



## Jumping depends on impulse not power

RUDDOCK, Alan and WINTER, Edward

Available from Sheffield Hallam University Research Archive (SHURA) at:

<http://shura.shu.ac.uk/11498/>

---

This document is the author deposited version. You are advised to consult the publisher's version if you wish to cite from it.

### Published version

RUDDOCK, Alan and WINTER, Edward (2015). Jumping depends on impulse not power. *Journal of Sports Sciences*, 34 (6), 584-585.

---

### Repository use policy

Copyright © and Moral Rights for the papers on this site are retained by the individual authors and/or other copyright owners. Users may download and/or print one copy of any article(s) in SHURA to facilitate their private study or for non-commercial research. You may not engage in further distribution of the material or use it for any profit-making activities or any commercial gain.

**Title:** Jumping depends on impulse not power

To the editor-in-chief,

We read with interest the manuscript by Russel et al. (2015) and noted their use of power to characterise performance in jumping. Such use is widespread in sport and exercise science, but it is also incorrect.

The success of either a vertical or horizontal jump is determined by velocity at take-off or departure. From Newton's second law of motion outlined in Principia that was published in 1687, this velocity is determined by the preceding impulse generated by an athlete. In the context of jumping, misuse of the construct power was highlighted several decades ago by Adamson and Whitney (1971). Because velocity is a vector quantity, it possesses both magnitude and direction. Newton's second law is expressed as the impulse-momentum relationship and the relationship allows precise identification of velocity at departure. The mathematical link that identifies this velocity is irrefutable.

Adamson and Whitney's (1971) objections were followed by others (Cronin & Sleivert, 2005; Knudson, 2009; Knuttgen, 1978; Rodgers & Cavanagh, 1984; Winter, 2005; Winter & Fowler, 2009) to clarify misconceptions. In spite of this authors often continue to associate and at worst attempt to explain jumping performance in scientific literature by means of "power" as if it were a clearly defined key performance variable (Knudson, 2009). The definition of power from classical (Newtonian) mechanics is the rate of doing work ( $J \cdot s^{-1}$ ) (Rodgers & Cavanagh, 1984).

It is problematic to consider short-duration, discrete projectile activities as 'power' events and hence incorrect to extend assessments of power to describe and explain performance in impulsive activities such as jumping.

When a jump is performed on a force platform, a key metric is the integral of force and time i.e. the area under the force-time curve. Information from this curve can be used beguilingly to provide a velocity-time profile of the body's centre of mass. At this point it is worth considering that power is also frequently but erroneously calculated as:

$$F \cdot v$$

such that instantaneous values of power, especially the peak, can be derived from force platforms. However, in doing so, there is no account of the values that precede and follow the calculated maximum (Winter & Fowler, 2009). Moreover, the use of "power" is often justified by citing existing malpractice that is typically accompanied by a correlation coefficient that indicates a strong relationship between peak power and jump height. This practice should be redundant since impulse has a perfect correlation ( $r = 1$ ) with jump height (Winter, 2005).

Objection to the use of power in attempts to explain jumping performance should not be confused with academic nitpicking (Knuttgen, 1978). Abuse of terms and nomenclature and misuse of mechanical principles hinder the advancement of sport and exercise science (Winter & Knudson, 2011). An effective sport and exercise scientist elucidates principal factors that describe and explain performance (Mendez-villanueva & Buchheit, 2013). Effectiveness is not demonstrated by misuse of mechanical constructs, especially as here, power.

This preference for research and practice to assess and develop power is misplaced at best (Cronin & Sleivert, 2005). If sport and exercise science is to advance, research into jumping that seeks meaningful explanations of performance should focus on factors such as height, impulse and rate of force development, not power.

ALAN D. RUDDOCK

The Centre for Sport and Exercise Science,  
Sheffield Hallam University,  
Sheffield, UK

EDWARD M. WINTER

The Centre for Sport and Exercise Science,  
Sheffield Hallam University,  
Sheffield, UK

## **References**

- Adamson, G., & Whitney, R. (1971). Critical appraisal of jumping as a measure of human power. In J. Vrenenbregt & J. Wartenweiler (Eds.), *Medicine and Sport 6: Biomechanics II* (pp. 208–211). Basel: Karger.
- Cronin, J., & Sleivert, G. (2005). Challenges in understanding the influence of maximal power training on improving athletic performance. *Sports Medicine*, 35, 213–234.
- Knudson, D. V. (2009). Correcting the use of the term “power” in the strength and conditioning literature. *Journal of Strength and Conditioning Research*, 23, 1902–1908.
- Knuttgen, H. G. (1978). Force, work, power, and exercise. *Medicine and Science in Sports*, 10, 227–228.
- Mendez-villanueva, A., & Buchheit, M. (2013). Football-specific fitness testing: adding value or confirming the evidence? *Journal of Sports Sciences*, 31, 1503–1508.

Rodgers, M. M., & Cavanagh, P. R. (1984). Glossary of biomechanical terms, concepts, and units. *Physical Therapy*, 64, 1886–1902.

Russel

Winter, E. M. (2005). Jumping: Power or Impulse? *Medicine and Science in Sports and Exercise*, 37, 523.

Winter, E. M., & Fowler, N. (2009). Exercise defined and quantified according to the Systeme International d'Unites. *Journal of Sports Sciences*, 27, 447–60.

Winter, E. M., & Knudson, D. V. (2011). Terms and nomenclature. *Journal of Sports Sciences*, 29, 999–1000.