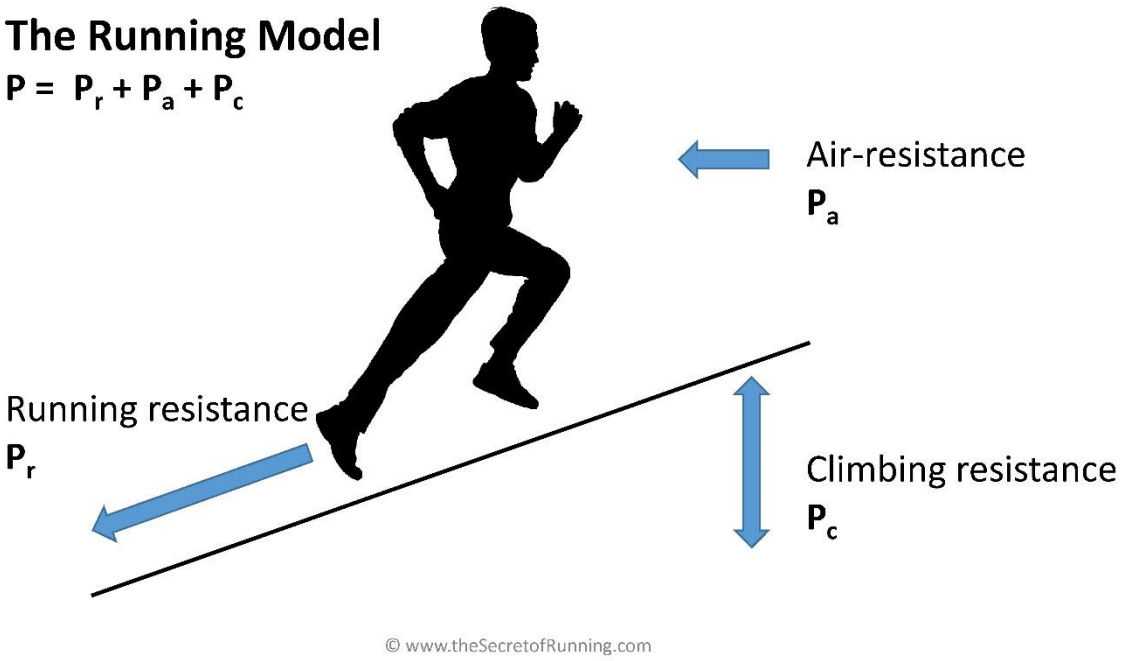
29. First test comparing Stryd and Garmin Running Power

In our books **The Secret Of Running** (www.thesecretofrunning.com) and **The Secret Of Cycling** (www.thesecretofcycling.com) we have described our unified theory for the performance in running and cycling. Our running model is based on the premise that the power produced by the "human engine" (i.e. the leg muscles and the heart-lung system) must be equal to the sum of the power required to surmount the running resistance $\mathbf{P_r}$, the air-resistance $\mathbf{P_a}$ and the climbing resistance $\mathbf{P_c}$, as indicated in the figure below.



This means that in practice a runner is slowed down by the air-resistance and – in case of hills- the climbing resistance. We have modeled $\mathbf{P_r}$, $\mathbf{P_a}$ and $\mathbf{P_c}$, using the laws of physics and in analogy to similar models used in cycling.

Next, we have modeled the power of the human engine **P,** using the laws of physiology. The result is a complete model which enables us to calculate the speed of a runner, depending on his running power and running economy and on the environmental conditions (wind, temperature, altitude, air-pressure, hills, footing).

Meanwhile, we have tested the model in many situations (running, cycling and both in the lab and in races) and found the results very convincing and consistent. Finally, we have tested the Stryd footpod on many occasions, both in the lab and in the field and we found that the Stryd power data match our model calculations perfectly.

Recently, Garmin entered the market of running power meters with their Garmin Running Power app, available in the Connect IQ Store for their high-end watches equipped with a barometer. For the time being, these include the Garmin ForeRunner 935XT and the Garmin Fenix Chronos and Fenix 5. Garmin Running Power also needs running dynamics data, which can be obtained from a separate footpod or a heart-rate band, the HR Run of HR Tri.

Garmin Running Power includes the impact of the wind resistance

Garmin Running Power offers the opportunity to include the impact of the wind resistance in the power calculations. This option can be switched on or off in the app, as you like it. If you want to use it, you should connect your watch for 10 minutes to the app on your mobile phone, prior to your run. Garmin Running Power will then pick up recent weather data from local weather stations. You do not need to take your phone along for the run, as the barometer will detect changes in the weather.

