Under attack: the heptathlon scoring method

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Introduction

This paper discusses the scoring method that is currently being used in women's heptathlon (athletics) and presents the outcomes of alternative scoring methods that display improved fairness and validity.
In the March/April 2006 issue of New Studies in Athletics[1] a revision has been proposed of the decathlon scoring method of the IAAF (see also the Atletics coaching website[2]). An analysis of the world top 100 decathlons showed that decathletes gather far more points in sprinting-based events like 100 m, 110 m hurdles and long jump than in throwing events (shot put, javelin, discus) and endurance (1500 m). Starting from the premise that allroundness is the true basis of decathlon, the current scoring method displays unacceptable bias as it favours some of the events and defers others. It lacks fairness and validity, because sprinters benefit disproportionately. In the NSA-paper, three alternative models have been proposed as candidates for replacing the existing model. The alternative scoring methods are uniform over the events and support self-stabilisation. They combine practical evidence and sound principles. Calibration to the current model is performed with existing data in order to enable smooth transitions from existing practice.
As will be shown in the current paper, the women's heptathlon displays similar anomalies and would also need alternative ways of converting performances into scores. Empirical heptathlon data have been fed into the alternative models and the outcomes are presented.

The IAAF heptahlon scoring tables

As is the case with decathlon, results for the women's heptathlon are calculated through official scoring tables that convert the separate performances in various jumping, throwing and jumping events into points to allow simple addition. The IAAF scoring tables are the outcome of many modifications over the years to remove manifest flaws. For spectators, reporters and even athletes the scoring method is quite impenetrable. They cannot but accept the scoring outcomes indiscriminately as a fact of life. Like the decathlon tables, the heptathlon tables are being used without modifications since 1984 and it turns out that today quite some unbalance has arisen.

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[1] Westera, W. (2006). Decathlon, towards a balanced and sustainable performance assessment method. *New Studies in Athletics*, March/April, pp. 37-48. Accessible at http://www.open.ou.nl/wim/publicationspdf/Pages%20from%20NSA%2001%202006.pdf
[2] Westera, W.(2006). Redefining the decathlon scoring method. The Athleticscoaching website. http://www.athleticscoaching.ca/UserFiles/File/Sport%20Science/Theory%20&%20Methodology/Combined%20Events/Decathlon/Westera%20Redefining%20the%20decathlon%20scoring%20tables.pdf

Where do heptathletes achieve their points?

Similarly to the decathlon case, we have used the all time women's heptathlon ranking of the IAAF (www.iaaf.org) in order to analyse the applicability of the heptathlon scoring method. Figure 1 shows the distribution of average scores over the separate heptathlon disciplines for the all-time top 99 heptathlons.

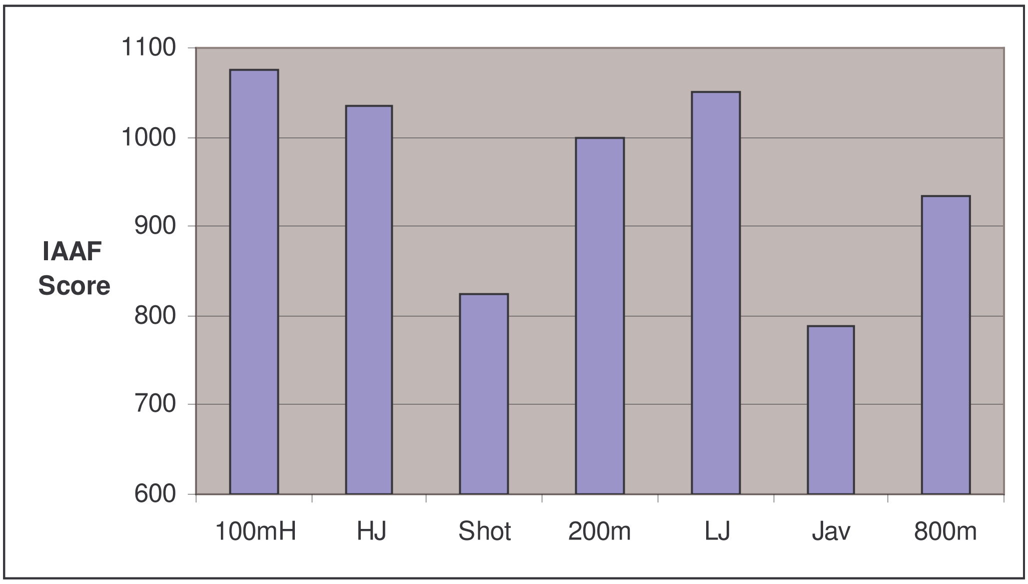

Figure 1. Average scores of the all time top 99 women's heptathlons (IAAF, August 2006)

