

Chapter 4 INTENSITY

Every time I suffer I'm a better man because of it.
-- LANCE ARMSTRONG

Recreational Cyclists generally believe that the more miles they ride the better they will race, regardless of what they do with those miles. To some extent they are right, as there does seem to be a threshold of miles or hours that a given athlete must ride in order to boost fitness to a sufficient level to race well. But once beyond that threshold, adding more miles has less benefit than increasing the intensity. It's not how many miles, but what you do with the miles that counts most.

Of the three elements of training – frequency, duration, and intensity – the most important element to get right is intensity. Oddly enough, this is the part cyclists all too often get wrong. Most train too intensely when they should be going easy. Then when it's time to go fast they are a little too tired to push their limits. As a result, all of their training becomes moderate. They race the same way: Stay with the pack until it's time to put the hammer down. Then they're off the back wondering how they got there.

In the context of this chapter, intensity refers to the effort or power output that closely simulates that of the A-priority events for which you are training. For a road race or criterium this may be a wide variety of intensities including steady efforts near lactate threshold while in a fast-traveling group, aerobic capacity intensities for several minutes while chasing down a break, or an all-out intensity for sprinting. For a time trial, century ride, or ultra-marathon the intensity will be much more narrowly defined. The intensity necessary to produce peak fitness must be well defined in order to create a sound training program.

Developing peak fitness is like building a house. The most important part of the house is its foundation. Without a solid foundation the house will settle, walls will crack, and it will have little value. If the foundation is constructed well, the house will be solid and last a long time. The same can be said of training to race. A solid foundation

第4章 强度

每次受苦的经历都使我成为更棒的人。
——LANCE ARMSTRONG

休闲派的车手一般认为他们骑得距离越长，比赛时的表现就会越好，至于应该怎么骑就不管那么多了。从某种程度上说这也没错，因为对任何一个车手来说，的确存在这么一个骑行里程和时间的门槛，只有达到这个门槛后才能获得比赛所需级别的身体素质。但是跨过这个门槛之后，增加更多的骑行里程所获得的好处却远不如增加强度效果好。所以说关键不在于骑多远，而在于怎么骑。

训练三要素——训练频度，持续时间和强度——其中最需要搞清楚的就是强度。但说也奇怪，车手们最容易搞错的也是强度。很多的训练课都在需要轻松的时候太大强度，而到了需要骑快的时候又因为太疲劳了而无法冲击其生理极限。结果是他们的训练变得稀松平常，而比赛也是一样：待在大部队里面直到无法跟住领骑集团，接着他们竞争名次的希望完全破灭，但自己也莫名其妙这一切是怎么发生的。

在本章中，强度的定义是在训练中模拟你准备参加的A级赛事所需要的功率输出及其费力程度。对于公路赛或者绕圈赛来说强度的范围可能比较广泛，包括跟上快速队伍时所需的接近乳酸极限阈值的稳定出力，追上前面队伍时所需的持续几分钟的有氧范围的出力，或者冲刺时的竭尽全力的强度。对于计时赛，百英里赛或者超长马拉松赛来说，强度定义的范围会窄很多。为了制定出好的训练计划，你必须精确地定义为达到颠峰状态所需要的强度。

塑造颠峰状态的过程有点象造房子。房子最重要的部分是地基。如果地基不稳房子就会下沉，墙会裂开，也就无法住人了。如果地基建得好，房子就会很稳固。为比赛所做的训练也是同样道理。轻松骑行的里程数是坚实的地基，你必须先完成这些，然后才能做进一步

built on a base of easy miles is necessary before the finish work – intervals, hill repeats, and fast group rides – is added. But once the foundation is well established, workouts that mimic the intensities expected in the race pay dividends. Do these same intense workouts too soon and your house will shift and crack.

Another training comparison that has stood the test of time is that of a pyramid. The broader the base of the pyramid (easy aerobic training), the higher the peak will be (fast racing speed).

The c is that high-intensity training needs to be undertaken with thought and planning in order to peak at the right times of the year. Too much, too soon and you won't be able to maintain the fitness. Too little, too late and you're off the back.

Learn to apply the intensity concepts in this chapter and you'll avoid overtraining and undertraining; your racing fitness will be high when the time is right.

Measuring Intensity

What's going on inside a cyclist's body during a race or workout? How does a rider know to go faster or back off during a time trial? Is a workout too hard or too easy? How is it possible to finish with enough left for a sprint?

The answers to these and other questions come down to keeping close tabs on your use of energy. By measuring intensity and comparing the information with what you have learned about your body in training and racing, you can make decisions as new situations such as breakaways, head winds, and hills occur. Today's technology allows an athlete to measure intensity quickly and accurately.

The oldest, and still one of the best, gross indicators of intensity is perceived effort. An experienced cyclist is able to judge his or her intensity quite accurately by taking a subjective survey of the entire body at work. This is a skill honed by years of riding, making mistakes, and relearning as fitness changes.

的练习——如间歇训练，重复爬坡，快速的小组骑行。如果地基已经完全建好了，进行模拟比赛强度的训练能带给你额外收获；但是如果地基还不牢就太早地开始这样强度的训练的话，你的房子就会倒塌。

另一说法把训练比喻成金字塔的建造。金字塔的底边越大（轻松的有氧训练），顶尖就可以造地越高（比赛时更快的速度）。

总的来说，高强度训练需要有目的有计划地安排从而在合适的时间达到高峰状态。安排地太多或太早都使你无法在比赛中保持高峰状态，若太少太迟的话会让你失去竞争力。

从本章中学会强度的概念以及如何运用，你就能避免过度训练或训练不足；你也会在合适的时候达到比赛所需的颠峰状态。

测量强度

在比赛或训练中车手们的身体里到底发生了什么？在计时赛中他们怎么知道何时该加速何时该放慢呢？这次训练是太累了还是太轻松了？怎样才能在最后冲刺之前留出足够的体力呢？

对这些问题的回答都可归结为密切监视你是怎样使用能量的。通过测量强度，并对比你的身体在训练和比赛中提供给你的信息，你就能在诸如突围，顶风或爬坡等新情况发生时做出正确决定。今天的科技已经能够让运动员快速准确地测量强度了。

最古老，也是最有效的综合测量强度的方法之一是个人感知发挥。一个经验丰富的车手能够通过对他或她的身体工作状态的主观感受，非常精确地判断出骑行的强度。这是通过年积月累的骑行，犯错误以及对身体素质变化的再认识逐渐磨砺出的一种技能。

Perceived exertion is quantifiable using the Borg Rating of Perceived Exertion Scale (see Table 4.1) and is frequently used by scientists to determine at what level an athlete is working. Some athletes are so good at using a Rating of Perceived Exertion (RPE) that in a laboratory graduated-effort test they can pinpoint their lactate threshold precisely just from feel.

