the difficulty. On the other hand, and following the same perspective, in the difficulty elements such as Dance Steps, in which there is a strong proximity to the DDS and FDS, there seems to be an almost perfect understanding of the criteria defined by the CoP.

The contribution of each type of difficulty element to the difference between DDS and FDS is higher in Rotations, DER and Mastery in the three groups of the ranking. These difficulty elements are very complex elements to perform and demand an extraordinary coordination, perfect control of the apparatus technic and a lot of practice hours (Lebre, 2011; Vitrichenko et al, 2011). Therefore, they are also the ones where the gymnast can make more technical faults which cancel the value of the difficulty, mainly the weaker gymnasts. The gymnasts with the intention of getting top scores should present routines with a high level of difficulty combined with good execution quality (Agopyan, 2014). In the case of high ranked gymnasts, this result cannot be explained by the execution scores received, because they were very high. In the case of the gymnasts ranked in groups 2 and 3 (middle and lower gymnasts), the inferior quality in the execution may justify these results, suggesting, therefore, that the coaches, do not have a real perception of the performance capacity of their gymnasts in these types of difficulty elements.

In conclusion, the results show there are significant differences between the scores proposed by the coaches and the difficulties that the judges could identify, which increase as the gymnasts go lower in the ranking. The contribution of the difficulty elements to these differences is higher in Rotations, DER and Mastery in the gymnasts placed in the three groups of the ranking. These results, can suggest that the coaches do not have a real perception of the performance capacity of their gymnasts, in these types of difficulty elements.

We suggest that future studies should examine if the difference between DDS and FDS depends on the type of apparatus.

We believe that the evaluation of the difference between DDS and FDS are variables to consider in order to help reconstruct the CoP definitions related to some types of difficulty: (i) the way coaches and judges understand the rules, (ii) the orientation of the training process to maximize the performance capacity of the gymnasts in the type of difficulty elements in which the difference of DDS and FDS is higher, and/or (iii) strategically give preference to the types of difficulties in which this difference is lower.

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