As in the case of the men's decathlon, the heptathletes seem to profit disproportionately from the long jump and 110 m hurdles, while javelin and discus throw are highly unfavourable. The standard deviation of the heptathlon score distribution is even higher than in the case of decathlon (113 points versus 77 points). When starting from the principle of allroundness, the ideal score distribution should be uniform over the disciplines. The large deviations from uniformity prompt for a revision of the current scoring method.

The current scoring method

The current scoring tables have been set up in the 1980s after extensive discussions, negotiations and compromises, while taking into account practical constraints and an abundant amount of empirical evidence. The current scoring method for each discipline is covered by a mathematical expression of the type:

$$S(P) = A.(P-B)^{C} \qquad (1)$$

where
P is the performance (i.e. the achieved distance in the long jump etc.).
S is the score (the number of assigned decathlon points).
A, B en C are event-dependent parameters that define the nature of the scoring table.
For running events (P- B) has to be replaced with (B-P) because of the descending nature of performance with time.

Note that the performance assessment method comprises two stages: first the performance P is measured (in units of time or distance), next the performances are converted to a score S in order to allow addition. Clearly, it is this second stage of assessment that is problematic.

Figure 2 shows scoring curve for the long jump for both decathlon and heptathlon.

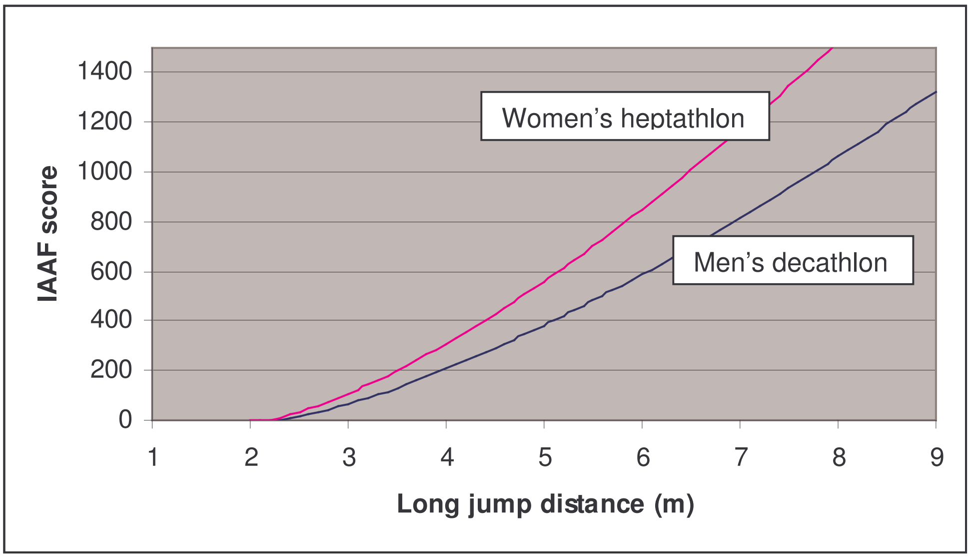

Figure 2. Current scoring curves for the long jump.

For men's decathlon it uses the following values: A=0.14354, B=220 cm, C=1.40, while P is expressed in cm; for women's heptathlon it uses A=0.188807, B=210 cm and C=1.41. As can be read from figure 2 the scoring curves according to equation (1) are slightly progressive, which nature is mainly determined by the power C. The underlying idea of this nonlinearity is that an improvement at low performances is much easier to achieve than an improvement at high performances. The overall scaling of the curve is determined by a parameter A. The parameter B defines a threshold value, below which no score is assigned. In case of the long jump no points are obtained when the long jump is below 220 cm. Note that A, B and C are different for each discipline, for instance, for women's javelin (A= 15.9803, B= 380 cm, C=1.04) and for women's 200 m (A= 4,99087, B= 42,5 s, C= 1,81). Clearly, the current tables are pragmatic in kind and based on tradition rather than solid explanation. Consequently, some arbitrariness is involved (210 cm and not 220 cm!). Altogether, the current multi-event scoring method thus comprises a set of 10 power laws that is specified by 30 calibration parameters: A, B and C for each of the 10 events.