个人感知发挥可以参考 Borg 分级表来量化（见表 4.1），科学家经常使用这个个人感知发挥度分级表来确定运动员的出力级别，简称 RPE。有些运动员对 RPE 使用得如此娴熟，以至于在实验室的递增出力试验中他们能够仅凭感觉精确地指出他们的乳酸盐极限阈值。

There are two other ways of measuring intensity that are related more or less to specific systems of the body. Heart rate is closely aligned with monitoring of the cardiovascular system, while power measurement relates closely to the ability of the muscular system to drive the pedals. Let's see how these and other methods can be utilized in measuring training and racing intensity.

除此之外还有两种测量强度的方法，都和某些身体系统有或多或少的联系。心率与心血管系统的监测紧密相关，而测量功率紧密关系到肌肉系统驱动踏板的能力。下面我们将看到这些方法是如何测量在训练和比赛中的强度的。

目标	等级	出力程度的感觉
恢复	6	非常非常轻松
恢复	7	
恢复	8	
恢复	9	非常轻松
有氧运动	10	还算轻松
有氧运动	11	
有氧运动	12	
快速骑行	13	有点费力
快速骑行	14	
接近乳酸阈值骑行	15	费力
接近乳酸阈值骑行	16	
超出乳酸阈值骑行	17	非常辛苦
培养有氧能力	18	非常非常辛苦
培养有氧能力	19	
培养有氧能力	20	

Table 4.1 Borg Rating of Perceived Exertion Scale

表 4.1 Borg 的个人感知发挥度分级表

Systems

系统

The body is made up of several interconnected and mutually beneficial systems, such as the energy production, cardiovascular, and nervous systems. Regardless of what method of intensity measurement is used, you’re taking a peek into the body through a small systems window, but since the systems are linked, you can draw

构成身体的几个系统，例如能量供应系统，心血管系统，神经系统之间是内部耦合和相互作用的。不管采用什么方法来测试强度，你也只是通过一个很小的窗口窥探到身体系统的一角而已。但是因为系统之间的相互关联关系，你可以据此推测整个身体的状况，只要你拥有足

conclusions about the entire body once you have experience and knowledge. I'll help you with the knowledge part in this chapter; you'll need to acquire the experience by using what you learn here. The systems we can presently use to peek into the body while out on the road and the measurable indicator of each are:

- Energy production system – lactate
- Muscular system – power
- Cardiovascular system – heart rate

Energy Production System

The metabolic system provides fuel to muscles in the form of carbohydrates, fat, and protein. Within the muscle, these fuels are converted to a usable energy form called adenosine triphosphate (ATP). This process happens either aerobically or anaerobically.

Aerobic energy production occurs while you are riding easily. It relies primarily on fat and to a lesser extent on carbohydrates for fuel and uses oxygen in the process of converting fuel to ATP. The slower you go, the greater the reliance on fat and the more carbohydrates are spared. As the pace of your ride increases, there is a gradual shifting away from fat and toward carbohydrate as the fuel of choice. At high efforts, around 15 to 17 RPE, oxygen delivery no longer keeps up with the demand, and you begin producing ATP anaerobically, meaning "without oxygen."

Anaerobic exercise relies heavily on carbohydrates for fuel. As carbohydrates are converted to ATP, a by-product called lactic acid is released into the muscle. This causes the familiar burning and heavy-legged sensations you've experienced while riding hard. As lactic acid seeps through the muscle cell walls into the bloodstream, it gives off a hydrogen molecule and becomes lactate. Lactate accumulates in the blood and can be measured by taking a sample from the finger or earlobe. The unit of measurement used in labs is millimoles per liter, expressed as mmol/L.

Since carbohydrates are in use during both of these types of energy production, to a lesser

够的经验和知识。本章我所介绍的都是知识部分的内容，而经验部分你需要通过对本章内容的实践来获得。以下列举的是那些我们现在可以在骑车运动中窥测到的身体系统，以及测量的指示器：

- 能量供应系统——乳酸盐
- 肌肉系统——功率
- 心血管系统——心率

能量供应系统

代谢系统以碳水化合物，脂肪和蛋白质的形式为肌肉提供燃料。这些燃料在肌肉内部被转化为可被使用的能量形式，即三磷酸腺苷（ATP）。无论是有氧或无氧方式的供能都是如此的过程。

在你轻松骑行时发生的是有氧供能过程。该过程主要靠脂肪以及少量的碳水化合物供能并把这些燃料转化成 ATP。你骑得越慢，脂肪供能的比例就越大，碳水化合物消耗得也越少。随着你骑行节奏的提高，供能方式就慢慢地从由脂肪供能向碳水化合物供能过渡。当出力级别达到 RPE15—17 级时，氧气供应将无法代谢需求，于是你开始用无氧方式制造 ATP，即所谓的无氧运动方式。

无氧运动几乎完全依赖碳水化合物作为燃料，并且在转化成 ATP 的过程中同时产生一种叫做乳酸的副产品。乳酸进入肌肉组织以后，就造成我们所熟知的感觉，即在奋力骑行时感到的灼痛和大腿沉重感。乳酸从肌肉细胞内渗透出来进入血液后，它会释放一个氢离子变成乳酸盐。乳酸盐在血液中的堆积程度可以通过在手指和耳垂采集血液样本的方式来测量。实验室使用的测量单位是毫摩尔每公升（mmol/L）。

在以上两种供能方式中都需要使用碳水化合物，不过在有氧运动时使用得少些，而在

extent in aerobic and more so anaerobically, lactic acid is always being produced. Even while you are reading this book, your muscles are producing measurable amounts of lactic acid.

