**The association between training load and changes in performance**

**Dr. James Hopker, Professor Louis Passfield, Mark Liversedge**

You are being invited to take part in the above-named research study as you are a user of the Golden Cheetah (GC) training analysis platform. Please take time to read the following information carefully and feel free to ask any of the research team questions regarding the study (contact details below).

**What is the purpose of the study?**

To date the process of prescribing training has relied upon the experience and intuition of those involved (i.e. coaches and athletes), as the necessary research in this area is lacking. In contrast to the advances made in our understanding of the adaptions that result from training, our knowledge of the scientific basis for prescribing training programs has advanced by a comparatively small amount over the past four decades. However, this could change with the capability to measure an individual athlete’s training and racing accurately and in detail in the field using power meters or GPS devices. Detailed monitoring of training and performance in the field provides an opportunity to access a tremendous amount of information. Specifically, we can measure an athlete’s training, and track their resulting changes in performance. It may then be possible to determine which aspects of their monitored training is most effective, given sufficient data. Here the bigger the data, the better the insight, as effective training may be identified more clearly when the number of participants involved and the diversity of their training is greater. Exploring a wide range of training regimes with large numbers of participants is not a viable option for laboratory-based research, but in a field study it becomes quite plausible. Thus, this study aims to investigate the relationship between training and resultant changes in performance using a prospective study design in a large group of cyclists with a wide range of training regimes. This study will allow us to better understand the link between training and performance.

**Who is carrying out this study?**

Hopker and Passfield are two Sports Scientists from the Endurance Research Group, based at the University of Kent. Our research work focusses on the prescription of training and evaluation of training within a variety of different sports. This research project is an extension of our work on the analysis of training data. Liversedge is the lead developer for the GoldenCheetah open-source software project. GoldenCheetah is a tool for collecting and analysing training data with a focus on applying the latest science and putting it into the hands of athletes and practitioners

**Who can take part?**

We would like to recruit trained cyclists who are users of the GC platform. To be a trained cyclist you must have completed a minimum of 3 years training, with a training regimen that incorporates a minimum of 150 km or 5 h per week, inclusive of at least 1 high intensity training session. You must have your own power meter, and use it for all of your training and racing in order to participate.

**Do I have to take part?**

No. It is up to you to decide whether or not to take part. If you agree to be included but later change your mind, you can withdraw from this study at any time without explanation. A decision to withdraw, or a decision not to take part, will, result in all data collected to that point being deleted.

**What will happen if I take part?**

We will require you to record all of the training and racing that you complete over a 12 week period. Training data will need to be recorded on a power meter that is appropriately calibrated and maintained. We will also require you to record heart rate data during each training session and race. We will not ask you to change your usual training or racing regimes, rather we would like to monitor what you do, and the end result. In order to assess your progression with training, we will ask you to conduct a performance test every 4 weeks of the 12 week period (see performance test below).

To ensure accuracy of the data you produce, we request that in accordance with the manufacturer recommendations, you appropriately zero offset/calibrate your power meter prior to/during each ride as is feasibly possible. We would then request that you record data on your power meter using a 1 second recording frequency.

Following each training session or race we would request that you download your data to GC as soon as possible, ideally within 30 mins of completing the ride. During the upload process we would also like you to provide us with two perceptual measures, which can be manually entered in to GC along with the file. The perceptual measures relate to a session RPE value, and a global rating of fatigue value (see perceptual measures below). Finally we request that you provide us with a short outline of the ride and any issues you think are important for us to be aware of when analysing the data. For example, “tempo ride with a bit of threshold on the inclines. Felt stronger 20 min in” or “L4 hard ride at FTP” or “only half ride recorded as head unit battery went flat – the session should have included 4 x 4 min full gas interval efforts”

**We will require you to upload your training data to a Google Drive account on a session-by-session basis.** Upon your agreement to participant you will be provided with a link to access a Google Drive folder to which you can upload your training data. In order to do this you must have a Google account. If you do not have a Google account you will need to get one. Once you have a Google account please let us know your Google account ID. This can be provided on the Informed Consent Form. Your data will be **securely transferred** to, and **securely stored** on, Google Drive, with restricted access only to Dr. James Hopker, Prof. Louis Passfield and Mark Liversedge during the course of the research study. Data will not be passed to any third party outside of the research team.

We will also need to know if you do not train on a particular day for whatever reason (i.e. if you have a planned rest day, if you are ill or injured, if you trained but did not record the data due to technical problems etc…). When you upload the next training file to GC, please make a note on that file as to why you missed training in the previous day(s). This will help us to account for any gaps within your training data. This is important as your data will be used to construct a unique signature of all of the training and racing that you complete each month and associate it with changes in performance that we see in your performance test data.

