

# IMPORTANT PERFORMANCE FACTORS IN GYMNASTICS FROM A BIOMECHANICAL PERSPECTIVE

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## INTRODUCTION:

Perhaps more than in any other sport, success in gymnastics depends on the ability of the athlete to blend a variety of physical, physiological, and psychological attributes in a routine that taxes the body and mind. Without denying the importance of physiological, psychological, and other variables, this paper (based on Prassas et al., 2006) will discuss performance variables important in putting together a winning gymnastics routine from a biomechanical perspective.

## IMPORTANT PERFORMANCE VARIABLES:

**Height:** Vertical take off velocity determines height attained in an airborne skill. Depending on the particular apparatus, vertical take off velocity is mainly generated by: a) *converting horizontal energy during running/preceding skills* (in vaulting and tumbling); b) *the jumping abilities of the gymnast* (on balance beam); and c) *the partitioning of the angular momentum of the preceding swinging skill into linear and angular components* (in release/re-grasp and/or dismounts in the rings, horizontal bar, and parallel and uneven bars).

**Rotation:** Without question, success in gymnastics directly relates to the gymnast's ability to somersault, twist, or to combine both elements. In turn, this ability is largely a function of the gymnast's ability to generate sufficient angular momentum during take off and to utilize: a) *the momentum conservation principle*; b) *the fact that the "total" angular momentum is made up of the sum of the angular momenta of the gymnast's segments*; and c) *the fact that angular momentum reflects the product of moment of inertia and angular velocity*. Properly applied, these "facts" enable gymnasts to: i) *generate twist(s)*; ii) *transfer angular momentum from one body part or from one axis to another*; and iii) *increase or decrease the rate of rotation by altering body configuration*.

**Ability to swing:** Gymnasts use swings in various movements and apparatuses. Although important to all, swings are critical as preparatory manoeuvres for release and regrasp skills and dismounts from the high bar, uneven and parallel bars, and still rings.

**Ability to land:** At least among elite gymnasts, the ability to land without errors determines who wins and who loses. Some of the variables dictating the success or failure in landing are: a) *the angle of the gymnast's body to the floor and related horizontal distance of the center of mass from the vertical*; b) *the ground reaction force*; and c) *the angular and linear momentum of the gymnast*.

**Balance:** Gymnasts employ both, *static* and *dynamic* balance in their routines. The former is seen in skills such as handstands and scales, whereas the latter is seen in landings from airborne skills and when gymnasts are already in motion, but with the line of gravity outside of the base of support.

## REFERENCES:

Prassas, S., Kwon, Y-H, & Sands, W. (2006). Biomechanics of artistic gymnastics. *Journal of Sport Biomechanics*, *5*, 261-292.