Individual characteristics

- First name: Daniel
- Age: 32
- Height: 1.78 m
- Weight: 60.0 kg
- Heart rate max estimated = 185 bpm

Session characteristics

- Total duration: 1:02:55 (excluding manual breaks)
- Distance: 12.02 km
- Structure:
    - Warm-up jog (0:25:57)
    - 2 accelerations (0:00:53) (hypothesis)
    - Speed intervals: 2 sets of 8*30/50 or 200/100 m with 0:2:20 recovery (0:23:42) (alternating between fast running and slow running/recovery)
    - Cool-down (0:12:22)

Analysis

First look

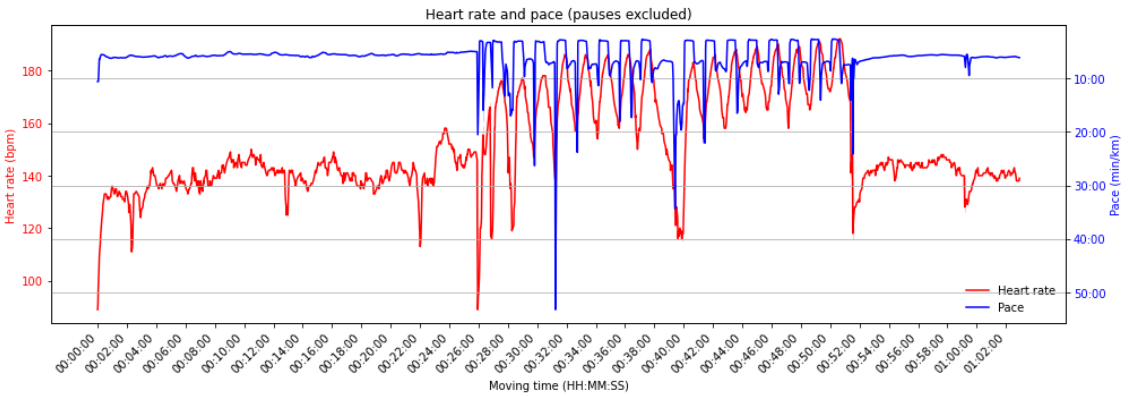

Figure 1 – Heart rate and pace during training session

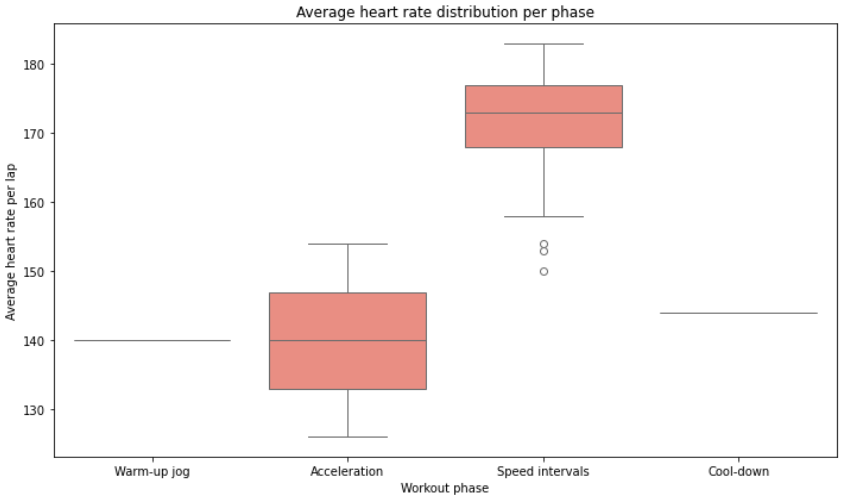

Figure 2 – Average heart rate distribution per phase

Daniel seems to have done a specific session to work on his VO_2 max, with fairly short recovery times between each fast interval. The two charts show a well-structured workout with excellent heart rate response and strong pace control during fast intervals.

