Performance Analysis

Track Cycling – Physiological Component

The sprint races are the Individual Sprint, Team Sprint and the Keirin. In the Individual Sprint, 2 cyclists compete against one another. The components of power, speed, muscular endurance, cardiovascular endurance, dynamic strength, balance, reaction time, flexibility, v02 max and maximal strength are all needed to perform at elite level, I consider the 3 most important to be power, speed and maximal strength.

Fitness testing is important to establish strengths and weaknesses. By comparing results to elite performers it shows you areas in need of improvement allowing training to be modified accordingly. They also give an indication of your fitness levels and something for you to track.

Power - is "the ability to exert a maximal force in as short a time as possible" (1). Power is strength x speed. The fastest competitor wins, therefore a high power output from the legs is required. The Wingate Test assesses power. "This test requires the athlete to cycle as fast as possible for 30 seconds.

The calculation for peak power is below.

"Force (amount of resistance added to the flywheel in kilograms) x total distance (number of revolutions x distance per revolution) / time in minutes". Peak power is also known as peak work rate which is a measure of exercise intensity. For track cycling this needs to be as high as possible as only lasts a small amount of time. (3).

The table in the appendix shows the normative data for the Wingate test. It shows the power outputs that male and females have to reach to make each %rank.

The results below were worked out by the computer on the Wattbike giving a more accurate reading as it eliminated the possibility of human error.

Type of test	My score	Normative data comparison
Wingate test	523	70%rank

The normative data shows that my score was in the 70% rank which shows that I am able to produce high amounts of power over a longer duration of time than what is needed in my events.

Reliability is "the degree to which a test is consistent and stable in measuring what it is intended to measure." (4) The test was conducted on a Wattbike. The data needed appears on the screen, which also calculates the resistance. Keeping the conditions the same (warm up, equipment, time of day) will make it reliable.

Validity is "the degree to which the test actually measures what it claims to measure and the extent to which inferences, conclusions, and decisions made on the basis of test scores are appropriate and meaningful" (5) This test is standard for sprint cyclists. Exerting high amounts of leg power is needed at the start of a race or to inject speed to pull away from opponents. Therefore, the test is valid as it tests power output and it is conducted on a bike.

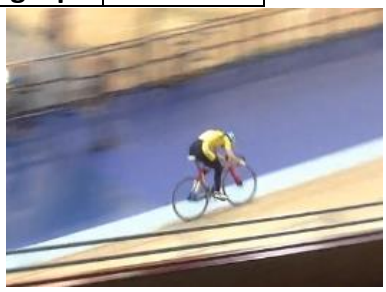
<u>Speed</u> – is "the ability to move all or part of the body quickly" (6). The highest cadence (pedalling rate) is needed to get to peak speed (in a set gear). Speed comes from power output and cadence - the high speed of leg movement (number of revolutions). Great speed increases the chance of winning.

The 200m flying lap is the sprint qualifying event in track cycling (a test of speed). The test is timed over 200m with 1-3 laps to use to build up speed before the timer starts. Athletes usually cycle round the top of the bank and drop down on the last bend before timing.

RANK	ATHLETE	TIME
1	JAMES Rebecca GBR	10.721
2	MERCHANT Katy GBR	10.787
3	LEE Wai Sze HKG	10.8
4	LIGTLEE Elis NED	10.803
5	ZHONG Tianshi CHN	10.82
6	VOGEL kristina GER	10.865
7	HANSEN Natasha NZL	10.871
8	MORTON Stephanie AUS	10.875
9	MEARES Anna AUS	10.947
10	KRUPEECKAITE Simona LTU	10.978
26	CASAS ROIGE Helena ESP	11.707
27	MOHAMED Ebtissam EGY	12.92

Type of test	My score
Flying lap	12.405sec

(7).



Above are results of the Women's 200m Flying Start at the 2016 Olympics. These are the qualifying times, the top 10 went through to the next stage. I am 1.684sec off the top time. To compete at this level, I need to improve my speed by 13%. I would rank 27th with my result.

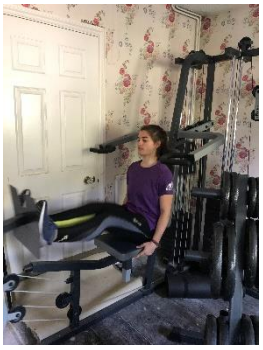
Reliability: The test was conducted on the track in Manchester meaning that I could use the technique described above which is what the athletes listed above did. A Swiss Timer was used meaning the timing is more reliable than a stopwatch. When I repeat the test I will conduct it under the same conditions.

Validity: The test is valid because I compete on the bike used, in the velodrome where I compete, doing Women's 200m Flying Start which is used to qualify for major events.

Maximal strength is the "greatest force that is possible in a single maximum contraction" (8). It is important in track cycling because having a high amount of strength means that you are able to use a bigger gear meaning you can get to greater speeds quicker.

Racing requires maximal strength, and a high amount of leg strength to maintain speed. It is also needed at the start of races to get the fastest start possible, which is hard in a high gear, creating high resistance.

