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Model for longitudinal analysis of an individual all-rounder athlete's potential

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Abstract

The main objective of this paper is an attempt to offer an efficient model and a tool that makes it possible to realize an objective, scientifically and methodologically suitable model for individual analysis and identification of typical structures of disciplines of the particular all-rounder athlete and its interrelationship structures of athletic disciplines of heptathlon, as one of the factors of importance for the development and demonstration of own maximum potential.

Key words: **athletics, heptathlon, structure and potentials**

Introduction

When considering the interrelationships structures among all-round athletics competition disciplines as a function of the maximum expression of an individual all-round athlete's competition potential among the most successful all-round athletes, it is necessary to take into account the heterogeneous and at the same time the contingent variability of structures of interrelationship among the all-round competition disciplines in terms of multiple influential factors.

The results of previous studies (Tidow, 1982, Xinmin, H.; Jiyingo, X, 1995, Smajlović, 2001, 2003, 2008, Sanderson, 1982, 1995, Ros, 1989, Etcheverry, 1995.) confirm that the heterogeneity of all-round competition disciplines interrelationship structures, found at the athletes at the occasion of achieving all-round disciplines results, are not the result of chaotic random and not random effects. It is also confirmed that the outgrowth of the so far manifested contingents (type groups) of related structures of all-round competition disciplines interrelationships during the sport life of the most successful world heptathletes is their individual characteristics of direction of change in their whole psychophysical potential. These contingents (type groups) are mutually irreducible in their complexity because their identity is derived from the qualitative differentiation of related structures. It is clear that the types are formed within the flexible boundaries and to monitor their changes it is necessary to have a suitable mathematical-statistical apparatus.

Considering the fact that "there are differences in the character of motor and functional structure among athletics disciplines of all-round competitions, and that there are some complex mutual relationships among psycho-motor qualities found in their basis'' (Brogli, 1974), it is necessary to determine the type and level of mutual functional dependance of heptatlon disciplines, to identify the natural and prescribed structure of success performance in the heptatlon disciplines as well as the psychomotor structures used for their manifestation.

The complexity of the answer to this problem is in the fact that the athletic heptathlon is a composite activity in which each of the given disciplines requires maximum expression, of one or more of the leading psychomotor skills together with the same time positive joint action in manifestation of other psychomotor skills.

It is about a complex manifestation and relations of mutual relationships of psychomotor qualities both within one discipline and also among the qualities manifested by the given order of heptathlon disciplines.

An athlete - all-rounder manifestates his/her maximally versatile psychomotor potential in the range of interrelationships of disciplines that make up all-round structure as a specialized composite athletic discipline.

It is necessary to identify and to isolate the typical effective structures of the interrelationship among disciplines the individual uses to realize his/her current all-round disciplines potential. Therefore, the longitudinal research approach is suitable for determining the evolution of relatedness among typical taxonomic structures of the interrelationship among disciplines with the most successful heptathletes during their sport life. The purpose is to make the evolution of existing typical structures visible to the new structures as a kind of specific quality of individual development in actualization of the present potential, in other words to recognize the cascading outgrowth of the existing relationships into the qualitatively new ones.

This paper aims to offer an efficient model and tools to the athletic practice that allow to achieve an objective, scientific and methodologically based model for an individual analysis and determination of the typical structure of heptathlon disciplines of the particular heptathlete and its structures of the interrelationships among the athletic heptathlon disciplines, as a factor of importance for the development and maximal performance of their own potential.

Method

To gain an insight into the dynamics of levels and structure of heptathlon of the particular heptathlete, her heptathlon results,, achieved and measured during her career at official international athletics competitions (continental, world championships and Olympic Games) by the rules of the International Amateur Athletics Federation (IAAF), were used.

A brief sport history of heptathlon, the values and ranges of minimum and maximum absolute and points achievements in disciplines and overall scoring results, the trend and polynomial functions of their development during their sport life activities were presented. To determine the structure of results and scoring values of all-round disciplines, the subprogram Principal-Components Analysis-rotation varimax-SPSS was used.

The type and level of mutual functional dependence of heptathlon athletic disciplines were determined by the program GCSE Maths-Kury, Version 1.1 (1992).

The identification and graphical representation of the polynomial trend curve of the structure of interrelationships among the disciplines of athletic all-round competition, together with the profile of the typical groups of all-round competition disciplines, was performed by using the subprogram of Grafs Windows Statistica.

The isolation of the typical taxonomic structures according to the relatedness of the interrelationship among the athletic disciplines was performed by using Hierarchical Cluster Analysis (SPSS) - the method of the most distant neighbors and the measure of distances expressed in cosines values. The checking of the significance of differences between the separate typical taxonomic structures and significance of the all-round competition athletic disciplines for the classification on typical groups was performed by using the subprogram multivariate analysis of Variance-SPSS.

