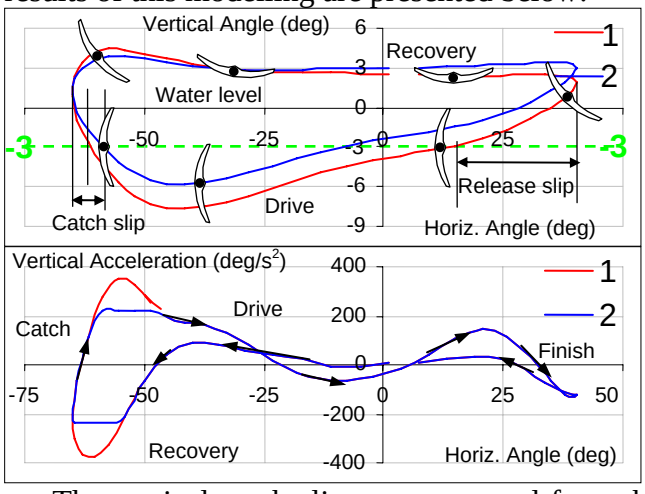
## *Facts. Did you know that…*

…gravitational acceleration is not enough to insert the blade quickly into the water at the catch? Some coaches believe that the rowers should just take the weight of the arms off the handle and "let the blade go" into the water. To check it, we made calculations of the angular acceleration of the oar under gravity and verified them using an oar angle transducer.

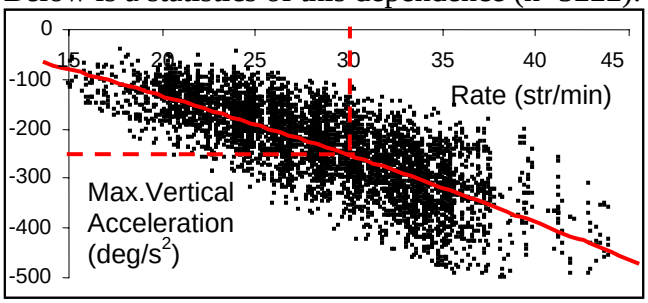
The free-falling angular acceleration of a standard sculling oar (2.90/0.88m, centre of mass (CM) at 1.42m from the handle top) was found about 240 degree/s$^2$ and for a sweep oar (3.77/1.15m, CM at 1.80m) it was 200 deg/s$^2$. At the catch the oar has to change its vertical angle from +5 degrees (positive indicates centre of blade above water level) down to -5 degrees, i.e. it has to travel about 10 deg. At that angular acceleration it takes about 0.28-0.32s, which is nearly one third of the drive time. The best athletes achieve peak accelerations more than 400deg/s$^2$. This means they apply an upwards vertical force to the handle, increasing the acceleration to nearly double that of gravity.

To illustrate, we took the measured vertical and horizontal angles of a good sculler (1) and differentiate the vertical angle twice to get its angular acceleration. Then we limited the value at the catch to 240 deg/s$^2$ (free-falling acceleration) and integrated the result twice to get the angle (2). The results of this modelling are presented below:




The vertical catch slip was measured from the catch to the point, where the angle of the blade reached -3deg, which corresponds to a fully immersed spoon. You can see that using only free-fall acceleration at the catch nearly doubles the vertical catch slip (from 6.0 deg up to 11.8deg). This increases the slippage of the blade in the water, decreases the blade propulsive efficiency and creates energy losses. Bearing in mind that the best athletes achieve the catch slip lower than 6deg, they have to apply quite a significant upward kick to the handle before catch.

The maximal vertical acceleration at the catch is highly dependant on the stroke rate (r = -0.76). Below is a statistics of this dependence (n=5222):




On average, the vertical acceleration exceeds the free fall value at stroke rates higher than 30str/min. This means rowers can "let the blade go" at a low rate, but have to apply upward force at a higher rate. Usually rowers can't compensate for a higher speed of horizontal movement of the oar at a high rate with a faster vertical movement. Evidence of this fact is the positive correlation of the stroke rate with the catch slip (r=0.24) and release slip (r=0.38).

Catch slip is shorter in scullers, but release slip is shorter in sweep rowers. The Table below shows normative data for slip and effective angle:

| Catch Slip (deg) | | | | | |
|---|---|---|---|---|---|
| | Very Good | Good | Average | Bad | Very Bad |
| Sweep | 6.9 | 10.1 | 13.4 | 16.6 | 19.8 |
| Scull | 4.3 | 7.1 | 9.9 | 12.7 | 15.5 |
| Release Slip (deg) | | | | | |
| Sweep | 3.6 | 9.0 | 14.3 | 19.7 | 25.1 |
| Scull | 7.7 | 13.2 | 18.7 | 24.2 | 29.7 |
| Effective Angle (%) = (Total Angle) - Slips | | | | | |
| Sweep | 82.5% | 75.4% | 68.3% | 61.3% | 54.2% |
| Scull | 86.3% | 79.7% | 73.0% | 66.4% | 59.7% |

Other points for an effective catch are:

- Do not raise the blade too high before catch: the catch slip has positive correlation (r=0.21) with the highest oar angle before catch.
- Using the thumb is the only method to accelerate the handle upwards before catch.
- The upward push before catch must be really quick. If it is applied for a long time, then the blade will be inserted too deep into the water, which is, in addition, not effective.

### *Contact Us:*

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