The maximal strength test was conducted on a leg press machine. It involves pushing against a weight in a sitting position using only your legs.



Gender	Female	Body weight	60	Kg
Age	20-29	1-RM Weight	145	Kg
Calculate	Body Weight to Weight ratio -		2.42	
Assessment of your 1-RM Leg Press is -			Excellent	

(10)

The calculator above shows my result as excellent. Meaning that my maximal strength is an area that needs less improvement than power or speed.

Reliability: A realistic weight was chosen to push. After the 8 repetitions, a 30-minute rest was taken for full recovery and the weight increased. An assistant set the weight during the rest period and helped to record results. When repeated, the test conditions will be the same.

Validity: The test is valid because it tests maximal leg strength needed for track cycling. However, more rest was allowed than the protocol explained, which may compromise the result.

Future priorities

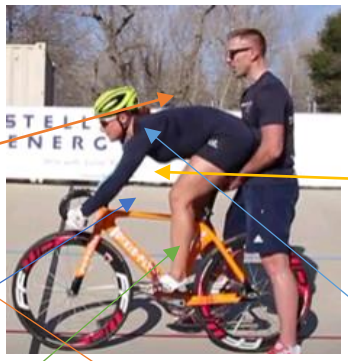
My poorest result was speed. Improving speed would influence my power as I already have excellent strength. I will use interval training (on a bike) and weight training and will apply progressive overload to gradually increase the amount of training. My target speed is sub 11 seconds. I will also use weight training to maintain strength and plyometric to improve power.

Performance Analysis – Technical Component

Standing start

A standing start is used in the Team Pursuit, Omnium (250metre flying lap time trial, 4km pursuit, 500m time trial), Team Sprint and the Individual Pursuit. If you are the leading rider at the start (on the inside on the start line) you are held by a starting gate in Team races, the team's time is taken from the lead bike.

<u>Preparation</u> – The position adopted when being held. By leaning back more power is able to be generated by your legs when you drive forward, throwing your body forward, putting as much power as possible through the pedals.

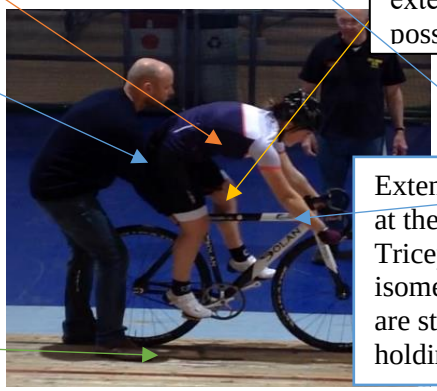


The cyclist's back is flat to be streamlined. The rectus abdominals are contracting to support the back.

Almost full extension at both knees. The Quadriceps contract isometrically to hold the position.

The muscles contract isometrically.

being held up by a person not a machine means full leg extension isn't possible



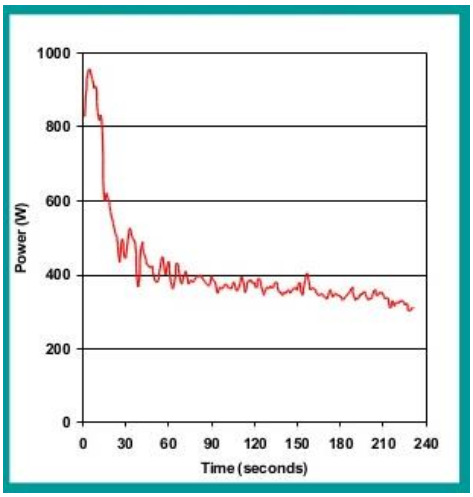
In the low position a greater degree of anterior rotation of the pelvis and less spinal flexion is required. When the Pelvis rotates the Hamstrings and Gluteal muscles are lengthened to be in the best starting position.

Extension of the arms at the elbows. The Triceps contract isometrically and wrists are straight with hands holding the bars.

<u>Anaylysis</u>

From looking at the athlete in the picture above you can see that they are in the perfect starting postion to give them the maximal advantage when the race starts. They are fully leant back, arms and legs are extended and head is low facing forward. Comparing the athlete to my preperation stage it shows that I need to be in a lower postiton. By droping my ankles down this will result in getting a lower body position and further extention in my legs.

<u>Execution</u> - When a cyclist explodes out at the start, driving their legs with all of their power going through the pedals. After 2-3 revolutions they should be at peak power, however this is not held for very long.



