Determinants of Success in the Olympic Decathlon: Some Statistical Evidence

Ian Christopher Kenny* Dan Sprevak†
Craig Sharp‡ Colin Boreham**

*University of Ulster, i.kenny@ulster.ac.uk
†University of Ulster, d.sprevak@ulster.ac.uk
‡Brunel University, craig.sharp@brunel.ac.uk
**University of Ulster, ca.boreham@ulster.ac.uk

Copyright ©2005 by the authors. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher, bepress, which has been given certain exclusive rights by the author. Journal of Quantitative Analysis in Sports is produced by The Berkeley Electronic Press (bepress). http://www.bepress.com/jqas
Determinants of Success in the Olympic Decathlon: Some Statistical Evidence

Ian Christopher Kenny, Dan Sprevak, Craig Sharp, and Colin Boreham

Abstract

In a recent communication, Van Damme et al (1) presented a statistical analysis of the performance of world-ranked decathletes, and made inferences about the ability of these athletes to respond uniformly to the demands of the ten events in the decathlon. Their argument was based on an interpretation of the negative correlation in a sample of 600 world-ranked decathletes between the best performance in an event and the overall performance. They used the principle of allocation (2) to argue that excellence in one task may only be attained at the expense of average performance in all other tasks. We present here a complementary view. We considered the 92 decathletes who competed in the last five Olympic games. For this elite sub-sample we found an opposite result to that of Van Damme et al (1): to compete successfully at this level, a uniform, relatively high performance in all individual disciplines is required.

KEYWORDS: decathletes, principle of allocation, Olympic Games, performance, elite
INTRODUCTION

In a recent paper, Van Damme et al [1] presented a correlation from which they argued that for world-ranked decathletes, increased performance in one task may impede performance in others. Complementing the principle of allocation [2] where excellence in one task can only be attained at the expense of average performance in all other tasks, Van Damme et al [1] found that when analysis of world-ranked decathletes, i.e. decathletes of comparable standards, was conducted, trade-offs became evident between certain traits. Performances in 100m (metres) were found to correlate negatively with speed over 1500m for those athletes scoring over 8000 points (generally accepted as the standard for world class decathletes). They noted that there were contradictions in their results, namely those outliers in their scatterplot that skewed results, thus creating a more severe negative correlation between mean overall performance and maximal performance in a particular discipline. These contradictions may have been caused by differences in the ‘general standard’ of athletes, masking trade-off effects when the entire population of world class decathletes was analysed. It is unclear whether there existed strong correlations between scoring in different events, or between specialist and uniformly-scoring decathletes.

Our approach to this research question is that these ‘differences’ are deemed negligible through analysis of that sub-group of elite world-class decathletes who have competed in the last five Olympic Games. Performances of these 92 Olympic decathletes have been used to determine how and where points are won by individuals of comparable athletic abilities. Cox & Dunn [3] recently argued that the decathlon should not be biased towards any one event or any group of events such as field events. The athlete who excels at only the long or high jumps should not be more likely to win a decathlon than an athlete who excels at the 100m or 400m, i.e. the points advantage for a top athlete over the other competitors should not favour any particular event or group of events. Anecdotally, decathletes are frequently described as being sprinter/jumper types, or thrower/pole vaulter types, roughly grouping speed and skill levels. Ward et al [4] assessed the validity of grouping such abilities by asking whether it is possible, knowing the performance in one discipline, with a small error, to determine the performance in some other event. Using data from the 5 Olympic Games from 1984 to 2000, they developed a scatterplot matrix for the decathlon, showing the correlation, if any, between disciplines. Highest correlations were found to exist between the discus and shot-put (0.58), 100m and 110metre hurdles (0.54), 100m and long jump (0.48), and 100m and 400m (0.53).

Whilst, physiologically and biomechanically, there may be an argument supporting excellence in a group of related events, (natural selection; principle of allocation [2]) the correlation between this physiological constitution and overall performance in a decathlon event, specifically for Olympic level athletes,
remained to be explored. In natural populations of animals, the evolution of different traits (e.g., speed and endurance) is not independent, because natural selection of one trait negatively affects the other. There may be a functional trade-off involved such that having a morphological/physiological/behavioural phenotype (A) would be interesting to perform task (A), but not to perform task (B), and vice versa.

To test these ideas in a subset of elite athletes, we decided to focus our statistical analysis on those 92 decathletes who have competed in the last 5 Olympic Games. The correlation between maximal excellence in a particular discipline and overall performance was predicted to follow a different pattern than the negative correlation produced by Van Damme et al [1].

METHODS
Data were obtained from the IAAF official website [5]. For each athlete, data were handled in a manner similar to that of Van Damme et al [1]. Excellence in a single discipline (specialist) and average performance across all 10 disciplines (generalist) for 92 Olympic athletes was represented via a scatterplot graph (Figure 1). Subjects were those 92 decathletes who have competed in the last 5 Olympic Games.

Figure 1. Scatter plot for performance of 92 Olympic decathletes.
To ensure that scores in different events received equal weighting, an athlete’s score was standardised for each event by subtracting it from the population mean and dividing it by the population standard deviation, for the entire data set across all Games. In order to ensure comparability between studies, the same statistical analyses were employed as were used in the original study [1]. Measures of excellence and average performance for each decathlete across all disciplines were calculated to test the assumption that there may be a performance trade-off between specialist and generalist phenotypes. For each decathlete the highest standardized score from his set of 10 events was selected and defined as that athlete’s ‘degree of excellence’. The average of the 10 scores was also calculated to estimate their overall performance.