Towards alternative scoring methods

Three alternative scoring methods have been described extensively elsewhere1. For these alternative models the following requirements have been expressed:

- allow a fair comparison between events,
- be uniform over all events (this follows from the starting points of the decathlon),
- use objective standards (distance and time measurements),
- be grounded in empirical evidence (practical significance),
- be based on sound principles and logic (consistent, transparent and substantiated),
- be stable over time and thus possess self-stabilising characteristics,
- allow smooth transitions from the existing model (acceptability).

The three alternative models combine practical evidence and sound principles. Hence they are to some extent a compromise between theoretical foundation and current practice and habits. The models share the idea that the performances for each event are converted into a normalised form and subsequently are awarded with scores that confer to a great deal to common practice. Yet, effects are not negligibale. Below, we will briefly describe the three alternative scoring methods.

Model 1. Power law

In accordance with the current method this scoring model assumes a power law curvature (cf. figure 2). Naturally, the power C (cf. equation 1) determines the progressive form of the scoring curve, so it follows that $C>1$. A simple estimate of the power C can be obtained by conforming to the IAAF heptathlon power parameters C that are used in the current method. When we equate the reference power C with the average of the current powers we obtain $C = 1.481857$.

Model 2. Parabolic

Theoretically, the progressive form of the scoring curve may be associated with the role of the kinetic energy that is developed by the athlete. Along this line of thought the resulting scoring curve should be parabolic in kind, because kinetic energy is expressed as (distance/time) squared and performance is always expressed in units of distance or units of (reciprocal) time. Clearly, the parabolic model yields $C=2$. It can be demonstrated that a power of $C=2$ prevails when we assume that the extra score $dS(P)$ that follows a performance improvement dP is proportional with the performance P.

Model 3: Exponential

Starting from statistics we arrive at an exponential curvature. The underlying assumption is that the distribution of performances can be approximated by the negative exponential distribution. It can be shown that this assumption is equivalent with the sensible premise that a performance increment dP causes a frequency (occurrence) change $df(P)$ that is linearly proportional with the frequency $f(P)$ (with coefficient λ). The exponential distribution is often associated with the survival of species in biology or similar processes that account for failures and drop outs. This process of survival has many things in common with heptathlon events. In order to establish the progression of the exponential curve we have set the pragmatic requirement that the exponential curve has an intermediate position between the power curve and the parabolic curve. By minimising the total squared differences between the curves, we find $l=1.6054$.

Mathematical summary of the models

All three suggested models meet the requirements for justified rating that we have expressed before. Relevant data and formulas for these suggested models are summarised in table 1. here P is the performance, S is the score, P_0 and P_1 are reference values, A, C and λ are constants.

I. Power law $S(P)=A\,.((P-P_0)/(P_1-P_0))^C$ with A = 957.83 en C= 1.481857		
II. Parabolic $S(P)=A\,.((P-P_0)/(P_1-P_0))^C$ with A = 957.83 en C= 2.000		
III. Exponential $S(P)=A\,.\,(e^{\lambda P_N}-1)/\,(e^{\lambda}-1)$ with A = 957.83 en λ=1.6054		
Event	**P_0**	**P_1**
100 m H	$(37.49\ s)^{-1}$	$(13.33\ s)^{-1}$
High jump	0.66 m	1.85 m
Shot put	5.14 m	14.46 m
200 m	$(66.98\ s)^{-1}$	$(23.82\ s)^{-1}$
Long jump	2.36 m	6.63 m
Javelin throw	16.44 m	46.23 m
800 m	$(6\ min\ 11.77\ s)^{-1}$	$(2\ min\ 12.23\ s)^{-1}$

Table 1. Summary of three alternative scoring models

Re-assessment of all time world ranking

Recalculation of the all time heptathlon ranking according to the proposed models shows some interesting changes. Table 2 shows the current IAAF all time top 99 ranking as well as the ranking outcomes and scores of the three alternative models. In the alternative rankings the original IAAF-ranking is indicated between parentheses.