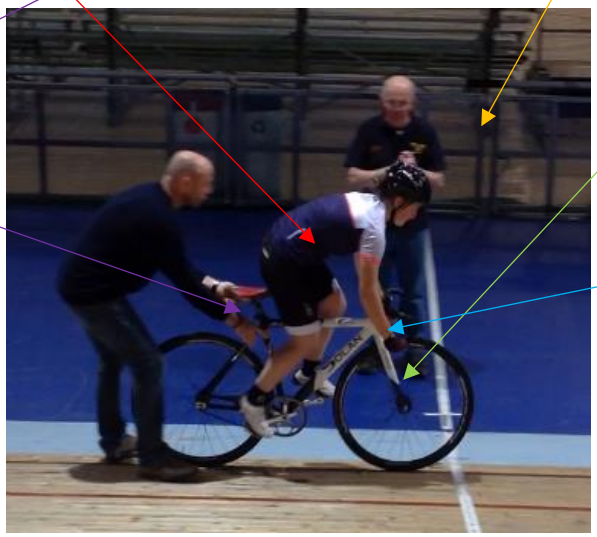
This graph shows the power output produced by a cyclist during the execution. Showing how quickly the peak power drops after a short time.

Biceps and Triceps Brachii are working antagonistically to create a push and pull action with the use of class 3 lever system to increase power

Upper body over the handlebars to assist with forward momentum.

The cyclist pulls up on the pedals as well as pushing down from the soleus, gastrocnemius and tibialis anterior contracting isotonically causing the ankle to be plantar flexing

Quadriceps and Hamstrings work antagonistically to create momentum to move forward with isotonic



The Hamstrings and Quadriceps are working over a small range of their total length meaning the knee isn't at full extension at a degree of 160 (when out of seat) depending on the flexibility of the hamstring

This stage uses Newton's 3rd law of every reaction has an equal and opposite reaction

Analysis

The cyclist above is showing a good example of the execution part. Their shoulders are over the bars and arms in a strong position working antagonistically. This means they are able to get the maximal amount of power from their legs. There ankle is also above the toes meaning they are pulling up on the pedals to maximise the amount of power and speed through each revolution. Comparing it to my execution I need to be further forward when leaning on the bike. This will help to maximise the amount of power I am able to produce in the first few revolutions creating a forward momentum.

During the race

The cyclist is sitting in the seat and has a balanced power output. The upper body should be low down to be as aerodynamic as possible. The elbows are tucked in and wrists and forearm are inline, not rolling in.

Soleus, Gastrocnemius and Tibialis Anterior contract isotonically.

The cyclist's shoulders are flat, there is no upper body movement.

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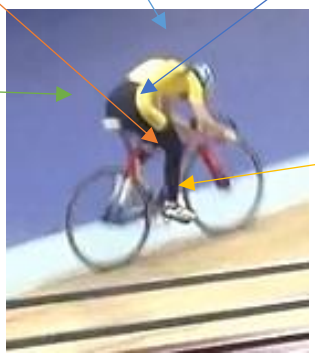
Quadriceps and Hamstrings work antagonistically to create power with isotonic contractions

Upper body is flat and head low to be streamlined.

The cyclist's head is down, looking at the wheel to be more aerodynamic.



Foot is between a 10-20 degree angle, engaging the Gastrocnemius and Soleus as well as the Quadriceps.

Analysis

The athlete is in a perfect aerodynamic position. Their body is low and shoulders are both flat showing that there is no lateral movement of the upper body. Their elbows are tucked in and not sticking out and wrists are not rolling into the bars although they are tucked in and their head is low they are still looking forward down the racing line. Comparing my position to this athlete it shows

that although am in a low position, I need to have a flatter back. This will mean that there will be less air resistance due to having a smaller total surface area of the body showing from a head on view.

Coach's feedback

Olivia's choice of power, speed and maximal strength in my eyes are those that are most important for her when competing in her disciplines on the track. Cycling (especially sprint events) are all about the maximal amount of power you can apply equalling to the best speed you can get. These tests done then indicate areas in need of improvement and for her this area would be speed. The technical component chosen is one that we are always looking to improve, from our body position, reaction time and how quick we can get to speed. Where she has compared herself to top athletes she can see the areas that need improvement and then can apply herself to learn/produce the best starts possible. – Tim Ferguson

Overall analysis

Comparing my performance of the different stages of a standing start compared to the elite athlete it shows that I need to make improvements in each stages to improve my standing start execution. In the preparation stage I need to have a flatter back and slightly extend my legs further. This we give me the greatest advantage from the start before even starting my race. To improve the execution stage I need to be further over the bars meaning that I will have more forward momentum and due the angle of the body I will get maximal amount of power out of my legs. Finally, to improve my recovery stage I need to have a flatter back creating a more streamline position which will mean that I will have a greater speed. Improving my core stability will help with all stages as I will be able to hold a lower position without putting strain on my lower back, as well as illuminating any upper body movement.

