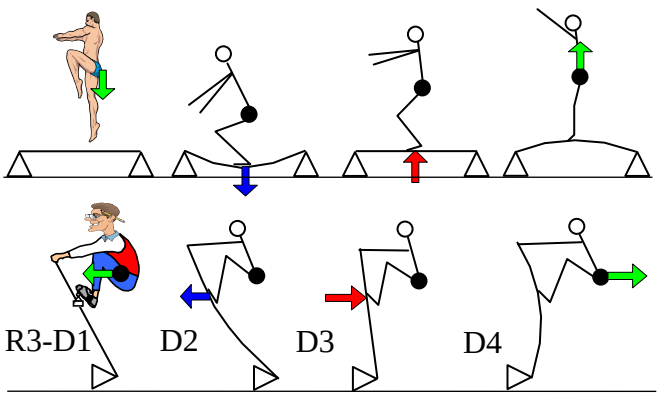
Ideas

✓ Recently we reached an interesting interpretation of our theory of rowing micro-phases (RBN 2004/1, 2 & 12). We call it the "**Trampoline effect**", which occurs at the catch and in the first half of the drive. The following logical steps will help us to understand the effectiveness of this theory:

1. To increase the boat speed, rowers have to expend more power to overcome higher drag resistance ($P = kV^3$).
2. The kinetic energy of the whole boat-rower system can be increased (accumulated) only during the drive phase. Increase of the shell velocity during the recovery is explained by transfer of the crew's kinetic energy (RBN 2004/7).
3. Because a crew's mass is higher than that of a boat, it accumulates 5-6 times more kinetic energy than the boat ($Ek = mV^2/2$). Therefore, the main target of an effective drive phase is to increase the velocity of a crew's centre of mass (CM).
4. The only force accelerating the rower's CM forward is the reaction force on the stretcher. The handle force pulls the rower backwards.
5. To apply a high stretcher force is not enough for a rower's acceleration. The stretcher must have a supporting connection to the water through the rigger and oar.
6. The stretcher (and the whole shell) has to move fast forwards at the moment of the leg drive.

In fact, rowing can be considered as a series of jumps. Each drive phase is a jump and recovery is a flight phase. The longer the jumps or higher their frequency, the higher the rowing speed. The major difference between rowing and real jumps is that rowers have to create support on the stretcher for themselves by placing the blade in the water and applying handle force. The picture below shows the analogy between rowing and real trampoline jumps. The "**Trampoline effect**" works as follows:



1. At the catch (end of R3 and D1 micro-phases), the rower approaches fast towards the stretcher and creates an impact push on the stretcher at the moment of the blade immersion.
2. This impact force is transferred though the rigger and pin to the oar sleeve and bends the oar (D2 micro-phase). The oar shaft accumulates elastic energy, which could amount to 25% of the total power at the catch (RBN 2001/05)
3. In the D3 micro-phase, the oar shaft springs back, i.e. the oar works as a trampoline. The recoil force goes back though the pin and rigger and creates a high positive boat acceleration called the "first peak".
4. Rowers use the accelerating stretcher as a support for effective acceleration of their CM during the D4 micro-phase.

The "**Trampoline effect**" theory can have a number of consequences. Here are some of them:

1. Fast approach to the stretcher before the catch is beneficial. This contradicts some theories, which propose a slower approach to the catch.
2. Good timing is really important. Each rower has to feel the moment when he/she: a) kicks "the trampoline" and bends it; b) applies the handle force to support "the trampoline" from the other side; c) picks up the recoil force and uses the legs to accelerate the body CM.
3. In crew boats, all rowers have one common trampoline because their stretchers are connected through the shell. Therefore, one rower can create the trampoline effect for other rowers in the crew. This happens quite often in pairs, where the stroke rower increases force much more quickly than the bow rower.
4. Optimal stiffness of the oar shaft is important and should correspond to the magnitude of the impact force. Oar shafts that are too soft or too stiff will decrease the trampoline effect.
5. Rowing on ergometers does not allow experiencing the trampoline effect.

What sort of drills can we use to improve the trampoline effect?

The best drill is to row using legs only with emphasis on fast explosive work through the stretcher. It is better to do this drill with the whole crew (not by seats), because the large passive mass of sitting rowers will significantly decrease the boat acceleration and trampoline effect.

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