Rank	IAAF-model		Power model		Parabolic model		Exponential model	
1	Jackie Joyner-Kersee	7291	Jackie Joyner-Kersee (2)	7445	Larisa Turchinskaya (24)	7798	Larisa Turchinskaya (24)	8028
2	Jackie Joyner-Kersee	7215	Jackie Joyner-Kersee (1)	7432	Jackie Joyner-Kersee (2)	7740	Larisa Turchinskaya (7)	7836
3	Jackie Joyner-Kersee	7158	Larisa Turchinskaya (7)	7427	Larisa Turchinskaya (7)	7739	Larisa Turchinskaya (20)	7799
4	Jackie Joyner-Kersee	7148	Larisa Turchinskaya (24)	7423	Jackie Joyner-Kersee (1)	7717	Jackie Joyner-Kersee (2)	7791
5	Jackie Joyner-Kersee	7128	Jackie Joyner-Kersee (3)	7354	Larisa Turchinskaya (20)	7655	Jackie Joyner-Kersee (1)	7763
6	Jackie Joyner-Kersee	7044	Larisa Turchinskaya (20)	7348	Jackie Joyner-Kersee (3)	7601	Ghada Shouaa (13)	7662
7	Larisa Turchinskaya	7007	Ghada Shouaa (13)	7311	Ghada Shouaa (13)	7575	Jackie Joyner-Kersee (3)	7631
8	Carolina Klüft	7001	Jackie Joyner-Kersee (4)	7302	Jackie Joyner-Kersee (4)	7527	Ghada Shouaa (42)	7571
9	Sabine Braun	6985	Jackie Joyner-Kersee (5)	7257	Jackie Joyner-Kersee (5)	7477	Jackie Joyner-Kersee (4)	7552
10	Jackie Joyner-Kersee	6979	Ghada Shouaa (42)	7208	Ghada Shouaa (42)	7454	Jackie Joyner-Kersee (5)	7517

11	Carolina Klüft	6952	Sabine Braun (9)	7182	Sabine Braun (9)	7369	Sabine Braun (9)	7401
12	Sabine John	6946	Ramona Neubert (14)	7134	Ramona Neubert (14)	7299	Ramona Neubert (14)	7321
13	Ghada Shouaa	6942	Carolina Klüft (8)	7087	Carolina Klüft (8)	7233	Sabine Braun (40)	7276
14	Ramona Neubert	6935	Jane Frederick (36)	7064	Sabine Braun (40)	7218	Jane Frederick (36)	7253
15	Jackie Joyner-Kersee	6947	Sabine Braun (40)	7058	Jane Frederick (36)	7215	Carolina Klüft (8)	7253
16	Sabine John	6897	Carolina Klüft (11)	7054	Carolina Klüft (11)	7183	Sabine Braun (37)	7229
17	Eunice Barber	6889	Jackie Joyner-Kersee (15)	7042	Sabine Braun (37)	7175	Carolina Klüft (11)	7195
18	Carolina Klüft	6887	Sabine Braun (37)	7029	Jackie Joyner-Kersee (15)	7166	Eunice Barber (17)	7184
19	Jackie Joyner-Kersee	6878	Sabine John (12)	7019	Sabine John (12)	7143	Sabine John (16)	7178
20	Larisa Turchinskaya	6875	Sabine John (16)	7000	Sabine John (16)	7134	Jackie Joyner-Kersee (15)	7176
21	Eunice Barber	6861	Jackie Joyner-Kersee (6)	6995	Eunice Barber (17)	7116	Sabine John (12)	7162
22	Natalya Shubenkova	6859	Denise Lewis (30)	6988	Jackie Joyner-Kersee (6)	7109	Jackie Joyner-Kersee (6)	7126
23	Anke Vater-Behmer	6858	Carolina Klüft (18)	6983	Denise Lewis (30)	7095	Denise Lewis (30)	7108
24	Larisa Turchinskaya	6847	Eunice Barber (17)	6970	Carolina Klüft (18)	7086	Carolina Klüft (18)	7094
25	Ramona Neubert	6845	Tatyana Blokhina (48)	6925	Tatyana Blokhina (48)	7037	Tatyana Blokhina (48)	7084
26	Irina Belova	6845	Ramona Neubert (38)	6922	Ramona Neubert (38)	7011	Sabine John (34)	7050
27	Eunice Barber	6842	Jackie Joyner-Kersee (28)	6911	Jackie Joyner-Kersee (10)	7008	Jackie Joyner-Kersee (10)	7049
28	Jackie Joyner-Kersee	6841	Jackie Joyner-Kersee (19)	6908	Jackie Joyner-Kersee (19)	7004	Jackie Joyner-Kersee (19)	7035
29	Jackie Joyner-Kersee	6837	Jackie Joyner-Kersee (10)	6903	Sabine John (34)	7002	Ramona Neubert (38)	7027
30	Denise Lewis	6831	Sabine John (34)	6898	Jackie Joyner-Kersee (28)	6989	Eunice Barber (27)	7014
31	Carolina Klüft	6824	Eunice Barber (27)	6857	Eunice Barber (27)	6959	Jackie Joyner-Kersee (28)	6997
32	Eunice Barber	6824	Natalya Shubenkova (22)	6835	Natalya Shubenkova (22)	6890	Eunice Barber (21)	6924
33	Carolina Klüft	6820	Anke Vater-Behmer (23)	6824	Eunice Barber (21)	6885	Natalya Shubenkova (22)	6902
34	Sabine John	6813	Ramona Neubert (25)	6821	Ramona Neubert (25)	6877	Chantal Beaugeant (49)	6899
35	Anke Vater-Behmer	6805	Chantal Beaugeant (49)	6813	Anke Vater-Behmer (23)	6874	Ramona Neubert (25)	6895
36	Jane Frederick	6803	Eunice Barber (21)	6810	Chantal Beaugeant (49)	6872	Anke Vater-Behmer (23)	6885
37	Sabine Braun	6797	Jackie Joyner-Kersee (41)	6792	Eunice Barber (32)	6836	Heike Tischler (66)	6870
38	Ramona Neubert	6789	Eunice Barber (32)	6792	Jackie Joyner-Kersee (41)	6832	Mila Kolyadina (73)	6860