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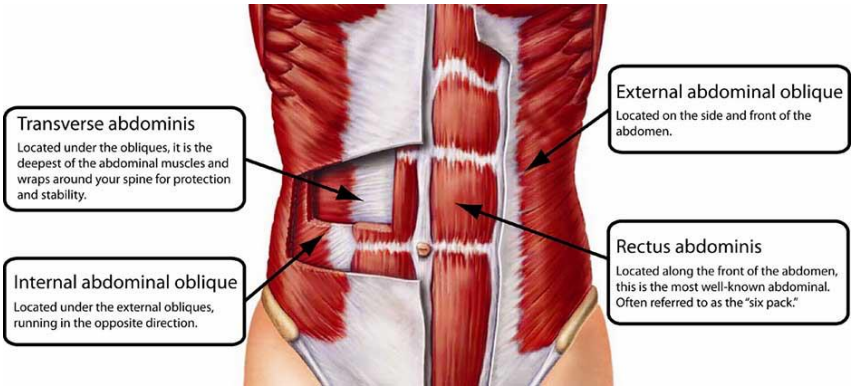
Performance Development Programme – Track Cycling

Improving power - planning

Introduction

This performance development plan is designed to improve power. Power is 'the ability to exert a maximal force in as short a time as possible' (19). I shall also improve core stability which although not my weakest component in my Performance Analysis, if I can improve these even more then it will help to improve other components such as speed. 'The action of riding a bike requires cyclists to generate force to turn the pedals, and to withstand the forces acting on their body caused by the

peddling action.' (12) 'During exercise, there are primary movers and stabilizer muscles. The primary movers are the muscles doing the majority of the work—they're what's moving the load and they're likely where you'll feel the exercise the most. While the stabilizer muscles aren't directly involved with moving the load, they work to keep certain parts of the body stable and steady so the primary movers can do their jobs efficiently.' (20) These stabilizers are the transversus abdominus, hence why I have chosen to improve core stability.



Coach's comment: 'The core muscles, abs and lower back, are the foundation for all cycling movement, including the pedal stroke. Without a strong and stable core, leg strength cannot be used efficiently. A solid core helps eliminate unnecessary upper body movement, enabling maximum energy to go into a smooth pedal stroke. While cycling relies on core strength it does not build it. This requires specific exercises.'

When planning this training program, I will apply the SMARTER principles of training to be able to get the best results over the 8 weeks. 'SMART goal setting creates verifiable trajectories towards a certain objective, with clear milestones and an estimation of the goal's attainability' (11)

The introduction of the original SMART goals came in 1981. Since then there have been different variations but now it is SMARTER goals after the Smartest Goals Formula in 2010 was created, 'Smart goals plus the best of the latest cutting edge research into how high achievers set their goals' (10)

Specificity – training must be specific to what you want to improve in your sport. I will combine weight training and plyometrics to develop my power. I will also include core stability work so that no power from the legs is lost by any upper body movement.

Measurable – I will be able to collect and show data so I am able to analyze it showing the improvements that have come from my training. I will be able to do this from my fitness test results that I will do before beginning this plan.

Achievable – training needs to result in you achieving what you wanted to at the start. for me this is to improve my power and core stability. This will be achievable as it will be within my capabilities.

Realistic – your training needs to push you but at the same time needs to be realistic to what you can do. Each week my training will gradually increase intensity/duration however will not exceed an intensity I'm not able to reach or sustain.

Time bound – your training needs to fit into the time that you have but you also need to be able to achieve your goal in that time. For this plan we have 8 weeks therefore my training during this time will have to be efficient enough for me to meet my goals.

Exciting – this training program needs to be designed so you do not get to a point where it becomes boring or repetitive. Having a mix of both bike and off bike work will mean that it won't be the same every week.

Recorded – results are collected so that you can view improvement and progression. I will compare my results from the start and the end and I will also be able to see each week whether or not I'm improving from the bike data.

Principles of training

'By using the principles of training as a framework we can plan a personal training programme that uses scientific principles to improve performance, skill, game ability and physical fitness.' (9)

Progressive overload – this is when 'The load must be progressively increased in order to further adaptive responses as training develops, and the training stimulus is gradually raised.' (21) I will apply progressive overload with the weights that I use to gradually increase my power without causing injury i shall also do this with duration and reps during plyometric training. You can see from the session plans (appendix 7 - 14)

F.I.T.T principles –

- **Frequency –** the 8 sessions will be done over 8 weeks equaling to one per week
- **Intensity –** the intensity of my training sessions will gradually increase each week. I shall use Borg Ratings to track how I find them as they increase
- **Time –** my session on the bike shall be longer than other training but on average they will be 40 minutes to an hour
- **Type –** the type of training that will be used is plyometric, core stability as well as specific bike training. This will be done in interval and fartlek. (see appendix 7 to 14 for training sessions)

Specificity- 'the exercise must be specific to the type of strength required, and is therefore related to the particular demands of the event.' (22) The use of plyometric training will increase my muscular power due to the eccentric muscle contractions isotonically. This then will train the muscle fibres that I have to be more explosive.

Reversibility - 'When training loads are reduced or removed completely, the state of fitness or performance returns to a normal untrained state' (13). Research has shown that the process begins within 5 days of stopping training, therefore at the end of the 8 weeks I shall carry on training to prevent this from occurring.

Individual needs - these 'are personal fitness needs based on age, gender, fitness level and the sport for which we are training. A successful training programme will also include exercise in the correct heart-rate target zone.' (23) It is important that this plan has my individual needs taken into account for the best results to come of it.