By measuring lactate, an athlete, or more than likely his or her coach, could determine – with some degree of accuracy depending on skill level and equipment used – several key aspects of fitness, such as:

- **Lactate threshold.** As previously described, this is the level of exertion at which metabolism shifts from aerobic to anaerobic marked by lactate being produced so rapidly that the body can't keep up with its removal. Lactate thus accumulates in the blood. I often explain lactate threshold using an analogy. If I slowly pour water into a paper cup that has a hole in the bottom the water will run out as fast as I pour it in. This is what happens to lactate in the blood at low levels of exertion. If I pour faster, there comes a point when the water begins to accumulate despite the fact that some is still leaking out through the hole. This is similar to the lactate threshold point that is achieved at higher levels of exertion. Lactate threshold is an important concept that will be used throughout this book.
- **Training zones.** Training and racing intensities may be determined based on lactate levels (see Table 4.2).
- **Physiological improvement.** The faster a rider can go or the more power that can be generated without accumulating high levels of lactate, the better his or her racing fitness.
- **Economy of pedaling.** The smoother one pedals, the less effort he or she uses, and therefore, the less lactate that accumulates in the rider's muscles.
- **Equipment selection.** Optimal crank arm lengths, saddle heights, and handlebar adjustments create a greater pedaling economy, which then produces low levels of lactate in the rider's muscles.
- **Recovery interval.** Reduced levels of lactate indicate that a cyclist is ready for the next work interval in a workout.

The key piece in achieving all of these

无氧运动时使用得多一些，并且都会产生乳酸。即使是在阅读本书时，你的肌肉同样会产生一定量的可以被测量到的乳酸。

通过使用仪器和技术测量乳酸盐，在一定程度上运动员或者他的教练就能够确定一些有关身体素质的重要指标，比如：

- **乳酸盐极限阈值：**前面曾经说过，这是指某种出力级别，在这样的强度下代谢系统从有氧方式转换到无氧方式，表现为乳酸盐的大量快速的产生以至于身体无法继续这种程度的运动。乳酸盐也会因此而在血液中堆积。我经常用一个比喻来解释乳酸盐极限阈值。当我慢慢地向一个底部有孔的纸杯子里倒水时，水流出的速度和我倒水的速度差不多。这就象出力程度较低时乳酸盐在血液中发生的情况。随着我倒水速度加快到某个程度时，杯子里的水就会堆积起来虽然这时仍有不少水从底部流走了。这就象出力程度较高以至达到乳酸盐极限阈值时的情况。乳酸盐极限阈值是个贯穿本书的非常重要的概念。
- **训练区间：**训练和比赛的强度可以基于乳酸盐水平来定义（见表 4.2）。
- **生理结构的进步：**在不会堆积高水平的乳酸盐的情况下，骑手的速度越快，或输出功率越高，那么他或她的比赛能力就越强。
- **踩踏效率：**每次踩踏越圆滑，耗费体力就越少，因而肌肉中堆积的乳酸盐也越少。
- **装备选择：**最优的曲柄长度，坐垫高度以及横把调整都可以产生更好的踩踏效率，也使骑手肌肉中制造的乳酸盐更少。
- **间歇恢复：**在每组间歇训练的恢复期间，乳酸盐降低的水平反映了骑手的恢复程度，以及是否为下一组间歇练习做好了身体上的准备。

要想达到所有这些目标，一个关键问题

benefits is the ability to accurately measure lactate in a "field" setting (using an indoor trainer or track) rather than a lab – in other words, inexpensively. Until recently, the only way to measure lactate was in a lab using an analyzer such as the YSI 2300, the accepted standard in the United States. Its size, expense, and the need for electricity, however, make it impractical for field use.

就是如何精确地在“外面”（如训练台或赛道上）而不是在实验室里测量乳酸盐——换句话说就是便宜的测量方式。前些年测量乳酸盐的唯一方式就是在实验室里使用分析仪，比如 YSI 2300，这是符合美国标准的仪器。但是该仪器体积大，价格高，并且需要电源，因而不适合在野外使用。

RPE	目标	乳酸盐 (mmol/L)
<10	恢复	<2
10-12	有氧运动	2-3
13-17	乳酸极限阈值	3-5
18-19	有氧能力	5-12
20+	无氧能力	12-20

Table 4.2 Lactate Zones

表 4.2 乳酸盐区间

In the past few years relatively inexpensive portable lactate analyzers have been introduced to the U.S. fitness market but these are not for the average rider's use. Using such a device requires extensive skill that comes only with the experience of sampling hundreds of athletes. The bottom line is that lactate sampling, while helpful, is not something for the rider to use, but rather a tool that may be used by his or her coach or a lab technician.

最近几年里，美国的体育用品市场上出现了一种相对便宜的便携式乳酸盐分析仪，但不太适合一般的骑手。使用这种仪器需要相当的技巧，只有为运动员取样数百次后才能掌握这种经验。这种乳酸盐采样方式虽然有用，但不是为骑手准备的，而是他或她的教练或实验室的技术人员使用的一种工具。

Muscular System

肌肉系统

Power is a measure of work compared to time. It is expressed in units called "watts," named for James Watt, the inventor of the steam engine. In physics, power is described in a formula as:

功率是测量相对于时间所做的功，它的计量单位是“瓦特”，由蒸气机的发明者詹姆斯·瓦特而命名。在物理学中，功率由以下公式来定义：

$$\text{Power} = \text{work/time}$$

$$\text{功率} = \text{做功} / \text{时间}$$

At the risk of oversimplification, in cycling "work" is essentially gear size and "time" is cadence. So if gear size is increased and cadence kept steady, power rises. Or, if cadence is increased (time per revolution of the crank is decreased) while using the same gear size, power also rises.

虽然有点过于简化，但你可以把骑车运动中的“做功”理解为齿轮比的大小，把“时间”理解为踏频。所以如果齿轮比增大但保持同样踏频的话，输出功率增加；而如果踏频增加（每次旋转曲柄的时间减少）但保持同样齿轮比的话，功率也会增加。

Several scientific studies have found that power is closely related to performance. If the

科学研究已经发现输出功率和比赛表现之间关系紧密。如果平均输出功率增加，比赛

average power output increases, race velocity also increases. The same cannot always be said for heart rate, as explained above; that is why power monitoring is such an excellent tool for bicycle training. It is the most effective way for the serious rider to monitor intensity.

The downside of power monitoring, as compared with heart rate, is equipment cost. In the early and middle 1990s, a powermeter cost about twenty times as much as a heart rate monitor. With the introduction of the Tune Power-Tap in 1999, however, the cost ratio was lowered to something approaching 4 to 1.