39	Ramona Neubert	6788	Miaolan Ma (46)	6780	Mila Kolyadina (73)	6820	Eunice Barber (32)	6852
40	Sabine Braun	6787	Jackie Joyner-Kersee (29)	6777	Sibylle Thiele (55)	6816	Jackie Joyner-Kersee (41)	6844
41	Jackie Joyner-Kersee	6783	Sibylle Thiele (55)	6774	Jackie Joyner-Kersee (29)	6813	Sibylle Thiele (55)	6841
42	Ghada Shouaa	6780	Carolina Klüft (33)	6771	Heike Tischler (66)	6809	Jackie Joyner-Kersee (29)	6827
43	Carolina Klüft	6769	Mila Kolyadina (73)	6770	Miaolan Ma (46)	6809	Austra Skujyte (90)	6818
44	Yelena Prokhorova	6765	Heike Tischler (66)	6750	Carolina Klüft (33)	6796	Miaolan Ma (46)	6813
45	Eunice Barber	6755	Eunice Barber (45)	6745	Ramona Neubert (39)	6783	Ramona Neubert (39)	6811
46	Miaolan Ma	6750	Ramona Neubert (39)	6743	Eunice Barber (45)	6780	Eunice Barber (45)	6803
47	Heike Drechsler	6741	Jane Flemming (50)	6735	Austra Skujyte (90)	6763	Carolina Klüft (33)	6800
48	Tatyana Blokhina	6703	Le Shundra Nathan (64)	6722	Jane Flemming (50)	6754	Jane Flemming (50)	6765
49	Chantal Beaugeant	6702	Austra Skujyte (90)	6719	Le Shundra Nathan (64)	6742	Le Shundra Nathan (64)	6759
50	Jane Flemming	6695	Yelena Prokhorova (44)	6704	Birgit Clarius (80)	6715	Birgit Clarius (80)	6743
51	Ines Schulz	6660	Irina Belova (26)	6698	Yelena Prokhorova (44)	6715	Irina Belova (26)	6735
52	Svetla Pishtikova	6658	Birgit Clarius (80)	6695	Irina Belova (26)	6714	Natalya Grachova (53)	6730
53	Natalya Grachova	6646	Anke Vater-Behmer (35)	6677	Anke Vater-Behmer (35)	6693	Yelena Prokhorova (44)	6727
54	Svetlana Buraga	6635	Carolina Klüft (31)	6677	Carolina Klüft (43)	6682	Anke Vater-Behmer (35)	6719
55	Sibylle Thiele	6635	Carolina Klüft (43)	6676	Carolina Klüft (31)	6681	Carolina Klüft (43)	6697
56	Natalya Roshchupkina	6633	Yelena Martsenyuk (69)	6670	Natalya Grachova (53)	6677	Carolina Klüft (31)	6696
57	Judy Livermore-Simpson	6623	Natalya Grachova (53)	6650	Yelena Martsenyuk (69)	6668	Yelena Martsenyuk (69)	6680
58	Liliana Alexandru-Nastase	6619	Svetla Pishtikova (52)	6632	Svetla Pishtikova (52)	6616	Svetlana Sokolova (63)	6626
59	Malgorzata Nowak	6616	Svetlana Sokolova (63)	6632	Svetlana Sokolova (63)	6615	Svetla Pishtikova (52)	6625
60	Remigija Nazaroviene	6604	Malgorzata Nowak (59)	6605	Malgorzata Nowak (59)	6589	Malgorzata Nowak (59)	6611
61	Irina Tyukhay	6604	Irina Tyukhay (61)	6585	Irina Tyukhay (61)	6551	Irina Tyukhay (61)	6558
62	Svetlana Moskalets	6598	Natalya Roshchupkina (56)	6571	Natalya Roshchupkina (56)	6532	Kelly Blair-La Bounty (85)	6547
63	Svetlana Sokolova	6591	Yekaterina Smirnova (75)	6561	Diane Guthrie-Gresham (77)	6515	Natalya Roshchupkina (56)	6540
64	Le Shundra	6577	Natallia	6558	Yekaterina	6514	Diane	6535

