Input at the right time

Today it is established, that the fly rod not only stores energy (potential spring energy), but also includes a redistribution of the introduced energy - consisting the interrelation of the modification of the moment of inertia and the redistribution of angular momentum, called **redistribution effect** - , which leads to an energy transfer from the grip towards the tip of the fly rod propelling the fly line at last[1]. This energy transfer allows the fly caster to generate the line speed needed to hit the target by minimizing his effort.

Teaching

Since the redistribution effect depends on the deflection, efficiency is hard to teach. To determine the "efficient deflection" during a casting lesson seems to be nearly impossible. But to me this difficulty is not an excuse to hang on longstanding teaching elements, but a challenge to identify those elements, which are important for efficiency !

A longstanding and accepted teaching element is "rotation at the right time". But the problem with this element is, that nobody knows the efficiency of the cast. Since this teaching element doesn't care a lot about the meaning of the deflection[2], it stays too much on the surface (as I already wrote in my essay "Fly rod deflection and rotation 03/2017)" and might be useful to teach effectiveness, but not necessarily efficiency. Obviously a "deeper" teaching element below the surface of "rotation at the right time" is needed to face efficiency[3].

Motion properties

There are already some motion properties known, which favour an efficient fly cast. In the video "What matters an efficient fly cast" - http://vimeo.com/221011910 - I worked out properties, which are important in my view. They are: a

- significant translatory motion at the beginning of the fly cast
- rotary motion which prevails very late (delayed rotation)
- damping of the fly rod during the later rotary motion
- harmonious movement through the entire casting stroke

Personally I was able to adjust my casting motions to the above enumerated motion properties by practicing with an ultra soft fly rod for a certain period of time[4]. The soft fly rod represents rather a "deflection dominated" mean, for which reason a softer fly rod is basically able to trigger the redistribution effect better than a stiffer fly rod, since a stiffer fly rod represents rather a "lever arm dominated" mean. If the caster tries to cast a softer fly rod lever arm dominated by using a shorter casting arc and by applying the required effort during a

1 More detailed Information about the redistribution of angular momentum and the modification of the moment of inertia (redistribution effect) can be found in my "Experimental investigations on the fly rod deflection" (Rev. 2.0 – November 2014), section F1 and annex 2.
2 In fact the deflection is the requirement for efficiency.
3 A good explanation about the difference of „effectiveness" and „efficiency" could be found here: http://en.wikipedia.org/wiki/effectiveness and http://en.wikipedia.org/wiki/efficiency
4 In the IFFF magazine "THE LOOP" January – July 2017 there is an article published about my experience practicing with ultra soft fly rods.

shorter time span as it works well for stiffer fly rods, for a softer fly rod the cast would probably fail. That is because a softer fly rod doesn't allow the caster to use generous deviation from the above enumerated motion properties since they highlight a deflection dominated cast.

By practicing with softer fly rods the caster is forced to think about the distribution of the effort he applies in the grip over the entire casting stroke, especially when casting a longer fly line. Finally, if a stiffer fly rod is casted similar a softer one, the lever arm property joins the redistribution effect which leads to a higher efficiency.

Grip tension

Applying effort into the fly rod requires grip tension and the amount of grip tension depends on the required effort. The caster can loosen grip tension when no effort is needed and must tense it up when effort is needed. The caster notices, that for a soft fly rod the casting stroke works best if the grip tension is smoothly increased up to a maximum around the vertical grip position for a very short moment, while grip tension could be smoothly decreased again during the further casting stroke when unloading prevails[5].

In any case in terms of efficiency it is better to focus on the grip tension instead to focus on the rotation. This seems to be a good way to ensure that the above enumerated, deflection dominated motion properties are considered. The longer the carried fly line is, the more the above enumerated motion properties must be respected to ensure a proper fly cast.

In the video "Energy transfer along the fly rod shaft" - http://vimeo.com/249444926 - I explain the "grip tension at the right time" (at 0:30 min) as it is useful for a better energy transfer. The idea of "grip tension at the right time" I watched first in the video "Dynamics of Fly Casting" by Joan Wulff, in which she squeezed a sponge around the vertical grip position to visualize the moment the caster should apply the highest effort.

Input in relation to rotation

The grip tension is the requirement for the input, energy or work respectively the caster applies into the fly rod[6]. Thus to me the appellation "**input at the right time**" is a proper advanced teaching element, which faces an efficient fly cast much better than "rotation at the right time". In contrast to "rotation at the right time" with "input at the right time" the caster is able to gain a better control over the deflection as it is not only important to achieve a better energy transfer, but also to minimize the waste of energy due to an improved damping[7].

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5 Especially during the unloading phase of the fly rod aside the spring effect for bigger deflections the energy of the lower mass elements contributes to generate the velocity of the upper mass elements leading to the redistribution effect accompanied by the energy transfer and a kind of **"self dynamic"** (self dynamic mechanism) of the fly rod. Therefore the caster is able to decrease his grip tension during the later rotation though the tip of the fly rod still gains velocity.