Variance - having variance in this plan prevents tedium. This is defined as 'training that lacks variety and causes boredom' (14). By using different methods of training (plyometric, interval, circuit) this will create variety within the plan preventing boredom and a lack of motivation.

Over-training - 'when the intensity of training and or volume of training are increased to extreme levels, and there is a lack of recovery within or between training sessions leading to an associated decline in physiological function' (15). To prevent fatigue and loss of performance it is important that enough rest has been had. Progressive overload should also aid this so you don't do too much, too quickly.

Planned methods of training

I will use plyometrics as well as core stability in interval and circuit training. I will also do specific training on a static bike meaning that I will have up to date data on if my power is improving each week. I will do this by doing fartlek as well as short intervals. I will use both body weight exercises as well as weighted (resistance).

Currently I train 6 days a week. Four are specific bike sessions either on the road or indoors with one of them being on the velodrome. I also do double days occasionally where my first session would be a base session of 'steady miles'. The two others are strength work. This performance development plan will supplement my training by improving the parts highlighted in specific ways.

I will use Karvonen formula to work out training zones so I can then apply this to training. **'**Target Heart Rate = ((max HR − resting HR) × %Intensity) + resting HR example' (8)

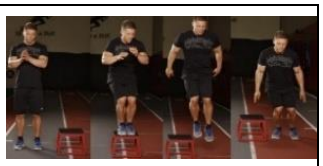
60-70%	144 – 158 bpm
70-80%	158 – 173 bpm
80-90%	173 – 187 bpm
90-100%	187 – 202 bpm

With each training session I will use the Borg Scale to rate its intensity due to how I feel. When training on the bike I shall use heart rate zones determined by functional threshold heart rate (FTHR) along with power zones. (See appendix 1,2, &3)

The standard exercises will be:

Plyometrics

Exercise	Explanation	Primary muscles	Secondary muscles	Picture
Box jump	'Stand in an athletic position, with your feet shoulder-width apart, at a comfortable distance from the box. When you're ready to jump, drop quickly into a quarter squat, then extend your hips, swing your arms, and push your feet through the floor to propel yourself onto the box.' (1)	Quadriceps	Hip flexors, Gluteus Maximus , Hamstring, Gastrocnemius, Soleus	
Blast off lunge	'Bend both knees and lower until your back knee barely touches the floor, then explode upward and about a foot to the side, landing softly in the same lunge position and going right into the next repetition' (2)	Quadriceps	Hip flexors, Hamstring	

Lateral box jump	'dip into a quarter squat… and immediately reverse direction to up and to the other side…land softly using your legs to absorb impact' (3)	Adductors	Quadriceps, Gluteus maximus, Gastrocnemius, Soleus	
Frog hop	'Jump forward several feet, avoiding jumping unnecessarily high. As your feet contact the ground, absorb the impact through your legs, and jump again' (4)	Quadriceps	Gluteus maximus, Hip Flexors, Soleus, Gastrocnemius	

I have adapted my set strength exercises into plyometric movements meaning you contracting the same muscles but in different ways. A box jump is in replace of a squat, blast off lunge replacing a Bulgarian split squat, lateral box jump replacing side lunge and frog hop replacing a weighted step up.

Core stability

Exercise	Explanation	Primary muscle	Secondary muscle	Picture
Plank	'Place elbows directly under shoulders and keep forearms parallel. Bring in your core muscles by sucking in your stomach. Lift up on to your toes creating a straight line through shoulder, hip, knee and ankle joints.' (5)	Rectus abdominis	Transversus abdominis, Anterior and Posterior Deltoids	
Russian twist	'Sit with knees bent and feet flat on the floor slowly leaning back from the hip until you feel your abs tighten. Rotate your hands to the left, holding hips square and then return to center before repeating on the other side.' (6)	Rectus abdominals, External and Internal Obliques	Deltoids, Erector spinae	
Leg raises	'Lay flat on your back with arms either by your side or under your lower back for support. Then raise your legs up keeping your back flat.' (7)	Hip flexors, Rectus Abdominal	Oblique's, Quadriceps	

Repetitions and time will depend on which session is being done (see appendix). With each week it will gradually increase.

Testing

My first set of tests test power in my legs however they are not specific to cycling. These tests are easy to complete and little equipment is needed. Although they are jumping tests they are still testing the explosive power from my legs. (See appendix for protocols of broad jump and vertical jump test and normative data)

Coach's comment: 'The jump tests measure the outcomes of explosive power and leg muscle power actions. The Wattbike test measures a cyclist's highest peak power. Power related tests provide hard data to measure short and long term trends in performance.'

Test	Fitness component	Result	Rating
Broad jump	Power	198	very good
Vertical jump test	Power	39	Below average
Plank test	core stability	4min 52sec	very good

The other tests will be conducted on a bike making it specific to my sport. I will do the test on a Wattbike meaning that all of my power data will be in front of me and it is more reliable as there is no human error. (see appendix 6 for protocol)

Validity - both the broad jump and vertical jump test are both valid due to them testing the maximal force you can exert with your legs.