Results

The analyzed heptathlete (S.B.) is one of the top world heptathletes, She is the winner of a bronze Olympic medals, a gold one (twice) and a silver medal at the World championships. She has been twice European champion.

In 14 years of all-round competition career in the period from 18 to 32 years of age, this particular competitor achieved the results in the range of 6112-6986 points (Table 1) in 32 successful appearances. The important point values are found in the high jump disciplines, 100m hurdles run, long jump and 200m run and above average values in the javelin throw discipline in the group of the most successful world all-rounders.

The lowest point values are found in the shot-put discipline. The largest negative trend has been found in the discipline of 800m run. All other disciplines have shown a slight oscillatory positive trend with the mutual point values convergence at the end of career. The greatest value of the coefficient of variations was 7.35% for the discipline of javelin throw and 7.11% for the discipline of shot-put. The variability of the scoring values of these disciplines show the highest values and amounts for shot-put (V%=8.35) and for the javelin throw (V%=8.29).

Table 1. Central and dispersion parameters of heptathlon result s- S.B.

Variable	Mean	S.E.M	StD	Range	Min	Max	V%	N
STAGOD	25.65	.76	4.28	13.94	18.62	32.56		32
RPRE	13.49	.04	.23	.81	13.10	13.91	1.70	32
RVIS	184.66	.92	5.19	19.00	175	194	2.81	32
RKUG	13.64	.17	.97	3.37	11.71	15.08	7.11	32
R200	24.38	.06	.35	1.34	23.65	24.99	1.44	32
RDAL	635.19	2.95	16.67	65.00	602	667	2.62	32
RKOP	48.82	.64	3.59	13.20	40.90	54.10	7.35	32
R800	137.30	.76	4.27	22.94	129.41	152.35	3.11	32
BPRE	1052.66	5.91	33.41	118.00	992	1110	3.17	32
BVIS	1038.03	11.67	66.03	242.00	916	1158	6.36	32
BKUG	770.75	11.38	64.35	225.00	642	867	8.35	32
B200	945.44	5.78	32.67	127.00	888	1015	3.46	32
BDAL	960.75	9.37	52.98	207.00	856	1063	5.51	32
BKOP	837.84	12.27	69.43	255.00	685	940	8.29	32
B800	862.03	10.26	58.02	310.00	664	974	6.73	32
UKUBOD	6467.66	39.75	224.83	874.00	6112	6986	3.48	32

The course of development of the all-round competition disciplines results and their interrelation during sports activities is presented in Graph 1.

Two successful periods can be seen during a sports career. The first one in the second third and the second one in the end of the analyzed period. The discipline of 100m hurdles run, long jump, 200m run, javelin throw and shot-put after the initial heterogeneous interactions show a well-balanced development flow of mild oscillations (polynomial curves). The points values for the discipline of running 800m fall down to the very end of the sports career, in which part they dramatically improve along with the growth of points values of all other disciplines.

Graph 1. The trend of profiles of scoring values in individual competitions in the heptathlon disciplines - Sabina Braun
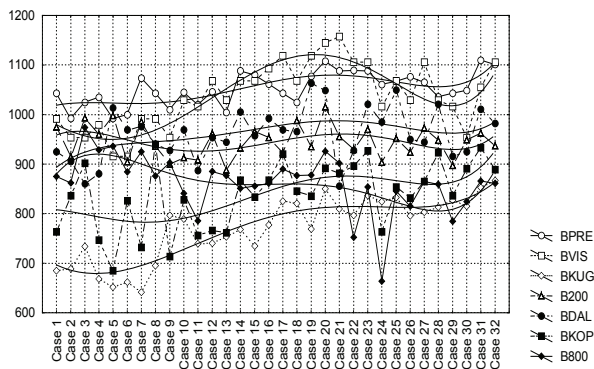
At the occasion of establishing her personal heptathlon record, a maximum potential was achieved in the discipline of 200m run (Graph 2.).

Graph 2. The relationship of the personal maximum potential results and the results in achieving her personal record -Sabine Braun
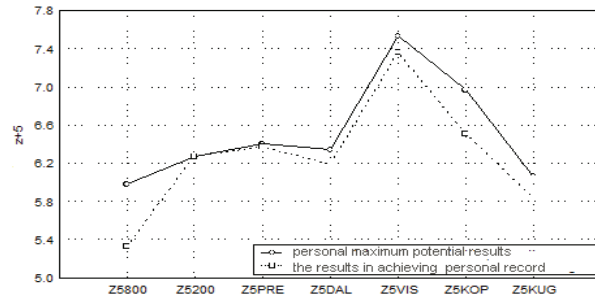
The results of component analysis indicate the presence of a two-component structure (Table 2). According to the values of all-round competition disciplines on the first principal component (42,8% of explained variance), some conclusions can be drawn about the important amount of homogeneity of the disciplines of 100m hurdles run, high jump, shot-put and javelin throw and about a very different character of the disciplines of running 800m and 200m, which showed high values on the second principal component.