Power-based training begins with determining one's "critical power profile". This is a visual representation of the ability to produce power at various durations. Finding and graphing average power output for the critical power (CP) durations of 12 seconds and 1, 6, 12, 30, 60, 90, and 180 minutes produces a curve or profile such as those shown in Figure 4.1.

时的速度也会增加。但是心率与比赛表现之间的关系就不能用这样的方式去解释。这也是为什么功率监测仪是很棒的单车训练工具。对认真的车手来说，这是监测强度的最有效的方法。

功率监测不如心率监测的方面是设备的价格。在 20 世纪 90 年代早期，功率监测仪的价格大概是心率表的 20 倍。但是 1999 年出现 Turn PowerTap 后，二者的价格差大幅下降到大约 4 比 1。

基于功率的训练从确定个人的“关键功率曲线”开始。这是用图形方式展现个人在不同时期的功率输出的能力。测量不同时间段——即所谓的关键功率（CP）时间段——分别为 12 秒，1 分钟，6，12，30，60，90 和 180 分钟里的平均输出功率，并将数值画到图上，就会得到如图 4.1 所示的曲线。

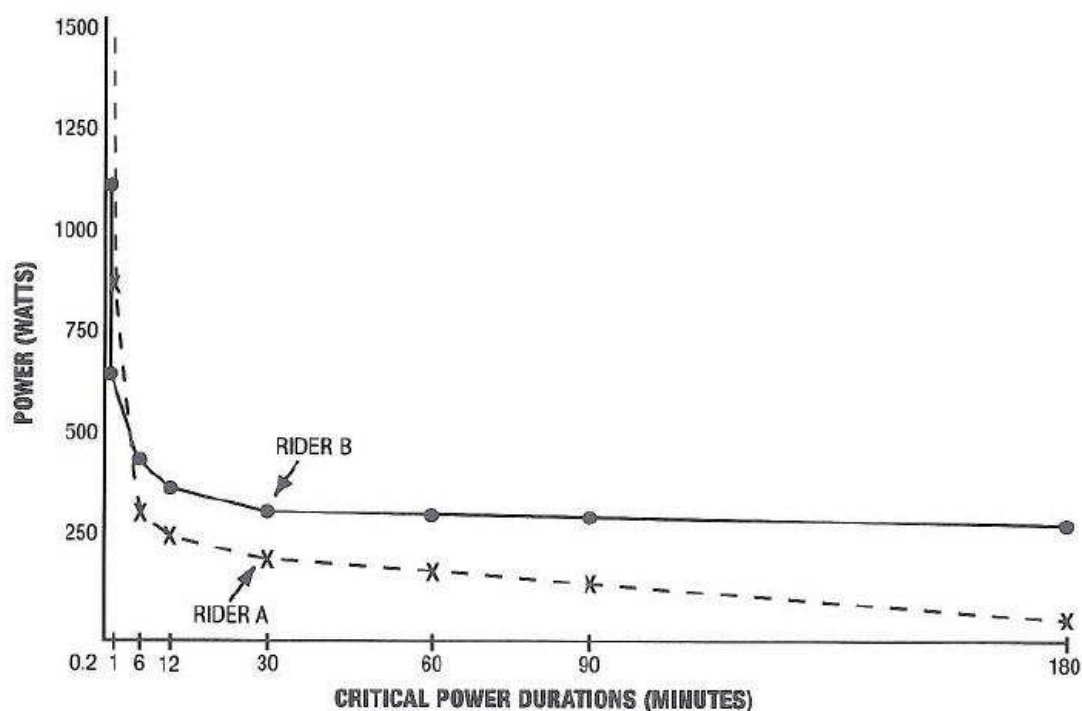


Figure 4.1 Critical profiles for two riders

图 4.1 两名骑手的关键功率曲线

Note that the profiles in Figure 4.1 are considerably different for the two riders. Rider A

注意图 4.1 中有两名不同骑手的关键功率曲线。骑手 A 在短时间里能够产生比骑手 B

is capable of producing far greater power than Rider B for short durations. Although Rider B lacks short-duration power, the generally shallower slope indicates much greater endurance capability. In an all-out sprint near the finish line, Rider A has an advantage, but Rider B has the upper hand as the duration increases.

大得多的功率输出。虽然骑手 B 在短时间里输出功率较少，但他的功率曲线坡度较缓，这表明他的耐力水平比较高。在临近终点的全力冲刺时，骑手 A 占有优势；但随着骑行距离的增加，骑手 B 就会慢慢占据主动。

Once you've determined average power for each of the above durations (Chapter 5 describes how to do this), your CP training zones can be established. For the average power at each duration, add and subtract 5 percent to establish zones. For example, if your average power for six minutes is 360 watts, then CP6 is 342 to 378 watts ($360 \times 0.05 = 18$. $360 - 18 = 342$, $360 + 18 = 378$).

一旦你能够确定不同时间段里的平均输出功率（第 5 章解释具体如何做），你的关键功率（CP）训练区域就可以计算出来了。对每个时间段的平均功率上下浮动 5% 就得到了这个区域。比如，如果你在 6 分钟里的平均输出功率是 360 瓦，那么 CP6 就是 342 瓦到 378 瓦（ $360 \times 0.05 = 18$. $360 - 18 = 342$, $360 + 18 = 378$ ）。

Focusing your training on a given range of CP zones has the potential to produce fitness benefits that can be applied in certain race situations, as shown in Table 4.3.

将你的训练集中在指定的 CP 区域内有可能改善你的某些身体素质来适应特定类型的比赛，如表 4.3 所示。

时间段	CP 区域	所需身体素质	比赛运用
12 秒	CP0.2	爆发力	临近终点的冲刺
			冲上短坡
			起步
1 分钟	CP1	乳酸盐清除能力	短时加速
			短距离爬坡
6 分钟	CP6	VO2max 时的速度	中等距离爬坡
			比赛中的短时高强度的片段
12 分钟	CP12	有氧能力（VO2max）	短时加速
30 分钟	CP30	超出乳酸盐极限水平	长距离持续地出力
60 分钟	CP60	保持乳酸盐极限水平	短距离比赛时的耐力
90 分钟	CP90	接近乳酸盐极限水平	中等距离比赛时的耐力
180 分钟	CP180	基础的有氧能力	长距离比赛时的耐力

Table 4.3 Critical Power Zone Benefits and Race Applications

表 4.3 关键功率训练区域及其对身体和比赛能力的作用

Cardiovascular System

心血管系统

In the early 1980s, the introduction of the portable heart rate monitor brought about a profound change in athletes' approaches to training. It is now a commonly used training device, second only to the handlebar computer in popularity.

