Case Study: The Strategic Benefits of Having Multiple Leaders in Road Cycling Races

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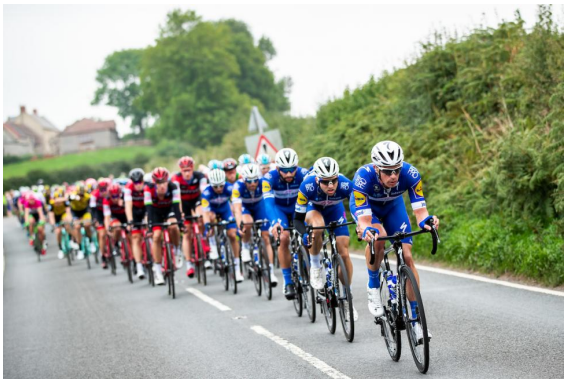
The tactics employed by cycling teams undergo periodical changes, like in most sports, as teams react to changes other teams make. However, certain aspects of bike races appear to remain constant. Typically, in most races, an early breakaway gets a small advantage early in the day, although there is virtually no chance for that breakaway to outlast the peloton later if one or more teams decide to *control the race*.

Controlling the race means having riders ride at the front of the peloton for most of the day to keep the gap to the breakaway constant, then increase the pace later in the race to outright catch the breakaway. Teams adopt this strategy when they aim to secure the win and are not satisfied with their prospects within the breakaway, such as when they lack representation in that group. In a flat race, most of the controlling comes down to the final kilometers of the race, when the teams that want to catch the breakaway form so-called *leadout trains*, as can be seen in Figure 1a.

Figure 1: Controlling the Race



(a) Controlling a Flat Race

(b) Team Sky's Mountain Train

In the early 2010s, the British cycling team Sky invested considerable amounts of money into the analysis of all aspects of road racing with the sole purpose of winning the Tour de France with a British rider for the first time. Among their tactical innovations was adapting sprint leadouts for mountainous races, leading to the concept of the "Sky Train" or "Mountain Train" (see Figure 1b). This strategy aimed to effectively control mountain stages by organizing a line of strong climbers, with the team captain positioned behind the last helper, at the front of the peloton during long climbs (lasting around thirty to forty minutes). This approach helped stabilize the race by discouraging attacks and maintaining a steady gap to breakaway groups, increasing the likelihood of catching them before the finish line. One of the main results of our paper states that controlling a mountain stage, however, is only helpful, if the hard pace benefits your leader more than the others.

Who Controls a Race?

Frequently, multiple teams may have motives to take control of the race. However, the practical implementation of this strategy can be disadvantageous for the team conducting it since riders at the front of the peloton can sustain high speeds for only a limited duration before fatigue sets in.

Our strategic analysis focuses on the coordination problem that the teams with an incentive to chase face because of this. Who controls the race? The intuitive answer suggests that the most pressure to do so will be put on the strongest team. Formalizing this is not straightforward, however. Our paper examines the role of strength along two different dimensions: Having more helpers or having a stronger captain. We find that teams with an incentive to chase should use their helpers relatively liberally, but once only team leaders are left, the one most likely to win in a direct sprint will be forced to do the hard work - unless that team has an outside option, i.e. a promising rider in the breakaway! That "unless" is what we want to focus on in the following because it is a factor teams can influence beforehand, e.g. by actively trying to put a rider in the breakaway or even earlier, in the selection of their race roster. As we will expand on now, in many instances, including several leaders with different specialities (for instance breakaway specialists and sprinters)is advantageous for a team. Even having multiple co-leaders of different capabilities in the same speciality can prove useful.

The Strategic Benefit of Multiple Leaders

One recent example of stellar team strategy in a one-day race was the 2024 edition of "Milano-San Remo". Team Alpecin-Deceuninck nominated two leaders: Breakaway specialist Mathieu van der Poel and sprint specialist Jasper Philipsen. Van der Poel managed to join a small breakaway late in the race, at this point the clear favorite to win the race. Meanwhile, this group was chased by a group containing Philipsen as the fastest sprinter.

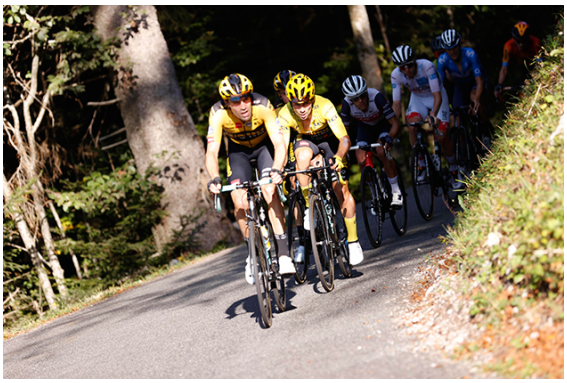
If van der Poel were not present in the breakaway, all riders of the chasing group would want Philipsen to ride at the front to catch the breakaway because he most likely would beat all the others in a sprint. Similarly, if Philipsen weren't chasing, van der Poel would be the one pressured to lead the breakaway in order to stay away from the chasing group. However, in reality, with both riders in their respective positions, they both could free-ride within their groups. Why? Van der Poel was indifferent to whether the breakaway was caught because if it was, his teammate Philipsen stood a good chance of winning. Similarly, Philipsen was unconcerned about the breakaway being caught because van der Poel would probably win if it stayed away. One of the events had to happen, of course. Eventually, van der Poel's group did get caught. When that happened, the optimal strategies changed, and Team Alpecin-Deceuninck was prepared! It was now Mathieu van der Poel who immediately started riding at the front. This is due to the fact that Philipsen was now the clear favorite to win the final sprint of the new, larger front group, so they were responsible for making sure that they did not get caught by other groups of riders behind them. Having van der Poel as a helper prevented Philipsen from needing to do the the riding at the front by himself. Now guess who won the final sprint? A very well rested Jasper Philipsen.