Table 2 . The component analysis of the results in the disciplines of heptathlon – Sabina Braun

Variables	Communality	Factor	Eigenvalue	Pct of Var	Cum Pct
Z5PRE	.75716 *	1	2.99512	42.8	42.8
Z5VIS	.74646 *	2	1.65182	23.6	66.4
Z5KUG	.76483 *				
Z5200	.81963 *				
Z5DAL	.27674 *				
Z5KOP	.49931 *				
Z5800	.78280 *				

Rotated Factor Matrix:

Variables	Factor 1	Factor 2
Z5PRE	.86783	.06343
Z5VIS	.86398	-.00263
Z5KUG	.79832	-.35708
Z5KOP	.70661	.00459
Z5DAL	.50375	.15159
Z5200	.25382	.86903
Z5800	-.18531	.86514

| Factor Transformation Matrix	FACTOR 1	FACTOR 2
FACTOR 1	.99762	-.06897
FACTOR 2	.06897	.99762

The discipline of long jump proved to be low related to other disciplines important to the first principal component and at the same time with the values of the second principal component indicating the traces of share in the disciplines of running 200m and 800m. The communality of this discipline is very low and amounts to .277.

The cluster analysis on the 12th scale of integrating, four typical clusters were isolated (Dendrogram 1.). The most successful results belong to the first cluster. The further consolidations are step-like on higher levels so that the unified cluster containing the results of low value is left on the highest level. All disciplines except the heptathlon long jump have their taxonomic significance. Typical structures of heptathlon disciplines interrelationship of this competitor are shown in the graph 3.

Graph 3. Typical structures of athletic heptathlon - Sabina Braun
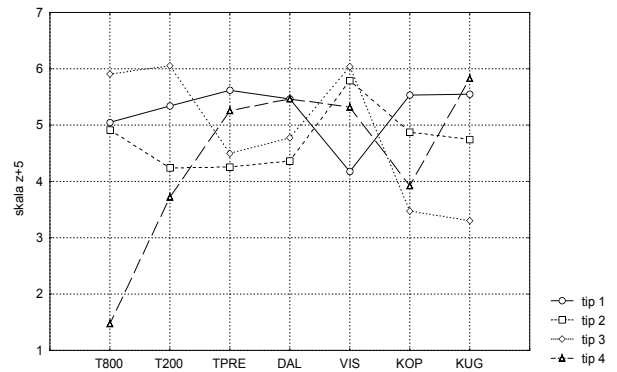
Dendrogram 1. Hierarchical cluster analysis of relatedness in heptathlon disciplines structures in competitions during a successful sports career - S.B.
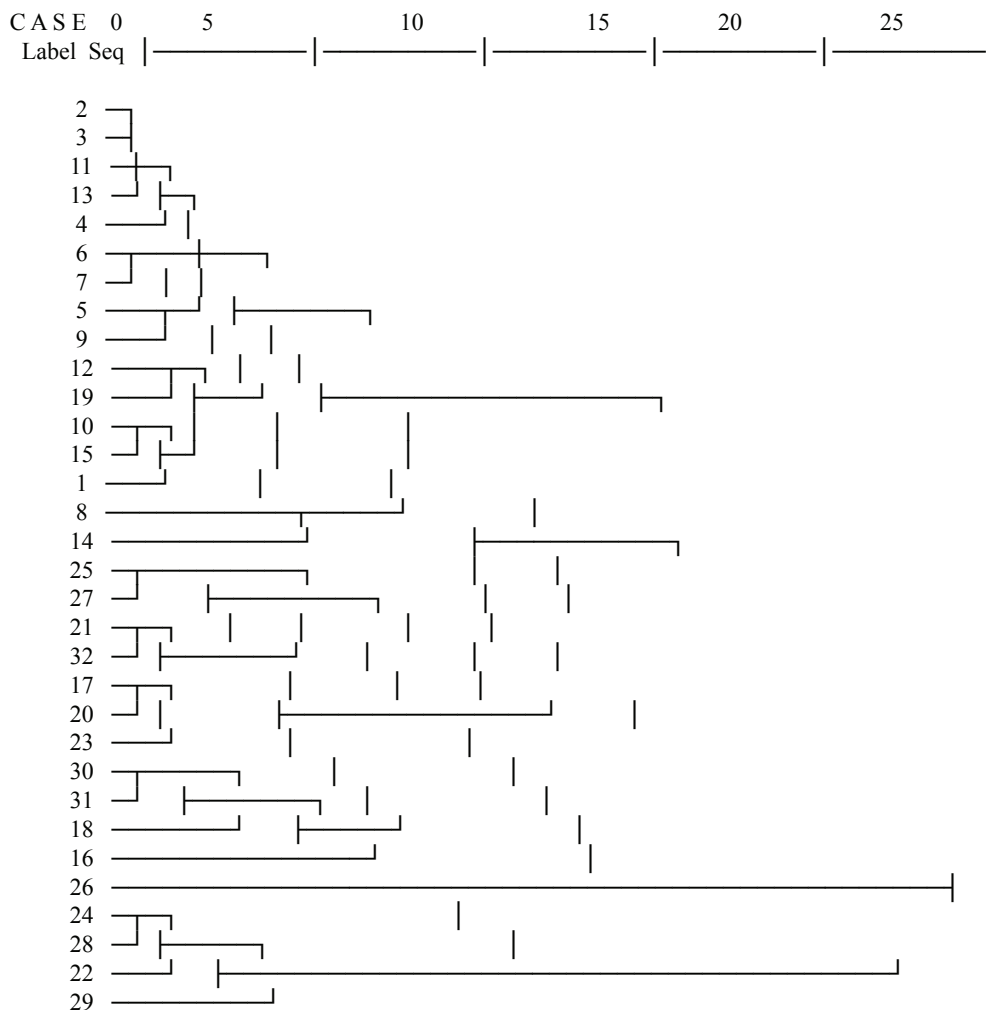
Discussion