在二十世纪八十年代，便携式心率表的出现曾使运动员的训练方式发生了深刻的变化，而现在心率表是很普通的训练设备，其普及率仅次于码表。

From the time heart rate monitors first hit the market until about 1990 they were "gee whiz" toys – fun to play with, but the numbers didn't mean much. Now that nearly everyone has one, athletes are becoming more astute in their use. At criteriums, road races, and time trials around the country you can find most cyclists wearing them to regulate or monitor exertion.

A heart rate monitor is much like the tachometer in an automobile. Neither one tells how fast you're going, but rather how hard the engine is working. Just as a car can rev up the engine without moving and redline the tachometer, heart rate can zoom while you are running in place.

Knowing how hard the heart is working is important information that allows you to make decisions as a workout progresses. Sometimes motivation, or lack of it, gets in the way of rating your perceived exertion during high-quality training sessions.

Be aware that a low heart rate is not always a bad sign. In fact, a low workout heart rate relative to what experience has shown to be more common for you can be a good sign. Improving aerobic fitness typically produces a lower heart rate than when you were less fit. In the same way, a high heart rate is not always a good sign, either.

For a cyclist, knowing lactate threshold heart rate (LTHR) is as important as knowing frame size. But forget about trying to find maximum heart rate. Not only does this require great motivation – as in a gun to the head – but it's not as good an indicator as LT.

Heart rate training zones are best if based on LTHR, since the percentage of maximum at which one becomes anaerobic (lactate accumulates) is highly variable. For example, one cyclist may have a LTHR that is 85 percent of his maximum heart rate, while another goes anaerobic at 90 percent of max. If both riders train at 90 percent of max, one is deeply anaerobic and the other is at threshold. They are not experiencing the same workout or getting the same benefits. If, however, both train at 100

从市场上第一次出现心率表开始直到 20 世纪 90 年代，它一直是所谓的很“炫”的玩具——好玩，但却没人注意其数据。现在几乎人手一个，而运动员玩得尤其熟练。在全国各地的绕圈赛，公路赛和计时赛中，你会发现大部分车手都戴着它们，用以调整和监测出力程度。

心率表很类似于汽车上的转速表，它们不能告诉你速度多少快，但能告诉你引擎的工作程度。你可以在原地不动让汽车引擎空转甚至使其转速超过转速表的安全区域；同样，你也可以让心率表记录你在原地踏步时的心率情况。

了解你的心脏工作负担有多少重，是你在训练过程中面临做决定时的重要依据。有时候在高质量的训练课中，你的训练动机的强弱会影响个人感知发挥度的判断。

请注意心率偏低不总是坏事。实际上，在进行熟悉的日常训练时心率偏低是个好现象。有氧运动能力提高后，一般都会使你的心率降低。同样道理，心率偏高也不一定都是好现象。

对一个骑手来说，了解自己的乳酸盐极限心率（LTHR）就象了解自己的车架尺寸一样重要。但千万不要试探达到自己的最大心率。这不光需要勇气——就象拿枪指着自己的头一样——而且最大心率对训练的指导作用也不如 LTHR。

心率训练区域最好是基于 LTHR 制定，因为每个人随着乳酸盐堆积而进入无氧区域时的心率占最大心率的百分比都相差很大。例如，某个车手的 LTHR 可能是他的最大心率的 85%，而另一个却是 90%。如果两个人都在最大心率 90% 的区域训练，前者已是深度无氧而后者却刚刚达到无氧边界。他们训练时的感觉会完全不同，训练效果也不会一样。但是，如果让两人都在 100%，或其他相同百分比的乳酸盐极限心率下训练，他们的个人感

percent of LT or any other percentage of LT, they experience the exact same exertion level and reap the same benefits.

Finding LT requires scientific precision, but don't let that scare you away. It's actually a simple procedure. I'll describe how to do it in the next chapter. For this reason I prefer to first determine LTHR and then establish heart rate zones on either side of it.

One "easy" way of finding your lactate threshold heart rate is to time trial while wearing a monitor. The distance of the individual time trial (ITT) could be 5k, 10k, 8 miles, 10 miles, or 40k. The test can be done at an established race or as a workout you do alone. The average heart rate from this test will serve as a predictor of your LT. Since you will undoubtedly have higher motivation in a race than when doing this test alone, the results should be interpreted differently. Table 4.4 provides guidelines for determining LT heart rate from an ITT.

距离	比赛	训练
5 公里	110%LT	104%LT
10 公里	107%LT	102%LT
13—16 公里	105%LT	101%LT
40 公里	100%LT	97%LT

Table 4.4 Lactate Threshold Heart Rates based on Individual Time Trial

Example: A 10-mile individual time trial is done as a race when the athlete is tested and highly motivated. The average HR is 176. Divide 176 by 1.05=167 for LT (See hold number 167 in table 4.6 for HR training zones.) Table 4.4 may also be used to determine HR to be used in an ITT. For example, a 40k ITT should be ridden at 100 percent of LT.

Another simple test that can be done alone and has proven to provide a fairly accurate estimate of LTHR is to ride a thirty-minute time trial alone. Ten minutes into the time trial click the lap button on your heart rate monitor. The average heart rate for the last twenty minutes of your time trial is a reasonable estimate of LTHR. As with all of these tests, the more frequently you repeat the test, the more accurately you can

觉发挥程度就会完全相同，训练效果也会比较接近。

找出精确的乳酸极限需要科学方式，但不要被它吓倒，实际上过程很简单。我将在下一章教你怎么做。所以我想先确定 LTHR 并且据此制定心率训练区域。

找出乳酸盐极限心率的一个“简单”方式戴着心率表进行个人计时测试。个人计时的距离可以是 5 公里，10 公里，13 公里，16 公里，或 40 公里。你可以在比赛时或训练时做这项测试。记录下测试期间的平均心率，据此就可估算你的乳酸盐极限心率。因为你在比赛时的动力肯定比在个人单独测试时要强，所以对其测试数据的处理也有不同。参考表 4.4 就可从 ITT 结果得出 LTHR 了。

表 4.4 基于个人计时数据计算乳酸盐极限心率

举例：某人参加 16 公里的个人计时赛并且比赛很努力。平均心率为 176。176 除以 1.05=167，即他的乳酸盐极限心率（然后根据 167 在表 4.6 中查找对应的心率训练区域）。表 4.4 还可以用来确定在个人计时赛中应该保持什么样的心率。例如，在 40 公里个人计时赛中你应该保持在 100% 的 LTHR 的心率骑行。

另一个简单的测试可以自己单独做，也能比较准确地估计 LTHR：独自骑行 30 分钟，前 10 分钟结束后按下心率表的圈数按键，后 20 分钟个人计时的平均心率就是你的 LTHR 的比较合理的估计值。对所有这些测试来说，你重复测试的次数越多，你的 LTHR 的估计值就越准。

estimate LTHR.

