PLATYPUS TECHNICAL CONSULTANTS

Opportunities for optimising motor-athlete physiology

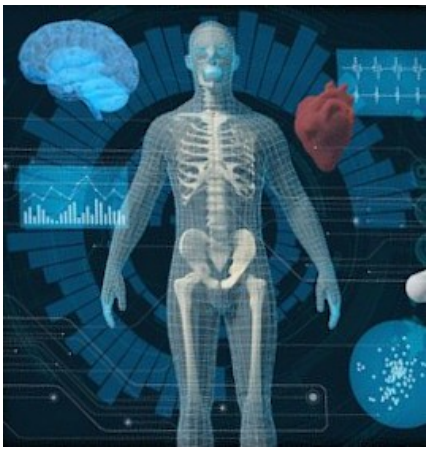
Dr Lee Walsh CPEng

Introduction

The drive to get an edge over other competitors is fundamental to sport. The edge could be gained many ways including athlete performance, better equipment, event preparation, intelligence about opponents, or data analytics. Motorsport is, of course, no different. Although it does lend itself to a greater focus on the equipment, or vehicle.

However, the athletes (drivers, riders, and pit-crew) all have critical roles to play and their performance can win or lose a race, regardless of who has the best car.

Motorsport physiology



Motorsport athletes have to perform at their peak in hostile conditions. Manoeuvring a motor vehicle around a track faster than anyone else is a physiologically and psychologically demanding task. The physical feats include braking, steering and tolerating high acceleration forces (g-forces). For example, some measurements and calculations have shown that drivers excerpt 60 – 120 kg of force on the pedal during braking[1]. In a race, this is every few seconds for the duration of the race. In endurance racing that could be over 1000 repetitions.

Added to the physical feats are the cognitive and psychological. The athlete is under time and psychological pressure. They are expected to

1 *Potkanowicz, E., Mendel, R.* (2013). **The Case for Driver Science in Motorsport: A Review and Recommendations** Sports Medicine 43(7), 565-574.

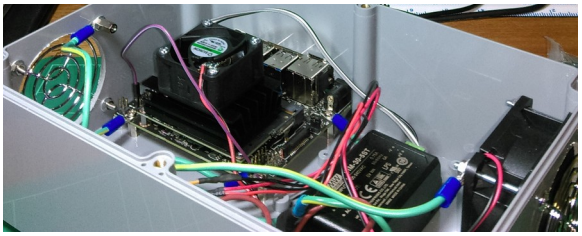
assess incoming information from instruments, radio and track, and then interpret it to execute a perfect corner. Getting the corner wrong loses time or, in the worst cases, means not completing the race.

All of this is under adverse physiological conditions. High temperatures, exposure to exhaust gases, dehydration, and muscle and cognitive fatigue. Many of these factors interact. Physical exertion and stress increase heart rates, which over time will increase fatigue. Dehydration reduces oxygen uptake, affects heart rate and blood pressure, and leads to lower physical and mental performance. The equipment can also make the environment more hostile. For example, drivers and riders are wrapped in protective clothing that drives up body temperature and dehydration, and closed cockpit front-powered cars can increase the exposure to heat and exhaust.

Optimising the performance of drivers and riders requires measuring their performance as well as the physiological, psychological and environmental conditions that they compete in. Once this data is interpreted against the athlete's physiology, then equipment, strategies and training can be adapted to improve that athlete's performance. Importantly, measurement of athlete performance allows teams to verify if changes have actually improved lap time and race performance. This way, changes that made no improvement can be dropped in favour of those that did. It also allows tailoring of strategy for a particular athlete. Every rider and driver is different, and so is their physiology.

Technology

Physiologists and biomedical engineers are experts at measuring human performance and interpreting its meaning against human physiology. Fortunately, there is a lot of existing technology available to support their work in motorsport.



Low-profile data acquisition systems are now widely available, as are physiological sensors and data analysis techniques that can be used at the track without laboratory facilities. The challenge in motor sport is to adapt systems and analytics to measure multiple performance parameters and correlate the athlete's physiology with both the vehicle's performance and lap times. Furthermore, instruments on a driver or rider must be compliant with race regulations, and safe in accident conditions.

Another issue is the lack of detailed data sets and detailed literature on driver and rider physiology and psychology. However, this also creates an opportunity to develop a competitive edge.

Challenges

My research so far has identified several challenges in engineering a rider or driver's physiology for higher performance. These include:

- Driving/riding under race conditions is complex requiring multiples physical and mental feats that interact. Therefore optimising performance will require measurement and detailed analysis.

- Measurement instruments must be safe for athletes during accidents, compliant with race regulations, and tolerate adverse race conditions.
- Some adaptation of measurement systems will be needed.
- Detailed data and research about driver and rider physiology is absent.
    - Some data on central effects (e.g. heart rate, temperature, muscle strength)
    - Next to no data on sensory and motor performance

Opportunities

Challenges create opportunity for those who solve them first. There are currently opportunities to engineer a driver or rider's performance to gain a competitive edge. Some of these are:

- Measuring motor-athlete performance during a race or practice can feed back into coaching and training regimes to focus on weaknesses as well as measuring which regimes are working.
- Combining physiological data with race and vehicle data will allow teams to objectively identify what is different about driver performance during a good versus bad corner or lap.
- Physiological data collected over a race can inform race and recovery strategies. E.g. how much water to carry, when to drink it.
- Where there is a need to adapt instruments to the racing environment, the team that does so will be the only one with that technology.
- The lack of detailed data sets in the research literature creates an edge for teams that invest in developing data sets and effective physiological strategies.
- Objectively understanding how a driver performs with their vehicle could identify opportunity for vehicle development or optimisation for a particular athlete.

Conclusions

Understanding and studying athlete physiology is just as important at the elite level of motorsport as it is for other sports, but seems to be overlooked in literature. However, this creates opportunity for those who invest in understanding their team's race physiology and psychology to develop a competitive edge.

You can't optimise lap times without optimising the performance of your drivers and riders.