Performance testing

In addition to the collection of power data files, we also request that you complete a self-administered performance test every 4 weeks during the course of the 12 week period (so at weeks 0, 4, 8 and 12). The performance test will enable us to validate the changes we see in your power data during the season. It is important that you adhere to the following for each performance test you complete in order to ensure that your performance test is a true reflection of your ability.

*Protocol:*

1. Complete the zero-offset procedure for your power meter according to the manufacturer guidelines.
2. Make sure that your heart rate monitor belt is communicating with the power meter head unit, and that both power and heart rate are being recorded.
3. Place a marker (lap) on the data when you are ready to commence riding.
4. Start the test by warming up for 5 minutes as approximately 100W, and 5 mins at approximately 150W. Place a marker on the file for the start of each 5 minute period.
5. Please make a note of your perception of effort during these two 5 minute periods, so one value for 100W and one value for 150W (see perceptual measures below).
6. Next you will be required to complete a maximal 12 min effort. The aim of which is to complete as much distance as possible during the allotted time. Please marker the file at the start and end of the effort.
7. After the first effort, undertake a period of low intensity or recovery riding for 30 mins.
8. At the end of the 30 mins, complete a maximal 7 min effort. Please place a marker at the beginning and end of the allotted time.
9. Have a 30 min recovery period of low intensity cycling after the effort.
10. Finally, complete a 3 min maximal effort. Place a marker at the beginning and end of the allotted time.
11. After the test, please download your data within 30 mins of finishing the test and provide a session RPE and rating of fatigue score. Plus, your perception of effort scores using the rating scale below (1-10 Borg Rating of Perceived Exertion Scale) for the 100W and 150W warm-up stages – please add these scores in the “Notes” section for the file on GC once you have downloaded the data.

Performance tests can be conducted on a turbo-trainer, or on the road. However, it is important that you test under the same conditions. So, if you decide to conduct your first performance test on a turbo trainer, then it is important that all of your subsequent performance tests are performed on the turbo – and that the turbo trainer is set-up exactly the same for each subsequent test. If you decide to complete your performance tests outside on the road, please select a suitable section of road – ideally somewhere that is relatively flat and doesn’t have heavy traffic, or a large number of roundabouts. Following your first performance test on the road, please use the same section of road for all subsequent performance tests. Please also try to test is as neutral weather conditions as possible i.e. minimal head or tailwinds and without heavy rain or slippery roads.

*Preparation for the performance tests*:

- Do not participate in **any** exercise in the **24 h** prior to the test, failure to comply will greatly influence your test results;

- Do not participate in **heavy** exercise in the **72 h** prior to the test;

- Drink **only water** and not to eat anything in the **2 h** before each test;

- Be free from illness/infection during the 2 weeks prior to testing;

- Eat as you would do coming up to an important race.

Perceptual measures

For each training session and race file, we ask you to provide a session rating of perceived exertion score (session RPE), and a global rating of fatigue score.

*Session RPE:*

This is quite simply your response to the question “How hard was your session?” The goal of the session RPE is to obtain a global rating of the training session, which incorporates all aspects of the session. Because the session RPE is a measure of the entire session, you need to provide the rating within 30 minutes of finishing training. The perception of effort scale is provided below. Try to appraise your feelings of exertion as honestly as possible, without thinking about what the actual physical load is (heart rate, speed, power output, etc..). Don’t underestimate your perception of exertion, but don’t overestimate it either. It is your own feeling of effort that’s important, not how it compares to other people’s. What other people think is not important either. Look carefully at scale and expressions, and then give a number.



*Performance Test Rating of Perceived Exertion:*

As outlined above, we require you to rate your perceived exertion during the warm-up at both 100W and 150W prior to the self-administered performance test. While exercising we want you to rate your perception of effort, i.e. how hard, heavy and strenuous exercise feels to you. The perception of exertion depends on how hard you are driving your legs or arms, how heavy is your breathing, and the overall sensation of how strenuous exercise is. It does NOT depend on muscle pain, i.e. the aching and burning sensation in your leg or arm muscles. The rating of perceived exertion you provide should be based upon the 1-10 rating of perceived exertion scale above. However, please use the scale to rate how much effort you feel the bout of exercise at 100W and 150W felt to you *while* cycling.

*Rating of Fatigue Scale:*

The rating-of-fatigue (ROF) scale (see below) will allow you to rate how fatigued you feel. The scale might be presented to you by another person or, in some circumstances, you might be asked to self-administer the scale. Whatever method is used, it is important that you first read the following guidelines:

* Please familiarize yourself with the scale by looking closely at the ROF scale now. You will notice that the ROF scale consists of 11 numerical points that range from 0 to 10. There are also five descriptors and five diagrams that are intended to help you understand the scale and make you rating.
* When you are presented with the ROF scale please carefully inspect the scale before giving a numerical   response from 0 to 10. Always try to respond as honestly as possible giving a rating that best reflects how fatigued you feel at the time.
* Try not to hesitate too much and make sure you only give ONE number as a response. For example, avoid responding by giving two numbers such as ‘three or four’.
* Now please read the following examples of what some of the ROF ratings mean:  A response of 0 would indicate that you do not feel at all
* fatigued. An example of this might be soon after you wake up in the morning after having a good night’s sleep. Now try to think of a similar occasion in your past where you have experienced the lowest feelings of fatigue and use this as you reference.
* A response of 10 would indicate that you feel totally fatigued and exhausted. An example of this might be not being able to stay awake, perhaps late at night but equally could include situations such as sprinting until you can no longer physically continue. Again try to think of a similar example that you have actually experienced in the past.

