

Understanding the holistic development of elite performance in Olympic weightlifting

Project overview

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The Project aim:

This project, a KESS 2 collaborative project between Bangor University and Weightlifting Wales, had analysed over 1500 individual factors across three studies using a novel machine learning approach to provide a holistic and evidenced based understanding of the development of elite performance in Weightlifting.

Study 1

A State-of-the-art British pathway analysis

18 years of data
9,236 entries
2,010 athletes

Machine learning used to find key pathway indicators at all youth, junior and senior age groups

Study 2

Retrospective interviews with Current and Past British Weightlifting Athletes

22 athletes
40+ hours of interviews
387 unique features from the holistic framework

Machine learning used to find key features that best discriminate performance

Study 3

A 10 month longitudinal observation of welsh youth and junior weightlifting athletes across wales

29 athletes
2 testing sessions
648 unique features from the holistic framework

Machine learning used to find key features that best discriminate performance

The key findings

The key findings from all three studies are summarised below. For a more detailed examination of these results, including practical recommendations from each finding, please see the full report.

Demographics and Family



Parental involvement in sport:
Encouragement into the sport tended to occur as a result of having a parent who was themselves involved in the sport.



Affordances for sport participation: Town infrastructure
Presented more opportunities for sport sampling and play throughout the athlete's formative years.



Sport participation at school
Schools with a wider range of sport provision may encourage athletes to engage in a wider array of sports training and competition.

Sport Participation History



Sport Sampling
Higher performing athletes were involved in more sports from a younger age (i.e., typically around 11 years of age).



Early exposure to flexibility & strength training
Substantial differences in the volume of general strength and conditioning, as well as flexibility and mobility training typically appeared from around the age of 15.



Weightlifting specific deliberate practice
As well as accumulating a higher volume of overall practice volume, high performing athletes tended to drastically increase the volume of their practice at around 14 years of age.

Physiological characteristics



Anthropometrics
High performing athletes reported longer tibia lengths and arms relative to their normative length for their gender and age



Maximum dynamic strength and lower body power
As expected, clear differences in the explosive power and maximum dynamic strength profiles of the athletes were found.



Trunk Stability
Noteworthy findings were also reported in trunk stability and squat mobility, as reported by a more upright torso position in the overhead squat in higher performing athletes.

Key pathway indicators



For Women
Moderate to important predictors of senior performance became most prevalent from the u20 age group onwards, although some predictors, which mainly centred around clean and jerk performance and competitive experience, were established from as early as the u15 age group.



For Men
Moderate to important predictors of senior performance from as early as the u13 age group were found, which would suggest that early pathway entry is indicative of long-term elite performance attainment for men.

Psychosocial profile



Athlete personality
Factors in the athlete's personality that were discriminative of performance were high conscientiousness and two features of perfectionism: namely high organization and low doubts about actions



Athlete attitudes towards training and competition
High performing athletes also reported more motivation towards the attainment of both mastery (i.e. better than own previous performance) and performance (i.e. normative standard) related outcomes. They also reported higher levels of passion for weightlifting and commitment to training.

Microstructure of practice:

Phase 1 (age 11 to 13)



In higher performing athletes, practice was generally identified as having very little developmental focus and was mainly centred around activities that were inherently enjoyable (i.e. deliberate play).



Very little mental rehearsal or vicarious learning were emphasized in high performers early in development, although an occasional observation of more experienced athletes may have been of motivational benefit.



For all athletes, practice was generally structured to practice both lifts as whole movements, with very little emphasis on movement organization.

Practice conditions were kept constant to encourage consistent performer-environment interactions.

Phase 2 (age 13 to 15)



Practice became predominantly centred around the development of performance (i.e., deliberate practice), with significant increases in volume in high performers.



In high performers, the technical aspects of each lift were emphasized in this phase of development, as the movements were broken down and practiced in parts.



Information from coach was still predominantly conveyed verbally, although for high performers, other mediums such as video were also used to allow the athletes to partake in the learning process.



Practice was set up more so to meet the specific demands of competition and began to contain more varied practice conditions.

High performing athletes also began to rely on their intrinsically derived sources of feedback, which was also accompanied by more mental rehearsal and vicarious experiences outside of their training.

Phase 3 (age 16 to 19):



Practice was predominantly if not completely deliberate practice, especially in high performers.



Both the snatch and clean and jerk were practiced as parts and as well as whole, although more emphasis is placed on the whole movement as the movements in high performers should have been well organised by this stage.



Information remained to be conveyed verbally and with demonstrations, although more emphasis was placed on video feedback.



Practice conditions contained a high degree of variety in terms of performer environment interactions. Athletes also reported to be self-sufficient in terms of their intrinsically derived feedback.

They were also voluntarily completing a high volume of mental rehearsal and watching other athletes vicariously for the benefit of their own learning.