- Daniel shows that he can maintain a fast and steady pace during the acceleration phases. (Figure 1). These high paces indicate strong aerobic capacity (VO_2 max), which is crucial in trail running for sustaining a high pace over time, producing bursts of speed when needed, and managing climbs efficiently without premature fatigue.
- During fast intervals, heart rate reaches high levels (170–190 bpm), consistent with intense effort (Figure 1).
- A progressive cardiac drift is visible: at similar paces, the heart rate tends to rise slightly as the session progresses—expected in interval training. (Figure 1).
- Importantly, Daniel's average heart rate returns to the same level at the end of the session as at the start (comparison between warm-up jog and cool-down), suggesting strong recovery ability. (Figure 2).

The rest of the analysis focuses mainly on the core of the session, namely the alternation between fast intervals and recovery phases. It is assumed that the laps correspond to the different phases of the session, in particular the alternation between fast intervals and recovery intervals.

Fitness and efficiency

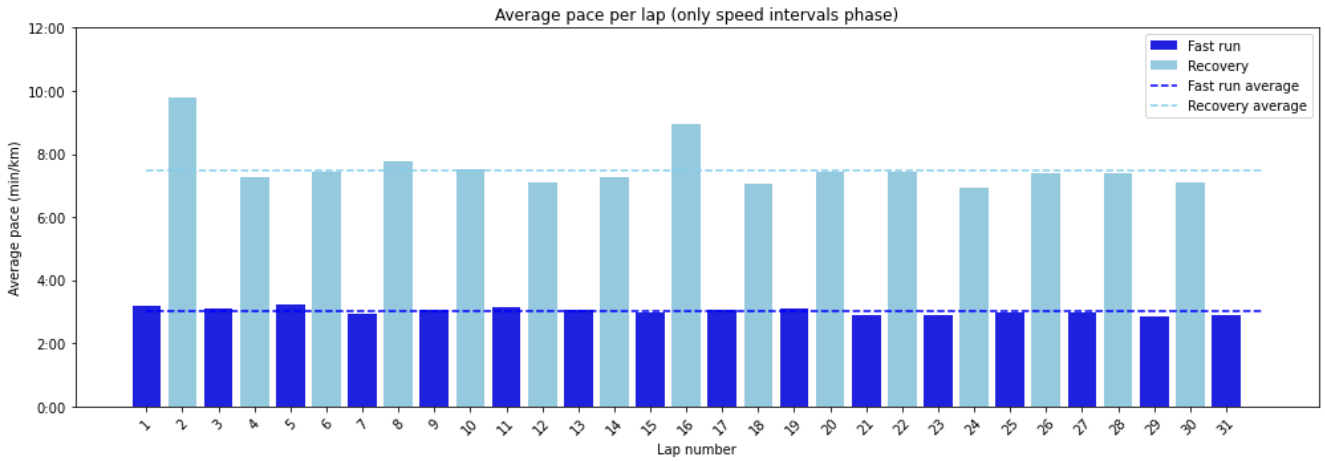

Figure 3 – Average pace per lap (during speed intervals phase)