You may even be able to use your workouts to help confirm what was previously found in tests to be LTHR. Simply pay attention to your heart rate whenever you feel yourself initially becoming anaerobic. This level of intensity will be marked by burning sensations in your legs and the onset of heavy breathing.

Once you've found your LTHR, you can determine your heart rate training zones by using Table 4.5 or Table 4.6.

你还可以在训练时证实原先通过测试估算出的 LTHR 是否准确。只要你感觉到自己刚刚进入无氧状态时，关注一下这时的心率就可以了。这种强度下通常是感觉到大腿有灼烧感，并且呼吸开始变得沉重。

一旦找到了你的 LTHR，你就可以通过表 4.5 或表 4.6 确定你的心率训练区域。

训练区域	RPE	目标	%LTHR
1	<10	恢复	65—81%
2	10—12	有氧	82—88%
3	13—14	快速（TEMPO）	89—93%
4	15—16	接近阈值	94—100%
5A	17	超出阈值	101—102%
5B	18—19	有氧能力	103—105%
5C	20+	无氧能力	106%+

Table 4.5 Heart Rate Training Zones based on Lactate Threshold Heart Rate (LTHR)

表 4.5 基于乳酸盐极限心率（LTHR）的心率训练区域

Since we'll be referring to it frequently, I've numbered each heart rate zone. Zones 1 through 4 are each aerobic zones and zones 5A, 5B, and 5C are each anaerobic.

我为每个心率区域做了编号，因为以后我们会经常提到它。区域 1—4 都是有氧区域，而 5A，5B，5C 区都是无氧区域。

Heart rate varies with sport. If you're cross-training in the winter by running, your lactate threshold heart rate will be different from cycling, as will all of your training zones. Because of this, you should either determine heart rate zones for each sport you crosstrain in or go only by RPE for other sports.

做不同运动时的心率也是不同的。如果你在冬季进行跑步之类的交叉训练的话，你会发现跑步的乳酸盐极限心率和骑车时是不同的。因此，交叉训练时你应该为该项运动确定其心率区域，或者根据该项运动时的个人感知发挥来决定强度。

The Cyclist's Training Bible (3rd edition)
Chapter 4 INTENSITY

自行车训练圣经（第三版）
第4章 强度

ZONE 1 RECOVERY	ZONE 2 AEROBIC	ZONE 3 TEMPO	ZONE 4 SUB- THRESHOLD	ZONE 5A SUPER- THRESHOLD	ZONE 5B AEROBIC CAPACITY	ZONE 5C ANAEROBIC CAPACITY
90-108	109-122	123-128	129-136	137-140	141-145	146-150
91-109	110-123	124-129	130-137	138-141	142-146	147-151
91-109	110-124	125-130	131-138	139-142	143-147	148-152
92-110	111-125	126-130	131-139	140-143	144-147	148-153
92-111	112-125	126-131	132-140	141-144	145-148	149-154
93-112	113-126	127-132	133-141	142-145	146-149	150-155
94-112	113-127	128-133	134-142	143-145	146-150	151-156
94-113	114-128	129-134	135-143	144-147	148-151	152-157
95-114	115-129	130-135	136-144	145-148	149-152	153-158
95-115	116-130	131-136	137-145	146-149	150-154	155-159
97-116	117-131	132-137	138-146	147-150	151-155	156-161
97-117	118-132	133-138	139-147	148-151	152-156	157-162
98-118	119-133	134-139	140-148	149-152	153-157	158-163
98-119	120-134	135-140	141-149	150-153	154-158	159-164
99-120	121-134	135-141	142-150	151-154	155-159	160-165
100-121	122-135	136-142	143-151	152-155	156-160	161-166
100-122	123-136	137-142	143-152	153-156	157-161	162-167
101-123	124-137	138-143	144-153	154-157	158-162	163-168
101-124	125-138	139-144	145-154	155-158	159-163	164-169
102-125	126-139	139-145	146-155	156-159	160-164	165-170
103-126	127-140	141-146	147-156	157-160	161-165	166-171
104-127	128-141	142-147	148-157	158-161	162-167	168-173
104-128	129-142	143-148	149-158	159-162	163-168	169-174
105-129	130-143	144-148	149-159	160-163	164-169	170-175
106-129	130-143	144-150	151-160	161-164	165-170	171-176
106-130	131-144	145-151	152-161	162-165	166-171	172-177
107-131	132-145	146-152	153-162	163-166	167-172	173-178
107-132	133-146	147-153	154-163	164-167	168-173	174-179
108-133	134-147	148-154	155-164	165-168	169-174	175-180
109-134	135-148	149-154	155-165	166-169	170-175	176-181
109-135	136-149	150-155	156-166	167-170	171-176	177-182
110-136	137-150	151-156	157-167	168-171	172-177	178-183
111-137	138-151	152-157	158-168	169-172	173-178	179-185
112-138	139-151	152-158	159-169	170-173	174-179	180-186
112-139	140-152	153-160	161-170	171-174	175-180	181-187
113-140	141-153	154-160	161-171	172-175	176-181	182-188
113-141	142-154	155-161	162-172	173-176	177-182	183-189
114-142	143-155	156-162	163-173	174-177	178-183	184-190
115-143	144-156	157-163	164-174	175-178	179-184	185-191
115-144	145-157	158-164	165-175	176-179	180-185	186-192
116-145	146-158	159-165	166-176	177-180	181-186	187-193
116-146	147-159	160-166	167-177	178-181	182-187	188-194
117-147	148-160	161-166	167-178	179-182	183-188	189-195
118-148	149-160	161-167	168-179	180-183	184-190	191-197
119-149	150-161	162-168	169-180	181-184	185-191	192-198
119-150	151-162	163-170	171-181	182-185	186-192	193-199
120-151	152-163	164-171	172-182	183-186	187-193	194-200
121-152	153-164	165-172	173-183	184-187	188-194	195-201
121-153	154-165	166-172	173-184	185-188	191-195	196-202
122-154	155-166	167-173	174-185	186-189	190-196	197-203
122-155	156-167	168-174	175-186	187-190	191-197	198-204
123-156	157-168	169-175	176-187	188-191	192-198	199-205
124-157	158-169	170-176	177-188	189-192	193-199	200-206
124-158	159-170	171-177	178-189	190-193	194-200	201-207
125-159	160-170	171-178	179-190	191-194	195-201	202-208
125-160	161-171	172-178	179-191	192-195	196-202	203-209
126-161	162-172	173-179	180-192	193-196	197-203	204-210
127-162	163-173	174-180	181-193	194-197	198-204	205-211
127-163	164-174	175-181	182-194	195-198	199-205	206-212