The analyzed athlete belongs to a uniform type of heptathlete, which means that she exerts a balanced interrelationship among heptathlon disciplines. It resulted in the present domination of high jump results.it is obvious that her strong qualities of speed of horizontal reflex have a positive transfer on the results in heptathlon disciplines with the similar psychomotor demands (long jump, hurdles run, 200m run and javelin throw). A somewhat lower level of the results of shot-put and running 800 m can be noticed.

However, one should be careful in making the conclusion that for the further increase in the total score system it is necessary to improve the specific strength qualities (shot-put) and endurance (800m). The development of strength is often associated with increasing mass which results in a negative transfer to the implementation of tasks in all other disciplines, just as the insistence on the development of middle-distance running endurance can have a negative transfer to speed strong qualities. However, in this particular case, the longitudinal analysis of all the results during the career shows that the better results in the 800m run resulted in better results in all other disciplines. It is obvious that a better aerobic-anaerobic preparation enabled a faster recovery between disciplines and an easier way of coping with all efforts during the two-day heptathlon competition.

In the tendency of further results development with the aim to have her best performance of her heptathlon potential, it is necessary to realize a complex and balanced approach of the score and psychomotor development for the improvement of motor knowledge essential to exploit biodynamic potential.

Since the result of the race at 800m at the occasion of achieving her personal record shows the largest fall behind for her all-round competition potential in the same discipline, one might think of the level of achievement motive or of the minimum score of being able to endure stressful situations. It refers to the last heptathlon discipline the result of which is crucial most often for the final score. The fatigue caused by all earlier disciplines has significant effects on the heptathlete's psychological state.

The cluster analysis as a part of the proposed model has shown the presence of four typical clusters (Dendrogram 1). The most successful results belong to the first cluster the characteristics of which is a balance and above average results in all disciplines except the discipline of javelin throw. This is not surprising considering the fact that the analysis of central and dispersion parameters (Table 1.) showed the largest variability in the results of javelin throw disciplines (7.35 for the score result and 8,29 for point values). Due to her personal record in javelin throw discipline, it is possible, with a good concentration and favorable weather conditions during a throw, to expect that during some competitions the result of javelin throw itself reaches the average result of other disciplines.

Conclusion

This paper has proposed a possible model for the longitudinal analysis of an individual all-round athlete's competition potential. The model includes the following analyses:

- heptathlete sports history;
- central and dispersion parameters of all-round athletics competition results and scoring values;
- trend and polynomial functions found in the course of results development during a sport career;
- projection significance of result score and point values of athletic disciplines in main components;
- types and levels of mutual functional dependence of athletic heptathlon disciplines;
- isolation of typical taxonomic structures according to the relatedness of interrelationship among athletic disciplines.

The application of the proposed model provides an objective, scientifically based approach for having an insight into the level of individual maximum potential. It is also possible to make an optimal choice of disciplines that should be emphasized in order to determine the effective way and time of achieving the following level of individual achievement. Also, it is a way to assess the efficiency of the so far realized process of finding directions for all-round athletics competition preparations.

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