Furthermore, Van Damme et al [1] produced a table detailing correlations between each of the 10 events to account for differences in general quality of athletes in their data set. However, the subset of Olympic decathletes we studied do not present such differences, rather demonstrating uniformity of performance across all disciplines.

RESULTS
Excellence in a particular discipline (represented by the highest residual score for a particular athlete) was positively correlated with average performance (expressed as the average of all 10 residual scores for that athlete). Correlation coefficient, r, was found to be 0.57 (p<0.001) (Figure 1). It could be argued that the score of the event with the best ranking in the sample gives a more meaningful measure of maximal performance. We found that the two measures differ for only an insignificant number of competitors.

Our results would seem to contradict those of Van Damme et al [1], showing a correlation opposite to that which their population demonstrated. They acknowledged that their sample contains a significant diversity of ‘general quality’ and this diversity is used to explain away some possible contradictions in their findings. Furthermore, it appears that their sample has a small but influential number of decathletes (in the sense that they greatly affect the correlation coefficient) who seem to behave as outliers in the group. If the twenty or so ‘outliers’ were removed from their graph, the plot might not show such a negative correlation.

DISCUSSION
We found that among the 600 decathletes analysed by Van Damme et al [1] there exists a subset of elite athletes that behaves differently. Van Damme et al make a connection, based on an evolutionary argument, between the selection of elite decathletes and the principle of allocation. Our findings show that such a connection is problematic. That is, that for Olympic decathletes there is a positive
correlation (r=0.57) between overall performance and maximal excellence in a particular discipline. So for Olympic decathletes the principle of allocation [2] would seem to operate in reverse, i.e. that a uniform, relatively high performance in all individual events is required to effectively compete at this level.

If performance in the decathlon were to follow the rule of principle of allocation, it would be expected that boxplots illustrating the variance of scores awarded would show a greater range for outliers and lower and upper extremes. Indeed, boxplots created using the population of 600 world-ranked decathletes as in [1] would illustrate just such a greater range. Results indicate that the subset identified as Olympic athletes are better able to apply superior and more uniform performances across all 10 disciplines, illustrated by reduced variance (standard deviation) amongst their scores and higher mean performances.

Our findings also contradict those by Cox & Dunn [3] who suggested that the decathlon favours those athletes who are good in the field events. The population studied in their paper consisted of those decathletes competing in the five IAAF World Athletics Championships from 1991 to 1999. Their argument was based on the fact that performance standard deviation for their decathlete population appeared greater for field events than track events. This suggested that decathletes specialising in field events scored disproportionately higher than decathletes excelling in track events. However, consistently a significantly smaller percentage of entrants for the World Championship decathlon completed all ten events compared with Olympic Games decathlon entrants [5], indicating that there is greater variability in performance associated with the World Championship decathlon. Those non-finishing decathletes could be considered outliers that skewed results in the scatterplot of the 600 world-ranked decathletes studied by Van Damme et al [1].

We would agree, though, that it is more difficult to combine excellence in some combinations of events than in others as there exist similarities in physiological demand between certain events. Nevertheless, our results show that athletes and coaches aspiring to Olympic representation should strive to uniformity of performance across all ten disciplines rather than enhanced performance in single events or groups of events. Specialisation in the decathlon is at the expense of poor performance.

Similarly, our findings have implications for the selection and identification of future Olympic decathletes. Particular efforts should be made to train for uniformity of performance over all events. Athletes could be selected based on their ability to perform evenly over a majority of the ten events, but also an athlete that may perform well in several events and poorly in a few, with the view to improve in those few poor events to produce a uniform overall performance.
Validation of the findings of the current research may form the basis of future work. A thorough test of our conclusions would require study of the effects of different training schemes on decathletes, one accentuating particular events, the other not. In addition, further analysis of those Olympic decathletes examined in our research may look at historical scoring by specific athletes showing whether they improved in one area and not in other areas, over the 5 Games period in question.

Finally, our paper highlights the danger in using correlation to establish general behaviour. Correlation does not imply causation- hence, as in this case, there may be populations which display an opposite behaviour to that indicated by the correlation demonstrated above. Within any population there may exist a subset which demonstrates a different behaviour than that which is expected and shown by the whole population.

CONCLUSION
We found that Olympic decathletes, a subset of the 600 world-ranked decathletes analysed by Van Damme et al [1], have a positive correlation ($r = 0.57$) between overall performance and maximal excellence in a particular discipline. Thus, for this subset the principle of allocation [2] is not applicable. We believe that this has implications for the selection and training of Olympic decathletes. Decathlon should be seen as a specialisation for which young athletes with good overall performances in a variety of events are selected, and that training should seek to minimise deficiencies within the ten events if success at the Olympic level is sought. Our results show that athletes and coaches aspiring to Olympic representation should strive to uniformity of performance across all ten disciplines rather than enhanced performance in single events or groups of events. Van Damme et al [1] use evolutionary arguments to suggest that the principle of allocation (predicting that excellence in one task can only be attained at the expense of average performance in all other tasks, and vice versa [2]) operates in the selection of elite decathletes. However, it is notoriously difficult to use a priori predictions based on evolutionary arguments. Our results indicate that when a different evolutionary pressure, i.e. to be able to compete as an Olympic decathlete, exists, then a different selection of the ‘fittest’ operates.

This also shows the perils that await the unwary when using correlation to establish general behaviour. Correlation does not imply causation- hence, as in this case, there may be sub-populations which display a behaviour opposite to that indicated by the correlation found for the whole population.
REFERENCES