	Nathan		Sazanovich (67)		Smirnova (75)		Guthrie-Gresham (77)	
65	Rita Ináncsi	6573	Diane Guthrie-Gresham (77)	6551	Kelly Blair-La Bounty (85)	6511	Margaret Simpson (96)	6532
66	Heike Tischler	6572	Ines Schulz (51)	6547	Natallia Sazanovich (67)	6509	Heike Drechsler (47)	6521
67	Natallia Sazanovich	6563	Kelly Blair-La Bounty (85)	6539	Ines Schulz (51)	6503	Yekaterina Smirnova (75)	6517
68	Nadezhda Miromanova	6552	Heike Drechsler (47)	6530	Heike Drechsler (47)	6495	Valentina Dimitrova (87)	6514
69	Yelena Martsenyuk	6551	Rita Ináncsi (65)	6527	Judy Livermore-Simpson (57)	6478	Ines Schulz (51)	6514
70	Kelly Sotherton	6547	Judy Livermore-Simpson (57)	6521	Margaret Simpson (96)	6475	Natallia Sazanovich (67)	6512
71	Mona Steigauf	6546	Svetlana Buraga (54)	6515	Valentina Dimitrova (87)	6472	Judy Livermore-Simpson (57)	6499
72	Urszula Wlodarczyk	6542	Valentina Dimitrova (87)	6506	Rita Ináncsi (65)	6469	Svetlana Buraga (54)	6479
73	Mila Kolyadina	6541	Margaret Simpson (96)	6502	Svetlana Buraga (54)	6465	Rita Ináncsi (65)	6473
74	Tatyana Shpak	6539	Liliana Alexandru-Nastase (58)	6497	Liliana Alexandru-Nastase (58)	6440	Liliana Alexandru-Nastase (58)	6455
75	Yekaterina Smirnova	6536	Urszula Wlodarczyk (72)	6475	Tatyana Shpak (74)	6407	Tatyana Shpak (74)	6439
76	Peggy Beer	6531	Remigija Nazaroviene (60)	6461	Urszula Wlodarczyk (72)	6399	Nadezhda Miromanova (68)	6424
77	Diane Guthrie-Gresham	6527	Tatyana Shpak (74)	6458	Remigija Nazaroviene (60)	6392	Shelia Burrell (84)	6408
78	Sabine Everts	6523	Svetlana Moskalets (62)	6447	Nadezhda Miromanova (68)	6390	Remigija Nazaroviene (60)	6406
79	Hyleas Fountain	6502	Nadezhda Miromanova (68)	6442	Shelia Burrell (84)	6377	Urszula Wlodarczyk (72)	6403
80	Birgit Clarius	6500	Shelia Burrell (84)	6439	Svetlana Moskalets (62)	6369	Svetlana Moskalets (62)	6379
81	Svetlana Drobyazhko	6493	Antonina Sukhova (91)	6438	Birgit Dressel (82)	6352	Birgit Dressel (82)	6360
82	Birgit Dressel	6487	Birgit Dressel (82)	6437	Antonina Sukhova (91)	6351	Antonina Sukhova (91)	6357
83	Marianna Maslennikova	6474	Jodi Anderson (93)	6413	Jodi Anderson (93)	6323	Jodi Anderson (93)	6336
84	Shelia Burrell	6472	Lyubov Ratsu (95)	6397	Cornelia Heinrich (88)	6302	Cornelia Heinrich (88)	6327
85	Kelly Blair-La Bounty	6465	Valentina Kurochkina (86)	6390	Lyubov Ratsu (95)	6302	Lyubov Ratsu (95)	6313
86	Valentina Kurochkina	6461	Cornelia Heinrich (88)	6388	Valentina Kurochkina (86)	6286	Svetlana Drobyazhko (81)	6304
87	Valentina Dimitrova	6453	Svetlana Drobyazhko	6376	Svetlana Drobyazhko	6283	Valentina Kurochkina	6291

