The phenomena of meta-technique in kayaking explained (part 1)

In our introduction to meta-technique for kayakers article, we divided the meta-technique phenomena into groups addressing the following 3 areas: managing the boat, managing the blade and managing the energy. Today we will briefly explain the meta-technique phenomena influencing how successfully you use your blade.

**Paddle slip**

The goal during paddling is to have zero slip. Zero slip means you anchored your blade in water so skilfully, that the tip of the blade exits the water at the same exact point it entered it (seen from the side, things are different seen from front or top). As a rule top paddlers have zero slip when winning.

Most paddlers have some slip. This means their paddle is moving backward during the pull phase of the stroke (again seen only from the side). In turn, sometimes we can observe a negative slip. This means the blade moved forward during the pull phase of the stroke. A negative slip seems impossible but it happens not so rarely. You observe it at lower speeds and with some champions even during races.

As an analogy with cars, we could compare paddle slip to tiers running on empty while driving on an icy road. In such an analogy zero slip means tiers with perfect grip.

A paddler who has paddle slip is not efficient, usually trying desperately to put even more energy into the pull to somehow find some grip at least towards the end of the stroke. This creates even more problems. The only situation when paddle slip is unavoidable in practice is the standing start.

*Picture 1: paddle anchoring with zero slip*  
*Picture 2: paddle slip with blade exiting behind the point of entry*  
*Picture 3: negative slip with blade moving forward during the pull and blade exiting in front of the point of entry*
Paddle Radius

Paddle radius defines with how much water the paddle will interact during one stroke. The more water mass we interact with, the more force we can apply on the blade without breaking the water resistance and obtaining slip. Paddle radius is the theoretical distance (again seen from the side) from the point in the shaft where the paddle is rotating from to the water. Theoretically, the longest radius is achieved if the shaft is rotating in the top hand. While the shortest radius is obtained if the shaft is rotating in the bottom hand.

The faster we want to go, the bigger is the force we need to apply onto the paddle (with stroke rate being constant). We can increase how much force we can apply efficiently only by increasing the radius of our stroke. An analogy with cars would be the size of your wheels. Bigger radius means bigger wheels for you.

On a standing start any paddler has to decrease their stroke radius otherwise the big forces applied on the blade will make them capsize (or brake force transmission in one or more joints). In turn, to achieve high speeds or an efficient traveling speed we need to increase the radius quite a lot after the start. Close to the finish line when tired, we have to adjust the radius again in order to find the best compromise between how hard we want to paddle and how much energy we still have left.\[1\]

The geometrical factors that directly influence the radius are: the height of the top hand (at the catch and its trajectory during the pull) and the speed of the top hand traveling forward in relation to the speed of the pulling hand traveling backward (relative to the boat). If you keep your top hand low, if it travels even lower during the stroke and it also punches forward quickly, this will all inevitably result in a very short radius. On the other hand, a top hand positioned at the eyes level or higher, traveling forward horizontally and slowly (serving as a pivot for the blade), will result in a very long radius.

In short, if you want to go fast, you need big forces on your blade. To be able to put big forces on your blade, you need a long radius. You can not achieve high speed with low radius.

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*Pic above: the maximum possible theoretical radius happens when the center of rotation of the shaft is in the top hand.*
*Pic below: the minimum possible theoretical radius happens when the center of rotation of the shaft is in the bottom hand.*
**Work angle**

In a very simplified version of the stroke model, the catch happens at a paddle angle of 45 degrees (when the tip touches the water) and the exit happens at 45 degrees again (tip leaving the water). This makes for a working angle of the paddle in the water of 90 degrees (again seen from the side). In reality, the paddler adjusts also this parameter to the outside condition and his/her own internal situation (fitness, tiredness, part of the race etc.). However, most of the times the working angle is bigger or smaller than 90 degrees. Most often the working angle increases over 90 degrees at lower speeds and decreases below 90 degrees at high speeds. The working angle is closely connected with radius and slip. When a paddler uses a long radius and no slip, it is normally not necessary or sustainable to also use a working angle of over 90 degrees. While on the other hand when the radius is low, a paddler may need a larger working angle and a bigger water to air ratio (see below).

![Diagram of a working angle of 90 degrees.](image1)

![Diagram of a smaller working angle of 50 degrees.](image2)

**The water to air ratio in a stroke cycle**

During the part of the stroke when the paddle is in the air, the boat inevitably slows down. It is only during the water part of the stroke, we can maintain or increase boat speed. The longer the part of the stroke cycle in the air, the more energy the paddler has to invest into the pull phase for a given speed or acceleration. That is why, the ratio between the water and air phases of a stroke is important.

With most top kayakers, we can observe the percentage of water time is somewhere in the range of 60-65%. Very rarely we can see numbers below 60%. Most elite paddlers are approaching 65% and more.
Pic above: at a stroke rate of 60 strokes/minute a stroke cycle lasts 1 second, if a paddler uses 65% water time, the water phase will last 0.65% of the whole cycle.

Pic below: at a stroke rate of 60 strokes/minute a stroke cycle lasts 1 second, if a paddler uses 40% water time, the water phase will last 0.40% of the whole cycle. With all other parameters being the same the amount of energy per stroke for the same speed between the two paddlers is in a ratio of 40:65. So by staying in the water for longer the paddler above can use significantly less force to achieve the same speed.
ARTICLE KEY POINTS

- When we talk about managing your paddle, there are 4 main physical phenomena we have to combine and use if we want to paddle fast. Always consider:
- Aim for 0 paddle slip! You may play around with your paddle having some forward slip, it may have some advantages, but it is still less efficient than 0 slip. Avoid at all costs any slip of the blade in the direction of your pull. This kind of slip is really bad for your efficiency as it creates a whole chain of errors that follow it.
- Shoot for the % of water time (%WT) around 65% (measured from tip touching the water to tip leaving the water). You have almost no chance of a good performance with %WT below 60%. Be careful in training with drills, endurance sessions and ‘power exercises’ where %WT tends to be low. They may work if you handle this phenomenon, but if training with low %WT makes you race with low %WT, than you should avoid or readjust these sessions.
- You need the ability to adjust your work angle to the situation. Starts, accelerations and race finishes may need lower working angles. Long distance session and races, travel speed on 1000m and 500m races may need larger working angles.
- Learn to control and use in your advantage the length of your radius. You may shorten it during starts and when you are running out of gas. But when you want to paddle really fast or need a huge advancement per stroke, you need to be able to use a long radius.
- All the above 4 phenomena and their interactions are crucial. If you are a paddler, master them and learn to use them instinctively. If you are a coach, learn to understand them deeply, to see them and discriminate them with a naked eye and finally learn how to coach them. In both cases, this will make a real difference for paddling performance!

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