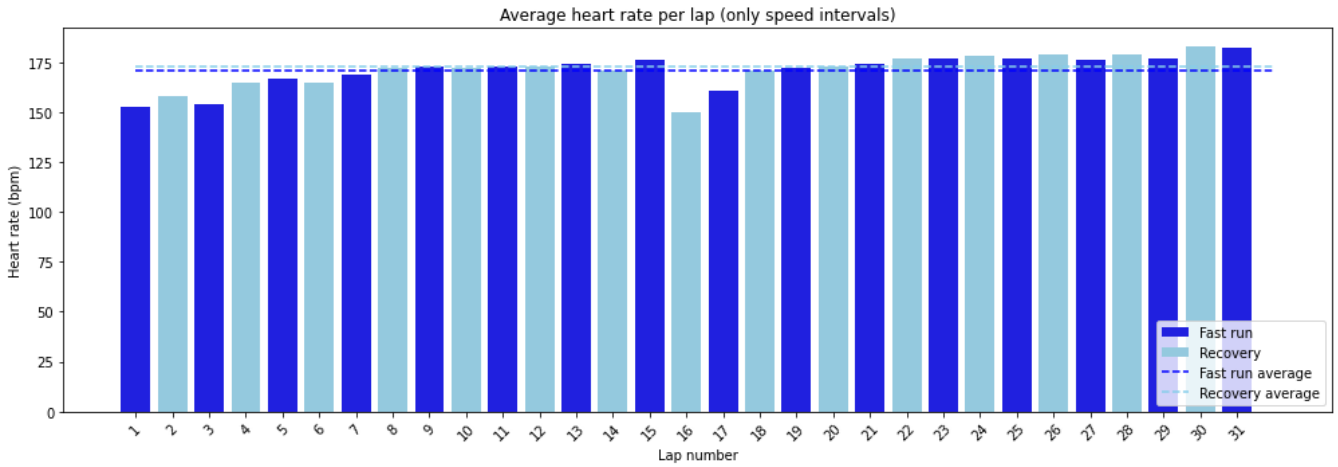

Figure 4 – Average heart rate per lap (during speed intervals phase)