Table 4.6 Heart Rate Training Zones Find your LT heart rate in the “Zone 5a” column (bold number). Read across from left to right for training zones.

表 4.6 心率训练区域。在 5a 区找到你的乳酸盐极限心率（黑体字），该行从左到右的数据就是你的训练区域。

Race-Fit Systems

Coming into top racing form means optimizing the performance of each of the three systems. A cyclist with a great muscular system but poor energy and cardiovascular systems won't last long on the roads. It takes all three systems working together.

These systems must go through many changes during the training year for you to race effectively and attain your goals. The following is a partial list of changes that occur as a result of training.

Energy Production System

- Greater utilization of fat and sparing of glycogen
- Enhanced conversion of lactate to fuel
- Increased stores of glycogen and creatine phosphate
- Improved ability to extract oxygen from blood

Muscular System

- Increased force generation within a muscle fiber
- Enhanced recruitment of muscle fibers
- More economical movement patterns
- Enhanced endurance qualities

Cardiovascular System

- More blood pumped per heartbeat
- Greater capillarization of muscle fibers
- Increased blood volume
- Enhanced oxygen transportation to the muscles

适应比赛的身体系统

进入顶级比赛状态意味着以上三个身体系统的能力达到最优。一个拥有强健肌肉系统但能量供应系统和心血管系统却很差的骑手无法在公路上骑多久。你必须把三个系统整合起来共同工作。

在训练年度里这三个系统都要经历很多变化来让你更有效率地比赛并达到你的目标。下面列出的是一部分训练后可能发生变化的清单：

能量供应系统

- 能够更多地利用脂肪和节省糖原
- 提高从乳酸盐转化为能量的能力
- 增强糖原和肌肉磷酸盐的储备
- 改善从血液中夺氧的能力

肌肉系统

- 增强单位肌肉纤维产生的力量
- 调动更多的肌肉纤维参与做功
- 运动方式更加有效率
- 增强肌肉的耐力素质

心血管系统

- 每次心跳泵出更多血液
- 肌肉纤维上有更多的毛细血管
- 总血量增加
- 改善氧输送到肌肉的能力

DON'T BE A SLAVE TO YOUR HEART RATE MONITOR

Ten years ago hardly anyone had a heart rate monitor. Now almost everyone has one. Generally, I'm glad to see that trend, but there's a downside. It seems that we're becoming overly concerned with heart rate. Let me explain.

Before heart rate monitors, when an athlete started a hard workout such as intervals, he or she

不要成为心率表的奴隶

十年前几乎没人听说过心率表，而现在却几乎人手一个。总体来说，我为这样的变化趋势而高兴，但也有一个担心，那就是我们变得太关注心率了。让我来解释一下。

在心率表出现之前，当运动员开始高强度训练

continually gauged how the session was going and may have decided to cut it short or to extend it. The usual basis for this pre-heart rate monitor decision was perceived exertion (PE). PE is based on a subjective reaction to breathing, lactate accumulation, fatigue, and other less-defined sensations during exercise. From this somewhat vague data the athlete would make decisions. What was good about this system was that it forced athletes to stay in tune with what their bodies were feeling. The downside was that it took experience to develop the skills to know what the sensations meant.

But now, with heart rate monitors, many athletes largely ignore their PE and focus solely on what their heart rates are. While it's effective to know your heart rate when training, it is not the only metric that should be monitored, in fact, doing so can really mess you up. Why is that so? Well, for one thing, heart rate is not giving you a complete picture of the body's workload, nor is it necessarily even giving you an accurate picture, since many factors – such as heat, diet, and stress, to name just a few – affect it.

Heart rate by itself does not tell you how well you're performing in a workout or a race, and yet many athletes try to draw conclusions from one number. For example, something I hear all the time is, "I couldn't get my heart rate up so I stopped the workout" Is a low heart rate bad? It could be, but then again, it might be good. One of the physiological side effects of improving aerobic fitness is an increased heart stroke volume – more blood is pumped per beat. That means a reduced heart rate for any submaximal level of exertion. So a low heart rate in a workout or race may be telling you that fitness is high and to keep going – not that you should stop.

In the same way, a high heart rate is not necessarily good, as most athletes typically conclude. "It was easy to get my heart rate up today" translates into "I'm in good shape." That's, again, not necessarily true. We could take a sedentary person off the street, put him on a bike, and force him to ride fast. Guess what? His heart rate would rise very easily. We might even be able to achieve a maximal pulse with very little power output. If his heart rate achieved the same max as that of a fit rider it would really tell us nothing about either one of them. You see, there is no difference between the maximal heart rate of a very fit athlete and that of an obese couch potato. The less fit you are, the easier it is to get heart rate up to max.