6 Some people think that rather the force the caster must appliy into the grip describes his effort. As the fly line is propeled by the energy and not by force of the tip, the same physical unit should be compared with each other (otherwise apples would be compared to pears).

7 In addition the figure XI of my work „Experimental investigations on the fly rod deflection" has estimated how the course of the introduced input of energy and momentum transfers the kinetic energy towards the tip and leads to its acceleration (green graph for the flexible fly rod). The rotation is an important aspect which goes together with the input of energy and momentum.

The rotary motion is the most important motion property of the input. If the caster neglects the rotation during he applies his input, the fly rod will respond with a very poor output, cast respectively[8]. As a big advantage of the teaching element "input at the right time" it is focussing not only on the rotation, but pays also a higher attention to the other important motion properties enumerated above – especially to the translatory motion[9].

Even the 5th principle of fly casting[10] stated by Jay and Bill Gammel is talking about the "power" instead of the "rotation" in the right amount and place during the casting stroke. It seems they have understood that "power" as a synonym for the input is a better principle to describe the casting stroke than "rotation" could be.

Right time and phase shift

Both teaching elements are talking about the "right time" and the caster may ask, when the right time is. For rotation as well as for input the "right time" depends basically on the casters aim, the rod action, the casting length and how especially the fly rod and the fly line are balanced. But there are tendencies showing the differences.

The "rotation at the right time" still holds true, if the caster doesn't delay the rotation and if he still applies further "input" at the end of the casting stroke when the grip already has passed the vertical position in order to "kick" or "boost" the cast. The benefit of this further "input" is rather less in relation to its drawback as it will produce a big waste of energy indicated by a big counterflex (bad damping).

In contrast to this the "right time" for the input is always delayed and its highest value occurs around the vertical grip position. It pays attention to a kind of phase shift between the highest input and the highest output, velocity of the tip of the fly rod respectively as the input precedes the output. This phase shift is vital in terms of efficiency since it allows the caster to reduce his input while at the same time the tip of the fly rod still gains velocity[11]. The phase shift explains, why a "kick" or "boost" at the very end of the casting stroke is detrimental in terms of efficiency.

The "right time" for the rotation tends not to face the phase shifting as the "right time" for the input does and this is a further reason why rotation alone can't face efficiency.

Technical point of view

Engineers and scientists usually investigate the dynamic behavior of complex bodies by stimulating them with different input functions (variation of the input) in order to determine the optimum output (input and output as a function of energy, work respectively). If the optimum output is determined, they have detected the best input function ("input at the right time"). Nothing else should hold true for the fly rod as it represents a complex and flexible slim body. The output on the one end (the tip) depends on the input on the other end (the grip). If the input is accentuated on one motion property like rotation, there is a risk to oversee the

8 So the caster didn't use "input at the right time" in this case.
9 See my essay „The meaning of the translatory motion in fly casting".
10 The 5th principle is: "Power must be applied in a proper amount and in a proper place during the stroke".
11 For a rigid fly rod there is no phase shift due to the lacking spring and redistribution effect.

interrelation of the other important properties, which must be involved to detect the best input function possible !

Even a technical point of view clearly shows, that the teaching element “rotation at the right time” could lack some important motion properties in terms of efficiency.

Insight

The softer fly rod supports the caster to find out the advantages of the deflection. He will be able to recognize the phase shift between the highest input and the highest output and will intuitively look for the best input function (“input at the right time”) needed to generate a deflection, which leads to the best output in terms of efficiency. If he switches then to a stiffer fly rod after he has adjusted his motion properties accordingly, he might be surprised how less effort / “input” is needed to generate a proper line speed. He has learned to control the deflection better, which means that aside the spring effect the redistribution effect plays a higher and the waste of energy a minor role.

Efficiency in fly casting doesn’t mean that the caster has to decide between the deflection **or** the lever arm property of the fly rod. It rather means to get closer to the best interrelation of both the deflection **and** the lever arm. The teaching element “rotation at the right time” highlights the lever arm property of the fly rod and tends to neglect the deflection property. In comparison to this “input at the right time” combines both properties better so that they join to an efficient fly cast. **Therefore “input at the right time” is a “deeper” and more complete teaching element for advanced fly casters than “rotation at the right time” could be.**

In addition the teaching element “input at the right time” is already used to explain the right moment the line hand has to haul, introducing “input”, energy respectively. For which reason this teaching element should not work for the rod hand as well ?

Is it too complicate to teach ? Is it too complicate to leave it at “rotation at the right time” instead ? For advanced fly casters I don’t think so. To me it is worth to think about teaching elements which are closer to an efficient, power minimized fly cast[12]! In my experience the teaching element “input at the right time” even works practicing with stiffer fly rods (if a softer fly rod is not available) to convey advanced fly casters what matters an efficient, power minimized fly cast.

