INTRODUCTION:
One aim of good rowing technique is to minimise fluctuations in boat velocity as they reduce efficiency. A rowing stroke can be divided into the drive phase and the recovery phase. In a single scull the velocity of the boat is decreasing at the beginning of the drive phase, increasing at the end of the drive phase and reaching a peak during the recovery phase. Soon after the beginning of the recovery phase, the rower accelerates his/her body towards the stern of the boat causing a reaction force on the stretcher towards the bow of the boat. Thus the stretcher force is propulsive while the rower's body segments are accelerating towards the stern of the boat. The force on the stretcher could be estimated by summing the product of all body segment (angular) accelerations with their (moments of) inertias. A useful and more readily measurable approximation of this body movement may be achieved by using the seat velocity. During the recovery phase most rowers exhibit a constantly increasing seat velocity, relative to the boat, for a fraction of the recovery phase.

It is hypothesised here that the greater duration of seat acceleration the smaller the fluctuations in the boat velocity during the recovery phase. The aim of this investigation was to determine the degree of association between these two variables.

METHODS:
Ten experienced club level scullers were directed to row at 32 strokes per minute in an instrumented single scull. A cable and drum potentiometer was used to measure seat position, the velocity of the boat was obtained from a small turbine, boat acceleration was recorded using a micro-machined accelerometer. Propulsive pin and stretcher forces were also measured. The transducers were all calibrated before each test, sampled at 100 Hz and telemetered to the shore. At least 15 strokes per trial were normalised and averaged to percent of stroke. The beginning and end of the seat movement was detected graphically, the range of boat velocity was calculated, and the regression between duration of seat acceleration and range of boat velocity was obtained.

RESULTS:
The average stroke rate was 33 ± 1.5 strokes per minute. A small (r = -0.31) but non-significant (p = 0.38) correlation was found between the range of boat velocity and the duration of seat acceleration (Figure 1).

DISCUSSION:
Short, large magnitude accelerations of the seat were expected to produce larger fluctuations in boat velocity during the recovery phase while longer, lower magnitude seat accelerations were expected to produce a smoother velocity profile. Failure to conclusively demonstrate this could have been due to: 1) too small a range of techniques in the group of rowers selected for the study; 2) the approximation of the
sum of body segment effects by the seat acceleration alone. A greater range of techniques has been observed in pair boats. Observation of seat movement alone ignores trunk motion that can occur independent of seat movement.

As a contrast to the club level rowers data was collected from a place getter in the Australian rowing championships. Some small differences can be observed between the variables shown in figures 3 and 4. Figure 3 is the ensemble average data for all club level rowers. There data for these variables was very consistent over the ten subjects. The place-getter achieved a slightly higher average velocity (4.75 m/s) than the average for the club level rowers (4.67 m/s). A higher net boat force during the drive phase and in the early part of the recovery phase caused a higher boat velocity for the latter part of the drive phase and early part of the recovery phase for the place-getter. The club level rowers had a higher acceleration of the seat during recovery which produced a higher “hump” in the boat velocity curve at the end of the recovery phase than the place-getter. Other factors, such as trunk motion, affect the stretcher force and thus the applied boat force during the recovery phase. Trunk angular velocity should be measured in future experiments.

Figure 2 Stretcher propulsive force, applied boat force (sum of propulsive pin and stretcher forces), boat velocity and seat velocity relative to the shore and the boat. These graphs represent the grand mean of ten club level rowers.

Figure 2 Stretcher propulsive force, applied boat force (sum of propulsive pin and stretcher forces), boat velocity and seat velocity relative to the shore and the boat. These graphs represent the mean of the sculler who came third in the Australian rowing championships.