Reviews on the internet

We have read reviews stating that Garmin Running Power calculates much higher power data (watts) than the Stryd power meter and cycling power meters.

We were quite surprised to read this as we have always found that the Stryd power data match our universal theory from TSOR almost exactly. In TSOR and TSOC (www.thesecretofcycling.com) we have also found consistently that the power of the human engine is similar in running and in cycling.

Obviously, we were curious to find out more, so we decided to test Garmin Running Power ourselves and to compare it to our theoretical calculations and to the Stryd Power data.

Training with Garmin Running Power

Ron got his new Garmin Forerunner 935 first. Hans and Ron performed a test run during a 30K LSD-run across the Utrecht Hill Ridge in the Netherlands on December 24th (Christmas Eve…). The run had both flat parts and hilly sections and the wind force was around 4 Beaufort. Ron ran with 2 watches, both his old Garmin 920XT connected to his Stryd footpod and his new Garmin 935XT connected to his HR-band for the running dynamics. Hans ran with his old 630 connected to his Stryd. We observed that all data were remarkable accurate regarding distance, the difference was less than 50 meter over the total run of 30K.

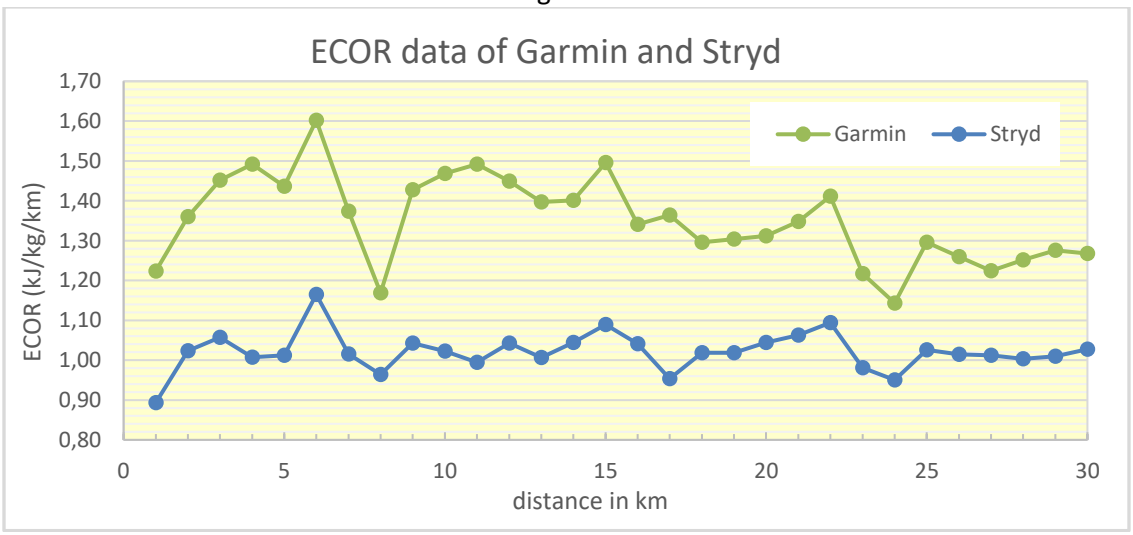
The ECOR according to theory and the data of Stryd en Garmin

As usual, we have determined the Energy Cost of Running (ECOR in kJ/kg/km) as the correct basis for comparison. Ron's average ECOR over the entire run was 1.03 according to Stryd and 1.35 according to Garmin.