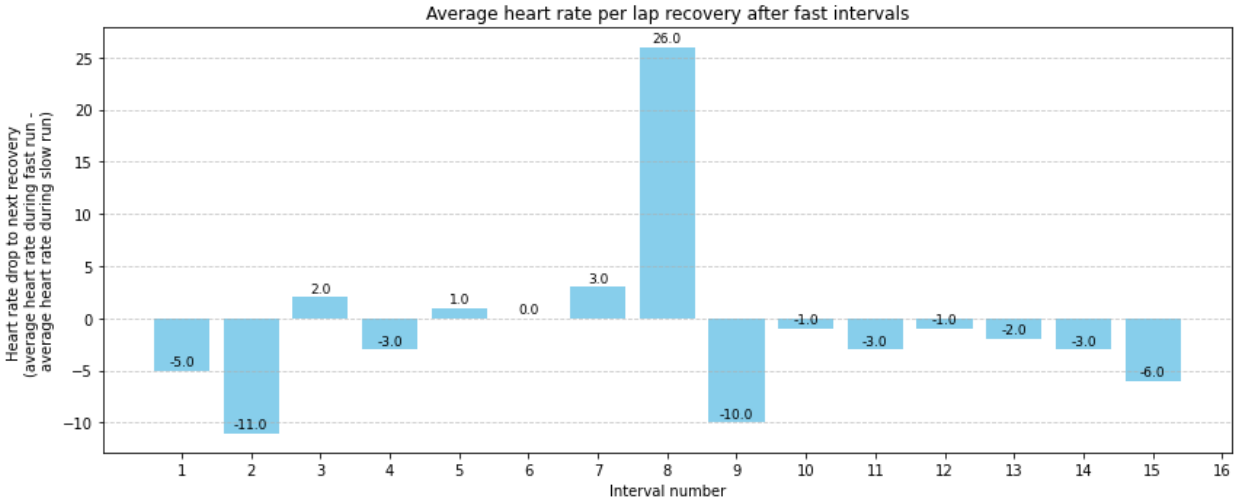

Figure 5 – Average heart rate per lap recovery after fast intervals

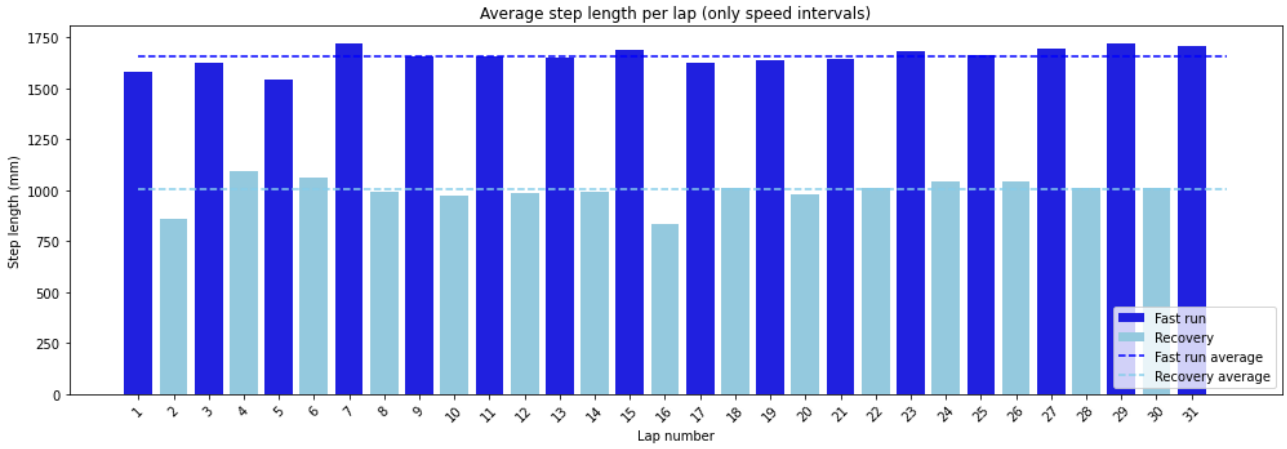

Figure 6 - Average step length per lap (during speed intervals phase)

- Fast intervals: Pace is stable and fast (about 3:00 min/km), with a high average heart rate (about 170 bpm, about 95% of estimated heart rate maximum). Effort clearly exceeds 90% of heart rate max, showing strong aerobic capacity. (Figures 3 and 4).
- Slow intervals: Pace is more variable (about 7:50 min/km), but heart rate stays high (about172 bpm). This suggests limited recovery within these phases, with most recovery occurring during the break between sets. Note that it may be the goal of the session to have short recovery intervals so as not to lower the heart rate too much. (Figures 3 and 4).
- Stride length: Slightly variable across intervals, but consistently large during fast repetitions, reflecting powerful mechanics. More stable cadence at similar paces could improve efficiency. (Figure 6)

Daniel is in excellent condition, capable of sustaining very fast paces over short intervals, which points to a strong VO_2 max.

Focus point: Recovery between fast intervals could be better. Heart rate remains high during slow intervals, likely due to either recovery periods being too short or the recovery pace being too fast. Reviewing additional sessions would help confirm this pattern. (Figure 5).

Pace during speed intervals

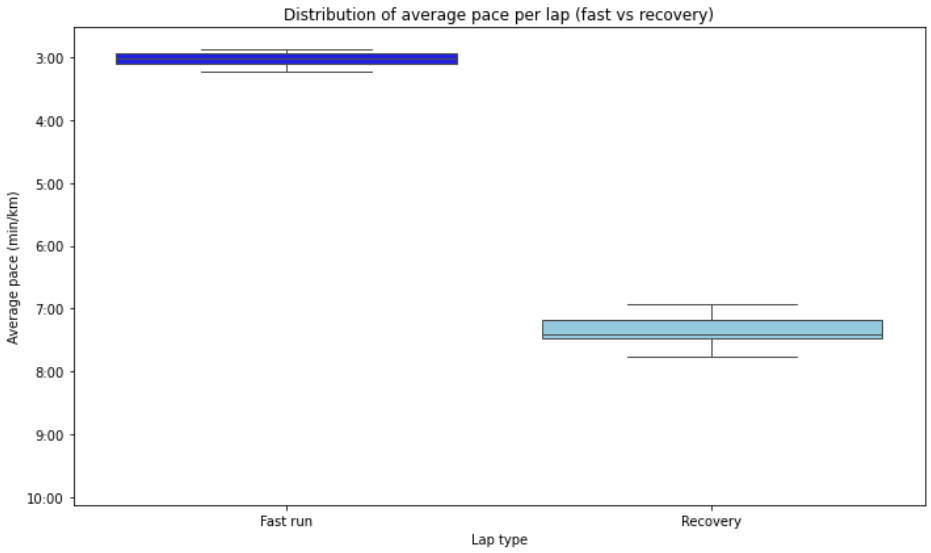

Figure 7 - Distribution of average pace per lap (fast vs. recovery)

During fast intervals, Daniel maintains a consistent pace throughout, showing no signs of collapse. He sustains the target speed (above 90% of estimated heart rate maximum) across all 16 fast intervals of the session. This is a strong indicator of performance capacity. (Figures 3 and 7).

