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Correction

Cavagna, G.A. Symmetry and Asymmetry in Bouncing Gaits. *Symmetry* 2010, *2*, 1270-1321

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I found some mistakes in equation (2) as well as in the two paragraphs below equation (2) at pages 1272 and 1273 of my published paper on *Symmetry* [1]. The symbol ΔF must be replaced with the symbol ΔG, same as in equation (1), and the parenthesis after the symbol W_m^+ must be deleted. A correct version is provided here.

The overall efficiency (equation 1) can be written as

$$\text{Overall efficiency} = (W_m^+/\Delta G)\ (\text{Distance} \times \text{drag})/W_m^+ \quad (2)$$

i.e., as the product of the efficiency of muscular contraction ($W_m^+/\Delta G$) and the efficiency of the machine (Distance × drag)/W_m^+, which we may call *propulsive efficiency*. The muscular efficiency indicates the ability of the motor to transform chemical energy into positive work by reducing to a minimum the losses into heat. The propulsive efficiency, on the other hand, is an indication of the ability of the machine to utilize in the best way the positive work supplied by the muscles to move the body forwards against the resistance offered by the surrounding.

A difference in muscular efficiency can hardly explain the different cost of transport in swimming, flying and terrestrial locomotion. The maximum muscular efficiency, in a complete cycle of contraction and aerobic recovery, is about 0.25 both in human [3] and in the frog skeletal muscle [4]. In addition, humans can reduce drastically the cost of transport by means of a bicycle indicating that the limiting factor is the propulsive efficiency, not the efficiency of muscular contraction. In fact, by using a bicycle, *i.e.*, a clever lever system applied to the leg, the overall efficiency attains 0.22, a value approaching the maximum efficiency of muscular contraction [5]. According to equation (2) this indicates a value of propulsive efficiency approaching unity:

$$(\text{Distance} \times \text{drag})/W_m^+ = 0.22/0.25 = 0.88.$$

It is therefore the propulsive efficiency, which is much smaller in walking and running than in flying and swimming. Why?

References

1. Cavagna, G.A. Symmetry and Asymmetry in Bouncing Gaits. *Symmetry* **2010**, *2*, 1270-1321.