Rating of Fatigue Scale



**To participate in this research, you must:**

* Be over 18 years of age, and under 55 years of age.
* Have your own power meter that is in good working order and is maintained on a regular basis.
* Have competitive racing experience.
* Have completed a minimum of 3 years training, with a training regimen that incorporates a minimum of 3 training sessions on average per week, inclusive of at least 1 high intensity training session.

**Exclusion Criteria – you are not able to participate in this study if:**

* You are younger than 18 or older than 55 yrs
* You are smoker
* You are taking medication that affects either metabolism or digestion
* You are taking any long-term anti-inflammatory medication
* You have a body mass index (BMI) less than 25 kg/m2 i.e., classified overweight
* You have a chronic injury or illness
* You have a history of heart disease or diabetes.
* You suffer medical conditions that are exacerbated by exercise.

**What are the possible benefits of taking part?**

By being involved in the study you will assist in developing our understanding of the exercise training process, and how it relates to changes in endurance performance. By logging your training and conducting performance tests on a regular basis, you will be able to track your changes in performance over the period of time you are involved in the study. You will also be provided with guidance of how to use GC to get the most out of understanding your training and race data.

**What are the risks and possible discomforts from being in this study?**

Even though you will be used to completing maximal efforts as part of your regular training regime, it is important that you are made aware of the risks associated with maximal exercise testing as part of performance testing involved in this research study. The risks associated with the maximal exercise test are fatigue, muscle soreness, irregular heartbeat, chest pain and sudden heart attack. To minimize these risks you will undergo a warm-up exercise prior to the starting of testing. Please stop the test, training session or race at any point if you are either (a) having difficulty breathing or (b) incurring any other form of distress. We will require you to complete a physical activity readiness questionnaire to check for contraindications for maximal exercise prior to you commencing the study.

We request that you ensure your own safety whilst taking part in the study. For example, that you wear a cycling helmet during training and racing when on the road, that you check your bike is in good working order before every session, and that you follow the country’s rules of the road (i.e. the Highway Code in the UK). We do not accept any liability for injury caused to you whilst you are taking part in this study. English law would apply in all circumstances.

**If I take part in this study, how will you protect my privacy?**

All the information about your participation and your training/race data will be kept in the strictest confidence. Your data will be stored on secure servers in password protected files on Google Drive. Personally identifiable data will be submitted to Kent, with data being anonymized at the point of data processing. ​Only the named researchers will have access to your identifiable data. If you withdraw from the study all of your data will be destroyed. Personally identifiable data will be destroyed should you request it to be so. The findings may be published in academic journals or presented at conferences, but this would not include any information that would let others know who you are. Training and race data will be anonymised using a participant code made up of numbers and letters prior to storage on Google Drive. We will hold your personal data separately on password protected and secure servers at the University of Kent. Your personally identifiable data will be destroyed within 12 months of you completing the study. We will continue to hold the anonymised data for 5 years after the study has finished to allow for publication of the results. If requested, you can receive a copy of study findings at the end of the study once the research paper has been drafted and submitted for publication.

**How long does the study participation last for?**

We request that you participate in the study and allow access to your power meter data for a 12 week period. Participating in the research study is voluntary, and does not constitute a contract of employment or services.

**Who is organising and funding the research?**

This research study is being organised and funded by the School of Sport and Exercise Sciences at the University of Kent. This study has been ethically approved by the School of Sport and Exercise Sciences Research Ethics Committee.

**If I have questions or concerns about this study, who can I contact?**

You can contact the principal researcher listed below for questions specifically related to this study.

Dr. James Hopker

School of Sport and Exercise Sciences,

University of Kent,

Medway Building,

Chatham Maritime,

Kent, ME4 4AG

Email: j.g.hopker@kent.ac.uk

**What if there is a problem?**

If you have complaints or concerns about this research you can contact Professor Samuele Marcora, the Director of Research at the School of Sport and Exercise Sciences (e-mail: [s.m.marcora@kent.ac.uk](mailto:s.m.marcora@kent.ac.uk)).

**What do I do now?**

If you understand the information given in this form, and wish to participate, then please fill in the attached consent form, health questionnaire, and cycling experience questionnaire and return them all to Dr. James Hopker: j.g.hopker@kent.ac.uk