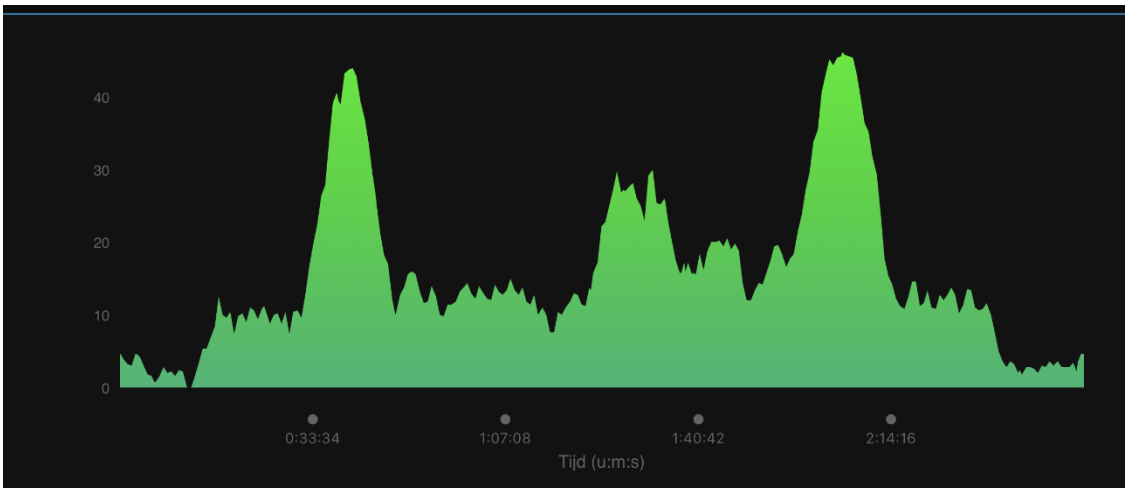
In TSOR we have derived that the standard value of ECOR is 0.98 kJ/kg/km. Of course this number is not the same for everybody. It depends somewhat upon body posture, running style and fuel mix (glycogen or fatty acids). Ron consistently has an ECOR slightly higher than 0.98, so we consider his average Stryd value of 1.03 as quite realistic.

Ron's Garmin Running Power ECOR was much higher throughout the run, on average some 32%! We feel these numbers are extreme and we do not understand how they can be so high. When we looked more closely at the data per km, we also observed that the Garmin data varied much more than the Stryd data.

Obviously, the ECOR is higher uphill and lower downhill. Consequently, we have prepared the 2 figures below which show the ECOR and the altitude difference per km along the run. The figures illustrate clearly that the ECOR goes up and down with altitude, both for Stryd and for Garmin. It is noted that the total altitude difference during the run was 167 m.

