Preferred speeds of mice during exposure to hypergravity

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1 Introduction

When animals are allowed to walk or run freely they tend to constrain their speeds at each gait to a relatively narrow range. It has been hypothesized that these 'preferred speeds' are the energetically optimal speeds for each gait, minimizing the metabolic cost of moving a given distance [1]. Animals often prefer to avoid the intersections between the metabolic curves for each gait when allowed to select their own speed; neither gait is optimal at that specific speed. Although absolute transition speeds increase with size, most animals tend to transition between gaits at the same non-dimensional Froude number; this is known as dynamic similarity [2].

Figure 1: Centrifuge

In this poster we will discuss the effect of hypergravity on the preferred running speeds of mice. Previous studies have attempted to manipulate animals' energy expenditure by increasing the subjects' body mass, either through an external load [3], by overfeeding or injection with saline solution [4]. However, this does not affect the body and limbs of the animal equally, meaning that energy expenditure associated with swinging the legs is unchanged. Additionally, harnesses could constrain natural movement, while obesity and medical procedures could affect behavior. Conversely, mice in our centrifuge are allowed to move freely around an environment very similar to their usual home cage, and all parts of their body are equally affected by hypergravity.

2 Methods

FVB mice were exposed to an increased gravity of 1.2*g* using a centrifuge (Fig. 1). The centrifuge consists of four 2m long arms rotating around a central platform; gondolas on the end of each arm carry a standard mouse cage, along with cameras and environmental controls. The gondolas are able to swing outward to keep the direction of the effective gravity vector perpendicular to the floor of the cage. During this time they were allowed to move freely around their cage and had access to an exercise wheel which could measure both speeds and ground reaction forces [5]. Measurements were triggered automatically when the wheel started to rotate, so that data could be collected continuously while the centrifuge was in motion.

3 Results

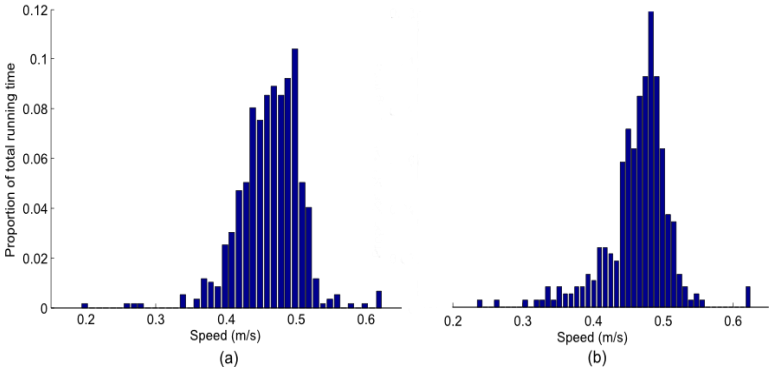

Figure 2: Preferred speeds at (a) 1*g* and (b) 1.2*g*

Preliminary data (Fig. 2) suggests that the preferred speed decreased from 0.50m/s at 1*g* to 0.48m/s at 1.2*g*, and overall mice spent a greater proportion of time running at lower speeds in hypergravity. Mice also preferred to avoid speeds around 0.39m/s at 1*g*, and 0.43m/s at 1.2*g*. These speeds correspond to Froude numbers of 0.62 and 0.63 respectively, close to the typical walk-run transition at a Froude number of 0.5. This suggests that although mice prefer to run at lower speeds in each gait when exposed to hypergravity, they transition between gaits at a higher absolute speed, which corresponds to approximately equal Froude numbers.

Acknowledgements:

This research was funded by the Wellcome Trust.

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