Reliability - for both of these tests to be reliable I used the same equipment, facilities and time of day to undergo the testing at the start and the end.

Test	Fitness component	Result	Rating
6 second peak power	Power	997	Average

Validity - this test is valid because it is done on a Wattbike meaning it is specific to cycling. It relies on you cycling as fast and hard as possible from a static start for 6 seconds.

Reliability - for reliable data to be produced at the start and end of this plan, the same equipment needs to be used as well as using the same resistant's on the bike. I also had the same coach to assist this test.

Results

Test	Past result/rating	New result/rating	Improvement
Broad jump	198 – very good	200 - very good	2cm
Vertical jump test	39 – average	43 - above average	4cm
6 second peak power	997 – average	1098 - excellent	101 watts
plank test	4min 52sec - very good	5min 24sec - very good	32 seconds

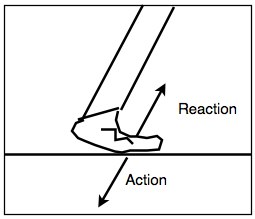
Coach's comment: 'The peak power test (Wattbike) is a significant improvement (10%) over a relatively short period of time and an indication of the effectiveness of the training programme that has been followed.'

Review and Evaluation

After completing the 8-week training plan I repeated the tests to see if any improvements were made. As you can see from the results I improved in all of the tests. This shows the effectiveness of this program and that I met my achievable goals of improving power and core stability.

This improvement of power was a 10% improvement meaning that this program was extremely affective for a short period of time. This is also recognized and backed up by my coach. This improvement of power will come from the combination of weight training, plyometrics and specific cycling sessions.
Weight training would have created muscular hypertrophy and the plyometric training would have increased the amount of fast twitch muscles fibers. Both of these improvements combined resulted in more power being generated through my legs.

This is also the same for both the broad and vertical jump test. My results for both of these tests have improved, again showing the quality of this program. Although these tests art specific to cycling (on a bike) they are still testing the explosive power in my legs. When jumping you create maximal force pushing down to propel yourself forward.



This action is then mimicking you pushing down on the pedals when cycling. This then can be applied to Newton's 3rd Law of Motion: for every action there is an equal and opposite reaction. The improvement of 32seconds for the plank test also shows that the training done over 8weeks for core stability was effective.

With all 4 tests having improved results, it shows that this 8-week Performance Development Plan was effective in that I improved in both areas that I set out to improve. With these improvements it will then help to better my performance on the track.

From this plan and results I can now build on to it, further improving my power, core stability as well as general performance on the bike. To improve further, progressive overload will continue to be applied. By doing a threshold test on the bike I will have more up to date zones to follow. This is because with the increased power my zones will change. This may also result in my heart rate zones changing. Having a tapering week may be beneficial before training with increased zones. This will give my muscles enough time to fully recover and repair and build muscle fibers.

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18) https://cdn.wattbike.com/uploads/uk/file_manager/6s-test.pdf

19) https://www.topendsports.com/fitness/power.htmAppendices

20) http://www.stack.com/a/stabilizer-muscles-what-they-are-and-why-theyre-so-important

21/22) https://www.brianmac.co.uk/trnprin.htm

23) http://www.bbc.co.uk/schools/gcsebitesize/pe/exercise/1_exercise_principles_rev1.shtml

24) https://www.topendsports.com/testing/tests/plank.htm

Appendix:

Wingate test protocol:

- The assistant weighs the athlete (kg)
- The athlete warms up for 10 minutes
- The assistant calculates and records the flywheel resistance required as follows:
    - Athlete's weight x 0.08
- On "GO" the assistant starts the stopwatch and the athlete pedals as fast as possible with no flywheel resistance
- After 3 seconds the assistant applies the calculated flywheel resistance and the athlete continues to pedal as fast as possible until 30 seconds has elapsed
- After 30 seconds the athlete stops pedalling and the assistant records the flywheel revolutions for each 5 second interval of the test" (2)

Normative data:	Male	Female
%Rank	Watts	Watts
90	822	560
80	777	527
70	757	505
60	721	480
50	689	449
40	671	432

30 656 399

Leg press test protocol:
“This test requires the athlete to complete as many leg presses as possible with no rest.

- The assistant weighs and records the athlete's weight
- The athlete warms up for 10 minutes
- The assistant loads the bar bell with a weight close to the athlete’s one repetition maximum load.
- The athlete conducts leg presses until they are unable to continue
- The assistant counts the number of successful leg presses
- If the number of leg presses exceeds 8 then the athlete rests for 10 minutes, the assistant increases the barbell weight and the athlete repeats the test
- The assistant uses the maximum load calculator to determine the athlete's 1RM” (9)