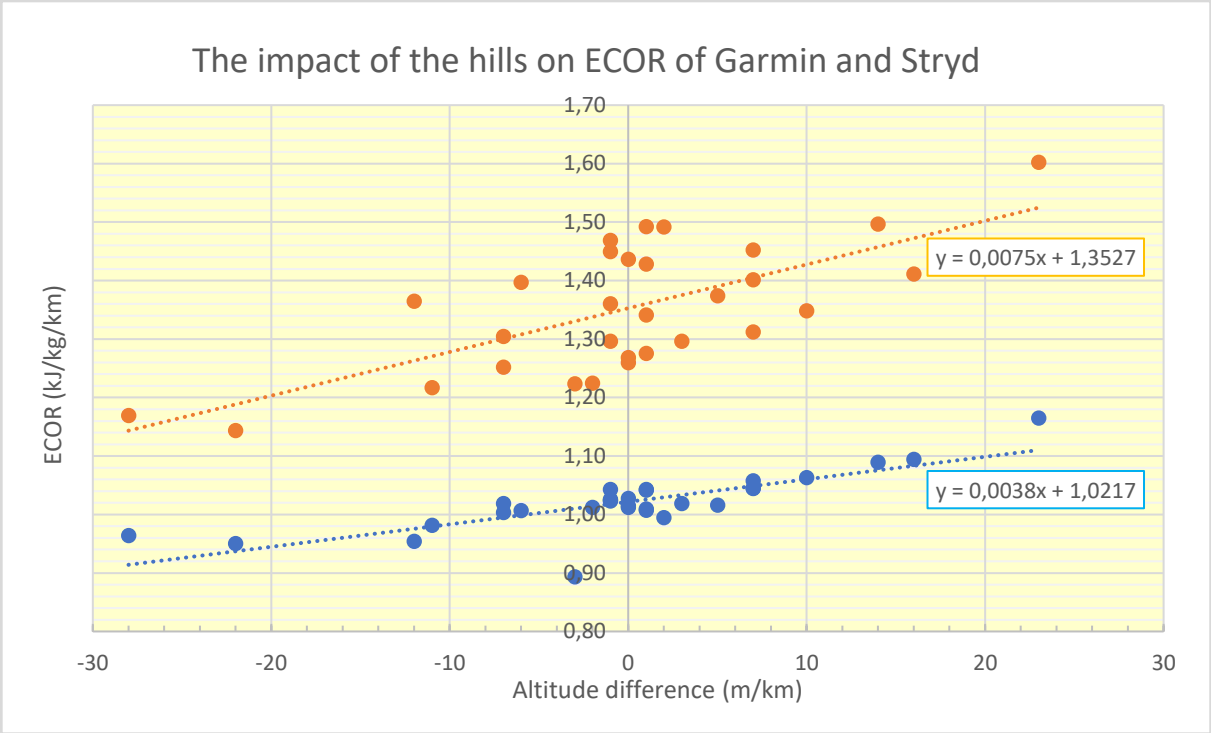


Height in meters



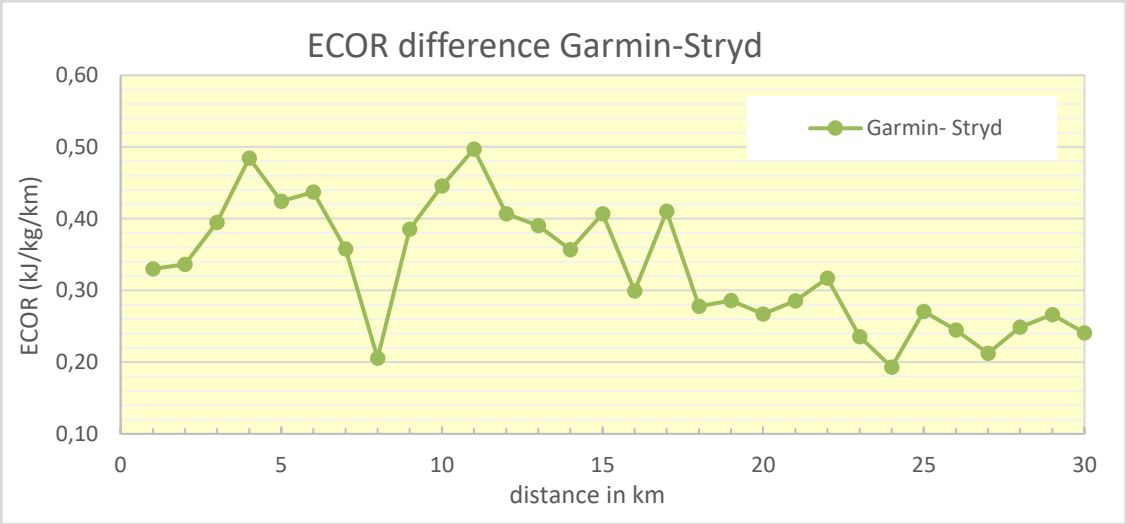
The impact of hills

We have detailed the impact of hills more closely in the figure below, which shows the ECOR as a function of the altitude difference per km. As before, we observe that the Stryd data with a slope of 0.0038 match our universal theory very well. According to theory the slope should be 0.0044. Once again the Garmin data are much higher with a slope of 0.0075. This is even 70% higher than our theory! Again, we find it hard to explain this. The result is that uphill the difference between Garmin and Stryd is more than the average 32%. Downhill, the reverse is the case and the difference is less than 32%.



The impact of the wind

At the beginning of the run, we faced a head wind and at the end of the run we enjoyed a tail wind. This is reflected in the Garmin ECOR data, which are lower at the end as compared to the beginning of the run. The Stryd data are quite constant throughout the run, so the difference between Garmin and Stryd ECOR data decreases significantly during the run, as shown in the figure below.



Obviously, the ECOR should be lower with a tail wind and higher with a head wind. Using the theory of TSOR, we have calculated that with wind force 4 the ECOR should be 0.015 lower in the tail sections and it should be 0.035 higher in the head wind sections. Consequently, the total impact should be limited to 0.05. The graph and the km-data seem to show a significantly larger impact of around 0.1-0.2. We conclude that also with respect to the wind the Garmin data are quite high. Of course, local wind conditions can vary a lot, so it will be very difficult to calculate the wind impact accurately. During the run, we did struggle a bit in the head wind sections and we really enjoyed the tail wind parts at the end of the run.

To be continued!

We intend to perform many more tests on Garmin Running Power. In later papers, we will zoom in on the various factors that determine the power calculations. We certainly do not intend to pass a negative judgement on Garmin Running Power. As a matter of fact, we want to praise them for incorporating the wind impact. We are also quite happy that Garmin has picked up the power meter development. Runners will definitely benefit from power meters and we are confident that Garmin will continue to develop and improve their IQ app.

We hope that many readers will join us in the effort. Let's share our data and conclusions on how we can use power meters to improve our running! We are curious to the reactions and experiences of the readers, we welcome you to share these at www.thesecretofrunning.com**.**

Hans van Dijk and Ron van Megen

www.thesecretofrunning.com

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Effective Power Metering and Training Analysis

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