

# Muscles more sensitive to stretch than previously thought

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Credit: University of Bristol

Almost 50 years after Nobel prize-winner Andrew Huxley published his seminal findings about muscle contraction, scientists from the University of Bristol have retraced Huxley's steps. Their findings, published today in the *Biophysical Journal*, could change our understanding of the response of muscles to changes in length during physical activity.

Skeletal muscle is the basic motor in the body that drives the functionality of many activities such as breathing, talking, walking, running and jumping. Muscles change length and develop force by the sliding of two kinds of filament, thick and thin.

Projections on the surface of the thick filament, called crossbridges 'row' the thick filaments past the thin filament, in a cyclic manner reminiscent of the oars in a rowing boat. Huxley showed that the rowing of crossbridges on the thick filaments could explain the main properties of muscles, for example the relation between the tension it exerted and the velocity of shortening. He later established that the crossbridges act independently of one another to produce tension.

As reported in *Nature* in 1971 and then in the *Journal of Physiology* in 1977, Huxley and his team subjected active muscle fibres to rapid (0.2 millisecond) length changes. According to their work, tension on the muscle fibre falls after a release and rises after a stretch, showing that the crossbridges contain an elastic element.

But in the next few milliseconds, the tension-generating step in the crossbridge cycle responds, causing the crossbridges to change shape in either direction. This results in the tension recovering towards the initial tension. This occurs without the crossbridges detaching or re-attaching to the thin filaments. A long-standing puzzle has been that this early tension recovery has two components, fast and slow and, it has been suggested, that only the slow component is due to crossbridge action.

Using a kinetic model of the crossbridge cycle, Dr Gerald Offer and Professor K.W. Ranatunga from Bristol's School of Physiology, Pharmacology and Neuroscience re-analysed the tension responses to these rapid length changes. But where Huxley concluded that the reversal of the tension-generating step was insensitive to strain, they found that the reverse step is as sensitive to strain as the forward step.

"We were both concerned for a long time about the differences between the response to releases and stretches," said Dr Offer. "If the size of the length steps were small, we would expect the tension transients to be mirror images of each other but this appeared not to be the case. We think our paper is the first to challenge this aspect and should be of interest to sports scientists in understanding strain sensitivity of active muscle."

Professor Ranatunga added: "By clarifying the molecular events occurring when a muscle is stretched and explaining the causes of the fast and slow components of the early tension recovery, the results add significantly to our understanding of the

crossbridge cycle and encourage more experimentation."

**More information:** Gerald Offer et al.  
Reinterpretation of the Tension Response of  
Muscle to Stretches and Releases, *Biophysical  
Journal* (2016). [DOI: 10.1016/j.bpj.2016.09.031](https://doi.org/10.1016/j.bpj.2016.09.031)

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