Session 1	Session type – plyometric + core	Borg rating 13
Warm up	2min jog with 30m sprint finish Dynamic stretching Static stretching	
Main activity	40 second work 20 sec rest X5 with 2 min rest same exercise repeated twice – repeated 4 times - Frog jump - Blast off lunge - Box jump - Frog jump - Box jump 1min rest then 2 min plank core = 20sec work 10 sec rest - Russian twist - leg raises (5kg) - knee touches - leg raises (5kg) - Russian twist	
Cool down	5min static stretching	
Heart rate		
Session 2	Session type – bike (sweet spot intervals)	Borg rating = 15
Warm up	5 min 90 rpm – 2min 95rpm – 2min 100rpm – 2min 105rpm – 1min 30sec 110rpm – 30sec 120-130rpm – 2min 90rpm – 6sec max – 1min 90rpm – 6sec max – 1min 90rpm – 6sec max – 2min 45sec 90rpm	

Main activity	5 minutes **Sweet-Spot** 90 + rpm during the efforts PZ 88-93% FTP 1 minute **Easy** 5 minutes **Sweet-Spot** **around 90% of threshold power** 1 minute **Easy** 3 minutes **Sweet-Spot** 1 minute **Easy** 3 minutes **Sweet-Spot** 1 minute **Easy** 3 minutes **Sweet-Spot** 1 minute **Easy** 3 minutes **Sweet-Spot** 1 minute **Easy** 3 minutes **Sweet-Spot**	I used a medium resistance/gear that allowed me to maintain spinning easily against minimal resistance for the recoveries. **Zones:** Efforts should be in Sweet-Spot HRZ high 3 - low 4 / **The term sweet-spot is an intensity of training that is**
Cool down	10 minutes easy spinning – in an 'active' recovery	
Heart rate		

Session 3	Session type – plyometric + core	Borg rating 15	
Warm up	2 min jog 3min – dynamic stretching - hip stretch with a twist, high kicks, lunges 1min – static stretches - sitting toe touch, leg extender, lunge, side lunge, shoulder/back stretch		
Main activity	box jumps 40sec work 20sec rest frog jump 40 sec work 20sec rest blast of lunge 40 sec work 20sec rest squat jump (10kg) 40sec work 20 sec rest single leg jump 40sec work 20 sec rest 3 sets with 3 min rest between Plank held for 1min Russian twists 6kg 1min Leg raises 1 min 2 sets 1 min rest between		
Cool down	4min bike 1min static stretching - sitting toe touch, leg extender, lunge, side lunge		

Heart rate	

Session 4	Session type – under overs	Borg rating 16	
Warm up	Ramp up in 6 steps 5min @ 90 W Zone 1 90 RPM - 2 min @ 110 W Zone 1 95 RPM - 2 min @ 130 W Zone 2 100 RPM -2 min @ 150 W Zone 2 105 RPM - 1:30 @170 W Zone 3 110 RPM - 30 sec @ 200 W Zone 4 120 RPM+		
Main activity	Cadences for both efforts should be above 90 rpm. Under efforts should be 90% of FTP/FTHR, over efforts should be 110% FTP/FTHR. Pace the efforts as accurately and consistently as possible. Keeping resistance and cadence constant.		
Cool down	10min zone 1		
Heart rate			

Session 5	Session type - v02 efforts	Borg rating 15	
Warm up	WU R – 10min		
Main activity	5min @ threshold – 5min@ Z1 3min @ threshold – 3 min @ Z1 X6 (zone 5 = threshold) 10min @ Z1 4min @Z5 – 4min @ Z1 X4		

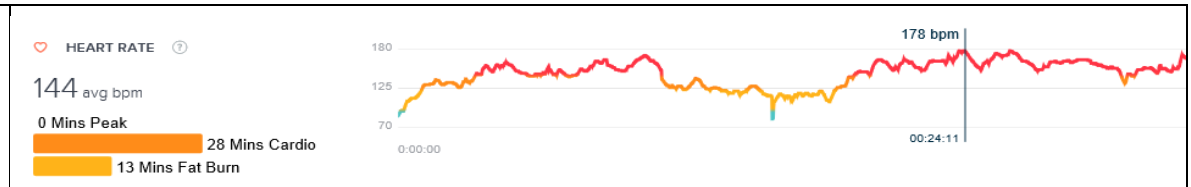
Cool down	10 min zone 1
Heart rate	

Session 6	Session type – plyometric + core	Borg rating 16	
Warm up	5min steady jog including high knees, heal flicks, leg swings, cherry picking 2min dynamic stretching		
Main activity	1min – box jump 1min – blast off lunge 1min – box jump 1min – lateral box jump 30sec rest 1min – plank 1min – Russian twist 1min – plank 1min – leg raises 30 sec rest X4		
Cool down	10 min static stretching		
Heart rate			

Session 7	Session type – 3x10 minutes (bike)	Borg rating: 13	
Warm up	5 min 90 rpm – 2min 95rpm – 2min 100rpm – 2min 105rpm – 1min 30sec 110rpm – 30sec 120-130rpm – 2min 90rpm – 6sec max – 1min 90rpm – 6sec max – 1min 90rpm – 6sec max – 2min 45sec 90rpm		