The Crucial Role of Beliefs

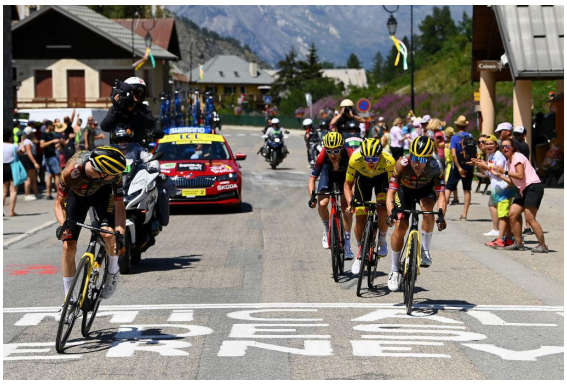
In the 2020 Tour de France, 21-year old Tadej Pogačar made his debut in the biggest stage race in the world with a team of helpers that were completely unable to provide him with assistance in the mountains. However, they were not the main favourite to win the race. That role fell to Pogačar's compatriot Primož Roglič, who arrived with a team that was perfectly capable of providing him with a mountain train in the decisive stages. In all of these stages, Roglič's team (Jumbo Visma) controlled the race, and every time Pogačar followed their train but never attempted to take the

race lead from Roglič. This was until the second last stage[1] of that Tour de France, an individual time trial up a mountain.[2] Only on that day, when team tactics had no impact at all, did it become obvious that Pogačar, not Roglič, was the strongest climber in the race. Roglič had built an advantage of 57 seconds over the previous nineteen race days, but lost close to two minutes on the day. It remains unclear whether Pogačar and his team knew at any point of the race that they had the strongest rider but from how they behaved over the three weeks in July 2020, it is obvious that Jumbo Visma never suspected it.[3] Otherwise, they should not have controlled the mountain stages the way they did.

Figure 2: How (not) to use your Teammates



(a) Pogačar (in white) behind Jumbo Visma's Mountain Train



(b) Pogačar (in yellow) against Roglič and Vingegaard (both in brown)

How to Use Multiple Leaders in a Stage Race

We have seen how Alpecin-Deceuninck used two leaders with different skillsets to win Milano-San Remo above. Reading how Roglič lost the Tour de France 2020, you might ask: "If Pogačar was the strongest rider, how could Roglič's team have defeated him anyway?" Our paper provides the answer: by forcing Pogačar to exert

[1]Since a few decades there is a "gentleman's agreement" among riders for the very last stage that ends in Paris: the general classification is not fought over. Consequently, the penultimate stage is the riders' last chance to attack the leader.

[2]In an individual time trial, the riders do not start all at once but separately in reverse ranking order of the general classification, making free-riding pretty much impossible.

[3]Jumbo Visma's director had stated the day before Stage 20 that they were "95 per cent certain to win the Tour".

himself by chasing down attacks. How this might look in detail became clear two years later, when Pogačar arrived at the Tour de France with a now much stronger team. Ranked as the best rider in the world after his dominant victory in the Tour de France 2021, Pogačar again faced his main rival, Primož Roglič, who now had the support of a co-captain, Danish climber Jonas Vingegaard (who had finished second only to Pogačar the previous year, after Roglič had crashed early in the race). Jumbo Visma designated both Vingegaard and Roglič as equal leaders and utilized their mountain train for both of them.

On stage 11 of that Tour, Jumbo Visma made their bet for the lead on the penultimate mountain of the day, the Col du Galibier. They alternated attacks between Roglič and Vingegaard, prompting Pogačar to close the gap to either attacker repeatedly. After Pogačar caught up, they immediately slowed down, allowing their other leader to follow Pogačar without sprinting all-out every time. That way, they made Pogačar so tired that when they attacked with Vingegaard on the final climb, Pogačar finally cracked and lost several minutes. Vingegaard won the Tour that year, genuinely looking stronger than Pogačar also later in the race. However, Jumbo's strategic brilliance lay in their willingness to sacrifice Vingegaard's ambition for Roglič's. Had Pogačar not followed Roglič on any occasion on the Galibier, the latter might have ridden away to win the Tour instead.

Jumbo Visma have since stuck largely to the multiple-leader strategy and took this to the extreme when they won the Tour of Spain in 2023 with Sepp Kuss, their third-strongest rider. Kuss had been let go in a breakaway in the first of three weeks of racing, gaining a large lead on all other teams' leaders. Jumbo Visma used Vingegaard and Roglič to put the other teams under pressure on all subsequent mountain stages but ended up winning the race with Kuss. Notably, Kuss struggled to follow Vingegaard and Roglič at times, and his odds to win the race before the first stage were a staggering 325:1.

The lessons drawn from these cases and scenarios highlight the value of having multiple leaders when managed strategically. The advantage gained from employing several leaders exceeds the benefits of mere diversification. This strategic benefit arises from a simple principle, which our paper is the first to point out: distributing riders across various groups can create opportunities for free-riding in each of the groups.