			(81)		(81)		(86)	
88	Cornelia Heinrich	6453	Peggy Beer (76)	6366	Peggy Beer (76)	6267	Peggy Beer (76)	6286
89	Marion Reichelt	6442	Mona Steigauf (71)	6364	Mona Steigauf (71)	6263	Mona Steigauf (71)	6279
90	Austra Skujjyte	6435	Hyleas Fountain (79)	6339	Hyleas Fountain (79)	6248	Hyleas Fountain (79)	6278
91	Antonina Sukhova	6427	Diana Koritskaya (99)	6306	Diana Koritskaya (99)	6186	Kelly Sotherton (70)	6216
92	Birgit Gautzsch	6425	Birgit Gautzsch (92)	6305	Kelly Sotherton (70)	6182	Diana Koritskaya (99)	6204
93	Jodi Anderson	6424	Marianna Maslennikova (83)	6284	Birgit Gautzsch (92)	6173	Marianna Maslennikova (83)	6191
94	Irina Matyusheva	6424	Kelly Sotherton (70)	6284	Marianna Maslennikova (83)	6165	Birgit Gautzsch (92)	6180
95	Lyubov Ratsu	6423	Satu Ruotsalainen (97)	6268	Satu Ruotsalainen (97)	6144	Satu Ruotsalainen (97)	6168
96	Margaret Simpson	6423	Emilia Dimitrova (98)	6251	Emilia Dimitrova (98)	6111	Emilia Dimitrova (98)	6127
97	Satu Ruotsalainen	6404	Irina Matyusheva (94)	6207	Irina Matyusheva (94)	6062	Irina Matyusheva (94)	6088
98	Emilia Dimitrova	6403	Sabine Everts (78)	6127	Sabine Everts (78)	6006	Sabine Everts (78)	6065
99	Diana Koritskaya	6401	Marion Reichelt (89)	6103	Marion Reichelt (89)	5944	Marion Reichelt (89)	5984

Table 2. Comparison of heptathlon all time world rankings

Through the alternative methods it seems that heptathlon world record holder Jackie Joyner-Kersee loses part of her outstanding position in favour of Larisa Turchinskaya. While the IAAF ranking is dominated by Kersee, as still is the case in the power law model, Turchinskaya is assigned world leader and hence the new world record holder in both the parabolic and exponential approach. A closer look at the underlying data reveals that the latter has been severely underrated in the IAAF-scoring method for her outstanding performances in javelin throw and shot put. The alternative models are just designed to prevent such underratings while they support uniformity over the disciplines. Remarkable are the big leaps (20+) of Turchinskaya and other good throwers like Ghada Shouaa, Sabine Braun and Jane Frederick. Reversely, excellent runners like current world champion and Olympic champion Carolina Klüft and current world record holder Jackie Joyner-Kersee are thrown back by the new methods because of relatively poor shot put and javelin throw. Indeed the alternative models seems to counteract the sprint bias of the current model.

Re-assessment of the 2005 world championships ranking

The alternative models have also been applied to the heptathlon data of the 2005 world championships (table 3).