Signs of fatigue, inefficiency, or weaknesses

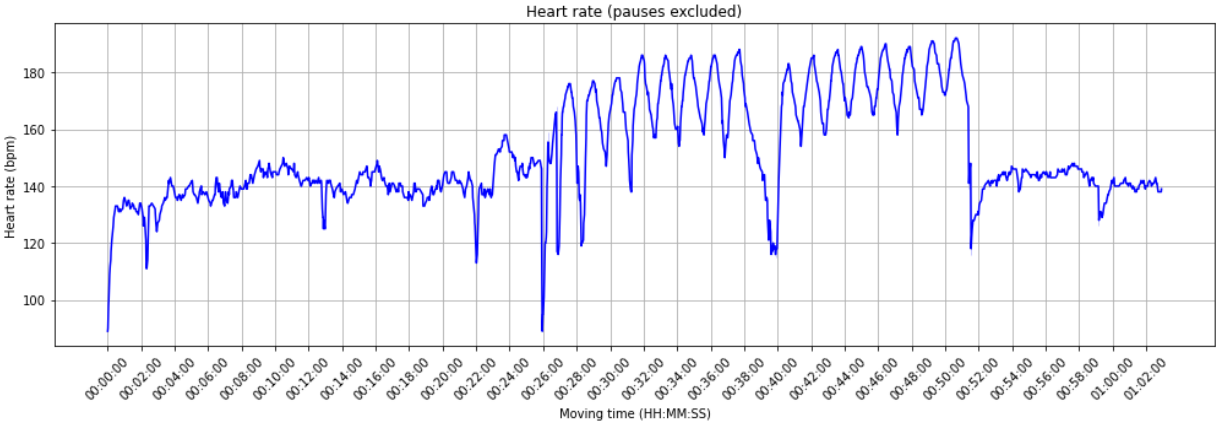

Figure 8 – Heart rate during training session

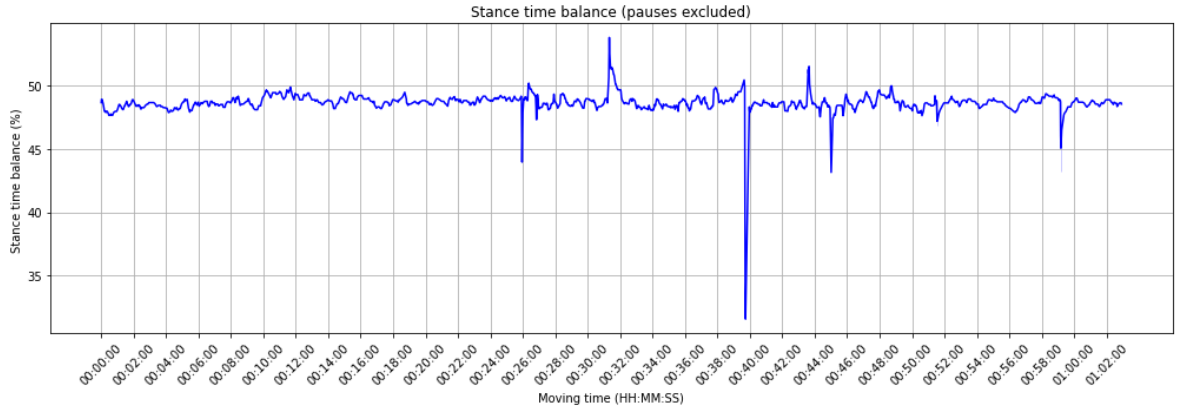

Figure 9 – Stance time balance during training session

- Pace and stride: No decline in pace, cadence, or stride length was observed during the final intervals, confirming consistency across the session. (Figures 3, 4, and 6).
- Heart rate response: A slight cardiac drift is visible, more noticeable in real-time monitoring, which may reflect fatigue. As noted earlier, recovery between speed intervals could be improved to better manage pace changes in trail running. (Figure 8)
- Running mechanics: Ground contact time remains stable on both sides, indicating that Daniel's stride does not deteriorate over the course of the workout. The two observed peaks are likely measurement artifacts. (Figure 9)

Overall, there are no significant signs of inefficiency or weakness. The main area for improvement is heart rate recovery, while the slight cardiac drift may suggest underlying fatigue.

