Scientific disciplines require depth to advance, but this comes at the price of underestimating the importance of related fields. One such example is the co-evolutionary process between brain and body. Neuroscientists tend to investigate neural function independently of the mechanics of vertebrate function, and biomechanists tend to study the structural properties of such function independently of the means to control it. This has lead to several missed opportunities and misconceptions in both fields. I will present several suggestions for how these two fields could profit from a better interaction. For example, understanding the coevolutionary process that led to organisms as we know them is critical to understanding their function, dysfunction and rehabilitation. In recent decades, the perspective that muscle redundancy is the central problem of motor control has dominated this scientific endeavor. Therefore the "problem" the brain solves is cast explicitly and/or implicitly as one of neural computation needed to select viable solutions from the many allowed by the redundancy/adaptability that comes from having "too many" redundant or overcomplete muscles or joints. However valuable and informative, this perspective is also paradoxical with respect to the evolutionary process, the clinical reality that even mild injury leads to measurable dysfunction, and a rigorous mechanical analysis of complex systems and complex behavior. Taking an approach based on mechanics, computational motor control, mathematics and pathology, I will describe a perspective for the study of sensorimotor function that begins to resolve these apparent paradoxes. Namely, that vertebrates have barely enough muscles to meet the mechanical requirements of real-world ecological tasks.

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