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Tobias

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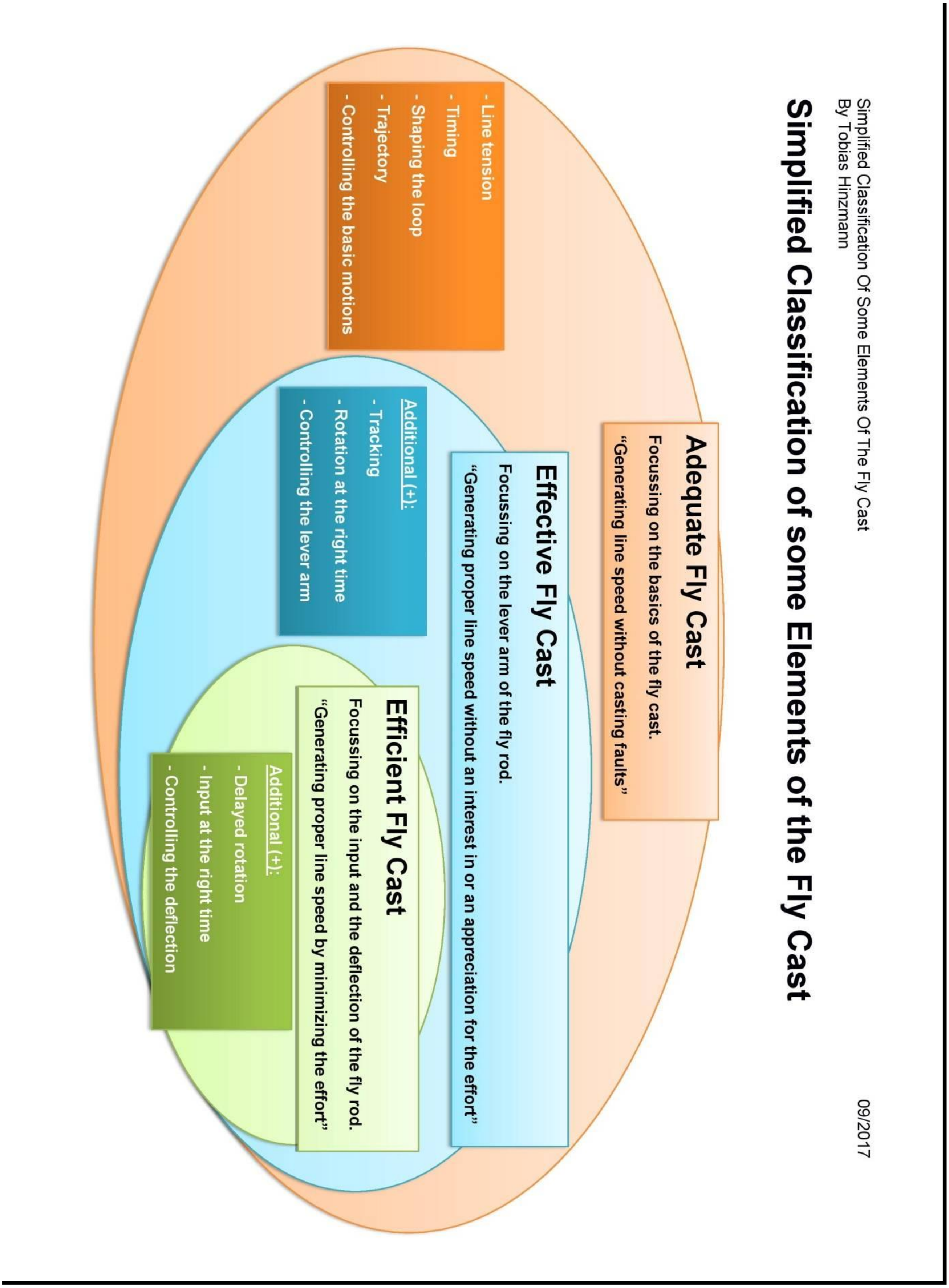
Annex on the next page: An outline of a simplified classification of some elements of the fly cast

12 Fly fishers, who want to reduce their effort when fishing the whole day long e.g. at bigger rivers, lakes or at the coast, could profit a lot by casting efficiently.



Simplified Classification Of Some Elements Of The Fly Cast
By Tobias Hinzmann
09/2017
Simplified Classification of some Elements of the Fly Cast
Adequate Fly Cast
Focussing on the basics of the fly cast.
"Generating line speed without casting faults"
- Line tension
- Timing
- Shaping the loop
- Trajectory
- Controlling the basic motions
Effective Fly Cast
Focussing on the lever arm of the fly rod.
"Generating proper line speed without an interest in or an appreciation for the effort"
Additional (+):
- Tracking
- Rotation at the right time
- Controlling the lever arm
Efficient Fly Cast
Focussing on the input and the deflection of the fly rod.
"Generating proper line speed by minimizing the effort"
Additional (+):
- Delayed rotation
- Input at the right time
- Controlling the deflection