Is track work really the key to trail performance?

What science says:

Alvero-Cruz et al. (2019) [2] and Pastor et al. (2022) show that VO_2 max is one of the best indicators of performance in short-distance trail running. Track training sessions aimed at improving VO_2 max are essential for trail runners.

However, trail running also involves factors not captured on the track. In his thesis, one of the objectives of which was to determine the main performance factors in short trail running, Ehrström (2020) [3] highlights the importance of running economy on uphill sections (ability to minimize energy consumption during ascent) and muscular endurance (the ability of a muscle group to maintain a high level of strength over time).5

Furthermore, according to Bettaga (2025) [4], downhill performance is crucial to overall trail running performance. Elite athletes lose proportionally more time on descents than on ascents.

How should Daniel train to dominate short-trail races?

- Consult a coach to tailor the training plan to current fitness, racing goals, and recovery needs, minimizing the risk of overtraining or injury.
- There are different realities behind short trail running: it is wise to find out in advance about the profile and technicality of the short trail you are aiming for.
- Keep running track sessions to further develop VO_2max through high-intensity intervals.
- Add trail-specific workouts, focusing on uphill repeats and controlled fast descents
- Integrate strength training, targeting the lower body, core, and explosive power (e.g., squats, plyometrics, single-leg stability).
- Include long runs with elevation gain to build endurance, running economy on gradients, and terrain-specific resilience.

Limitations of the analysis

- The Garmin device uses a non-constant sampling frequency, which may introduce distortions in graphical representations.
- The session analysis was based on manually defined circuit times. This method may contain errors, as peaks and troughs could also have been identified directly from the recorded data. Additionally, this step was not automated, so the code would need adjustments to analyze another session.
- As with any measurement system, a margin of error is always possible.
- The total duration includes breaks detected by Garmin, which may be interpreted differently depending on the context.
- The analysis is limited to a single session, with no additional data to assess progress over time.
- It is also unknown whether Daniel has previously completed a 20 km / +1000 m elevation run or what his current performance level is, which limits the contextualization of the results.

These factors should be considered when interpreting the results. While the analysis provides valuable insight into the session, it remains limited by the methodology, the tools used, and the lack of comparative data.

Bibliography

[1] Pastor, F. S., Besson, T., Varesco, G., Parent, A., Fanget, M., Koral, J., Foschia, C., Rupp, T., Rimaud, D., Féasson, L., & Millet, G. Y. (2022). Performance determinants in trail-running races of different distances. *International Journal of Sports Physiology and Performance*, *17*(6), 844-851. https://doi.org/10.1123/ijspp.2021-0362

[2] Alvero-Cruz, J. R., Parent Mathias, V., Garcia Romero, J., Carrillo de Albornoz-Gil, M., Benítez-Porres, J., Ordoñez, F. J., Rosemann, T., Nikolaidis, P. T., & Knechtle, B. (2019). Prediction of performance in a short trail running race : The role of body composition. *Frontiers in Physiology*, *10*, 1306. https://doi.org/10.3389/fphys.2019.01306

[3] Sabine Ehrström. Analyse de la performance en trail courte distance : Déterminants physiologiques, spécificité de la sollicitation musculaire et stratégies d'optimisation. Physiologie [q-bio.TO]. Université Côte d'Azur, 2020. Français. ffNNT : 2020COAZ4104ff. fftel-03187923f

[4] Bettega, S., Pellegrini, B., Viscioni, G., Fornasiero, A., Bortolan, L., Schena, F., & Zoppirolli, C. (2025). Kinematics and performance on uphill and downhill trail running in elite and well-trained athletes. *International Journal of Sports Science & Coaching*, 17479541251352176. https://doi.org/10.1177/17479541251352176