Main activity	10 minutes sweet spot **The term sweet-spot is an intensity of training that is around 90% of threshold** 10 minutes active recovery 10 minutes sweet spot 10 minutes active recovery 10 minutes sweet spot
Cool down	10 min cool down – this is at an 'active recovery' state 10 min static stretching and foam roller. A foam roller is an ergogenic aid used to aid recovery and prevent DOMS.
Heart rate	

Session 8	Session type - plyometric + core	Borg rating 17	
Warm up	3min steady jog 1min of high knees, heal flicks, cross overs 1min static stretching		
Main activity	box jumps 40sec work 20sec rest frog jump 40 sec work 20sec rest blast of lunge 40 sec work 20sec rest squat jump (20kg) 40sec work 20 sec rest single leg jump (10kg)40sec work 20 sec rest 3 sets with 2 min rest between lateral box jump 40sec work 20sec rest Plank held for 1min Russian twists 6kg 1min Leg raises (6kg held between feet) 1 min 2 sets 1 min rest between		
Cool down	4 min of static stretching		

Heart rate	

(1)

Rating of Perceived Exertion Borg RPE Scale		
6 7 8 9 10 11	Very, very light Very light Fairly light	How you feel when lying in bed or sitting in a chair relaxed. Little or no effort.
12 13 14 15 16	Somewhat hard Hard	Target range: How you should feel with exercise or activity.
17 18 19 20	Very hard Very, very hard Maximum exertion	How you felt with the hardest work you have ever done. Don't work this hard!

(2)

	Power (Watts)		
Power Zone	Low end zone		High end zone
1 .. Active Recovery		<	75
2 .. Endurance	75	to	104
3 .. Tempo	104	to	123
Sweet Spot	120	to	127
4 .. Threshold	123	to	143
5 .. VO2 max	143	to	164
6 .. Anaerobic capacity	164	to	205
FTP (Watts)	137		
Power to Weight (Watts per Kg)	2.21		

(3)

	Heart rate (Beats per minute)		
HR Zone	Low end zone		High end zone
1 .. Active Recovery		<	123
2 .. Endurance	123	to	151
3 .. Tempo	151	to	171
4 .. Threshold	171	to	191
5 .. VO2 max	191	to	220
6 .. Anaerobic capacity	N/A		N/A

(4) **broad jump protocol**

The athlete stands behind a line marked on the ground with feet slightly apart. A two-foot take-off and landing is used, with swinging of the arms and bending of the knees to provide forward drive. The subject attempts to jump as far as possible, landing on both feet without falling backwards. Three attempts are allowed. (16)

Gender	Excellent	Above average	Average	Below average	Poor
Male	>65cm	50 - 65cm	40 - 49cm	30 - 39cm	<30cm
Female	>58cm	47 - 58cm	36 - 46cm	26 - 35cm	<26cm

(5) **vertical jump test**

the athlete stands side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. This is called the standing reach height. The athlete then stands away from the wall, and leaps vertically as high as possible using both arms and legs to assist in projecting the body upwards. Attempt to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height is the score. The best of three attempts is recorded. (17)

	males		females	
rating	(inches)	(cm)	(inches)	(cm)
excellent	> 28	> 70	> 24	> 60
very good	24 – 28	61–70	20 – 24	51–60
above average	20 – 24	51–60	16 – 20	41–50
average	16 – 20	41–50	12 – 16	31–40
below average	12 – 16	31–40	8 – 12	21–30
poor	8 – 12	21–30	4 – 8	11–20
very poor	< 8	< 21	< 4	< 11

(6) **6second peak power**

From the Main menu select workout/Tests and then Tests – the Tests screen appears. Select Peak Power 6" Test then input rider Weight, Gender, Countdown length and Bike model. Press ENTER to continue.
The WPC will recommend settings based on the inputs from previous screens. Pressing ENTER will start a countdown. The monitor is set at 6". The live display will show each pedal revolution, the peak power achieved and a live graph build up with the time counting down.

Categories	Peak power (W)	Peak power (W/kg^{-1})	Anaerobic capacity (W)	Anaerobic capacity (W/kg^{-1})
Elite	>1,163	>13.74	>823	>9.79
Excellent	1,092–1,163	13.04–13.74	778–823	9.35–9.79
Above average	1,021–1,091	12.35–13.03	732–777	8.91–9.34
Average	880–1,020	11.65–12.34	640–731	8.02–8.90
Below average	809–879	10.96–11.64	595–639	7.58–8.01
Fair	739–808	9.57–10.95	549–594	7.14–7.57
Poor	<739	<9.57	<549	<7.14

(7) **plank test**

The aim of this test is to hold an elevated position for as long as possible. Start with the upper body supported off the ground by the elbows and forearms, and the legs straight with the weight taken by the toes. The hip is lifted off the floor creating a straight line from head to toe. As soon as the subject is in the correct position, the stopwatch is started. The test is over when the subject is unable to hold the back straight and the hip is lowered. (24)

Rating	Time
Excellent	> 6 minutes
Very Good	4–6 minutes
above average	2–4 minutes
Average	1–2 minutes
below average	30–60 seconds
poor	15–30 seconds
very poor	< 15 seconds