Rank	IAAF-model		Power model		Parabolic model		Exponential model	
1	Klüft Carolina	6887	Klüft Carolina (1)	6983	Klüft Carolina (1)	6916	Klüft Carolina (1)	5904
2	Barber Eunice	6824	Barber Eunice (2)	6792	Barber Eunice (2)	6784	Barber Eunice (2)	5797
3	Simpson Margaret	6375	Skujyte Austra (4)	6639	Simpson Margaret (3)	6417	Skujyte Austra (4)	5503
4	Skujyte Austra	6360	Simpson Margaret (3)	6612	Skujyte Austra (4)	6350	Simpson Margaret (3)	5449
5	Sotherton Kelly	6325	Dobrynska Nataliya (9)	6169	Sotherton Kelly (5)	6285	Dobrynska Nataliya (9)	5400
6	Collonvillé Marie	6248	Collonvillé Marie (6)	6084	Zelinka Jessica (11)	6268	Collonvillé Marie (6)	5337
7	Gomes Naide	6189	Kesselschläger Sonja (10)	6083	Collonvillé Marie (6)	6217	Kesselschläger Sonja (10)	5272
8	Ruckstuhl Karin	6174	Gomes Naide (7)	6029	Gomes Naide (7)	6138	Gomes Naide (7)	5235
9	Dobrynska Nataliya	6144	Sotherton Kelly (5)	5954	Kesselschläger Sonja (10)	6123	Sotherton Kelly (5)	5263
10	Kesselschläger Sonja	6113	Zelinka Jessica (11)	5944	Dobrynska Nataliya (9)	6122	Zelinka Jessica (11)	5261
11	Zelinka Jessica	6097	Schwarzkopf Lilly (13)	5897	Ruckstuhl Karin (8)	6091	Schwarzkopf Lilly (13)	5377
12	Fountain Hyleas	6055	Szczepanska Magdalena (19)	5887	Schwarzkopf Lilly (13)	6077	Szczepanska Magdalena (19)	5119
13	Schwarzkopf Lilly	5993	Ruckstuhl Karin (8)	5845	Naumenko Irina (14)	5988	Ruckstuhl Karin (8)	5224
14	Naumenko Irina	5991	Naumenko Irina (14)	5765	Johnson Virginia (16)	5981	Naumenko Irina (14)	5152
15	Wheeler Kylie	5919	Stratáki Aryiró (17)	5726	Szczepanska Magdalena (19)	5979	Stratáki Aryiró (17)	5074
16	Johnson Virginia	5911	Fountain Hyleas (12)	5717	Fountain Hyleas (12)	5945	Fountain Hyleas (12)	5147
17	Stratáki Aryiró	5884	Wheeler Kylie (15)	5597	Stratáki Aryiró (17)	5937	Wheeler Kylie (15)	5111
18	Oberer Simone	5882	Johnson Virginia (16)	5563	Wheeler Kylie (15)	5889	Johnson Virginia (16)	5021
19	Szczepanska Magdalena	5880	Oberer Simone (18)	5486	Oberer Simone (18)	5821	Oberer Simone (18)	5147
20	Nakata Yuki	5735	Nakata Yuki (20)	5462	Nakata Yuki (20)	5726	Nakata Yuki (20)	4945

Table 3. Re-assessment of the 2005 world championships results.

Clearly, there is no dispute about gold and silver medallists Carolina Klüft and Eunice Barner. In two of the alternative models, however, bronze medal winner Margaret Simpson swaps positions with number 4 Austra Skujyte. Remarkable leaps can be observed for Nataliya Dobrynska who enters top 6 in both the power model and the exponential model. The same holds for Jessica Zelinka when the parabolic model is applied. Magdalena Szczepanska moves forward substantially in all three models, because her weak sprinting is now compensated for by her strong javelin throw and shot put. Conversely, Karin Ruckstuhl loses quite some positions due to weak javelin throw and weak shot put.

In this paper we have shown that the current heptathlon scoring method suffers from severe bias and produces unfair outcomes. Sprinting events are overrated at the expense of throwing events. Three alternative models[1] have been applied that display uniform characteristics over all events in order to meet the notion of allroundness. We have recalculated the all time heptathlon world ranking as well as the 2005 world championships results. Current world record of Jackie Joyner-Kersee is not quite as extreme as the IAAF scores suggest. In two of the alternative models Larisa Turchinskaya is denoted the new world record holder. In the 2005 world championships two out three alternative models designate Austra Skujyte as the bronze medallist at the expense of Margaret Simpson.