When testing athletes I have found that when they are in very good race shape their maximal heart rates

比如做间歇练习时，他或她需要不断地调整训练过程的进行，并且可能将训练缩短或延长。在前心率表时期，他们做决定的依据就是个人感知发挥（PE）。PE 是身体基于训练时的呼吸，乳酸盐堆积，疲劳，以及其他无法描述的感觉所做出的主观反应，根据这些有点模糊的数据运动员就可以做出判断。这种训练系统的好处是它迫使运动员倾听身体的语言并与之保持一致。不足之处在于掌握了解身体的语言需要相当的经验 and 技巧。

但是现在，因为有了心率表，许多运动员都不再关心他们的 PE，而是完全依靠心率了。虽然训练时你的心率一目了然，但却无法告诉你其他一些需要被监测的参数。实际上，这么做会让你陷入困境。为什么这么说？首先，心率不能让你全面了解身体的负荷，它甚至不一定能告诉你正确的信息，因为许多因素——随便列举一些，比如气温，饮食，心理压力——都会影响心率。

心率本身不能告诉你在训练和比赛中的表现如何，但许多运动员却试图靠这个数字得出结论。比如，我总是听到这样的话：“我无法让自己的心率上去，所以就停止训练了”。心率低是坏事吗？也许是，但我们说过也许会是好事。有氧能力提高的一个标志性生理变化就是每搏输出量的增加——心脏每次跳动都泵出更多血液。这就意味着亚极量的发挥水平下心率的降低。所以比赛或训练时心率偏低也许是说明你的身体素质提高了，应该继续下去——而不是停止。

同样道理，高心率也不一定是好事，虽然大部分运动员都这么认为。“今天我的心率很容易就上去了”被解读成“我今天状态很好”。我再说一遍这不一定正确。我们可以从街上拉一个缺少运动的人，把他按到自行车上，然后强迫他玩命得骑快。猜猜结果怎样？他的心率很容易地就上去了，甚至可以达到他的最大心率，但输出功率却很小。从心率图上我们得不出任何结论，因为他也达到了和训练有素的运动员一样的最高心率。你看，一个训练有素的运动员和一个肥胖的懒散家伙的最大心率完全一样，你的身体素质越差，心率上升就会越容易。

对运动员做测试时，我发现一种情况：当他们处于很好的比赛状态时，他们的最大心率会下降。

appear to drop. I don't know exactly why that is. It may have something to do with their aerobic system adapting so well to endurance training that the muscular system is incapable of driving it any higher.

Another misuse of the heart rate monitor number is drawing conclusions about one's state of well-being. "My resting heart rate is high (or low) so I must be overtrained", is another common complaint I hear – It is not possible, however, to look at resting or exercising heart rates and draw such a conclusion. If it was, sports scientists would have stopped looking long ago for a way to gauge overtraining – something they have not been able to find.

Heart rate by itself tells you nothing about performance or well-being. It must be compared with something else to have meaning. For example, when it comes to cycling performance, comparing heart rate with power (for example, on a CompuTrainer or with a Power-Tap or SRM) is an excellent way to determine gains in fitness. If heart rate is low and power is normal to high, when compared with previous performances, then fitness is high. If heart rate is high and power is high then the athlete is probably still building fitness. This is a good way to gauge when the Base period should come to an end.

If heart rate is low and power is also low then the athlete may be experiencing fatigue, lifestyle stress, or even overtraining. There are other possibilities in this combination, so all we know is that something is not right.

Metrics other than power could also be used in conjunction with heart rate to help draw conclusions about the athlete's status. For example, what would low heart rate and high PE be telling you? This is saying that fitness and well-being are probably good. What would you say about high heart rate and low PE? Common sense would suggest that something isn't right. Think your way through the various possibilities.

The main point here is that heart rate alone tells you only one thing – you are still alive. Drawing conclusions only from what your monitor says on a given day is folly. Use the information that this miraculous training tool gives you, but don't rely on it alone.

Sidebar 4.1

我不清楚为什么，也许是因为他们的有氧系统更好地适应了耐力训练，以至于肌肉系统无法驱使它达到更高的心率。

另一个关于心率监视数据的误解就是靠它来确定一个人的身体状况。“我的静止心率偏高（或偏低）了，所以我一定是训练过度了”是另一个我常常听到的抱怨——但是，光靠静止或运动时的心率是无法得出这样的结论的。否则的话，运动科学家就不用忙着寻找度量过度训练的方法了——他们已经找了好久了，但仍然没有找到。

心率本身无法告诉你的表现如何或身体状况。它必须和其他数据结合对比才有意义。比如对骑行表现来说，把心率和功率做对比（例如，使用 CompuTrainer, PowerTap 或 SRM）就是一个非常好确定身体素质是否提高的方法。如果与上次测试相比，输出功率不变或提高而心率降低了，说明身体素质提高了；如果心率和输出功率都提高了，则说明运动员的能力可能还在培养阶段。这个方法也可用来确定基础期训练是否可以结束了。

如果心率和功率都降低了，则说明运动员可能是疲劳，生活压力太大，甚至是训练过度了。二者的组合还会有其他的可能性，现在你们应该了解某些观念的错误之处了吧。

除了功率以外，还有其他一些数据可以和心率相结合来帮助确定运动员的状态。例如，心率较低而 PE 较高说明了什么？这说明你的身体素质和健康状况很好；那么心率较高但 PE 较低说明了什么？一般来说这不是什么好事情。根据你的个人情况分析一下各种可能性吧。

总而言之，心率本身只能告诉你一个事实——你还活着。单单依靠心率表数据得出结论是愚蠢的。你应该利用这个神奇的训练工具提供的数据，但不要完全依靠它指导训练。

工具栏 4.1

Multisystem Training

RPE, heart rate, and power each offer unique benefits for the serious cyclist when it comes to monitoring intensity of a workout or race. RPE provides a subjective yet comprehensive view of what you are encountering when on the bike. Heart rate offers a window into the cardiovascular system and thus a glimpse of the workload the body is experiencing. A powermeter reports what the body is accomplishing. Power is a measure of performance rather than an indicator of the physiological stress experienced. Each is valuable in the training process.

Using all three is like seeing a picture in three dimensions instead of only one or two – training makes more sense. Whether or not a number is assigned, RPE should be an integral method of monitoring intensity in all workouts. This will pay dividends in races where closely observing heart rate and power is not possible. RPE is the "stake in the ground" – the supreme reference for all intensity monitoring. You must become good at using it. Heart rate is best used for steady-state training, particularly that done below the lactate threshold. It is especially effective during long, aerobic rides and for recovery workouts. Focus on power for intervals, hill training, sprint-power training, and all anaerobic workouts. I've seen significant improvement in race performance when riders have begun training with power. This is unquestionably the future of bicycle training. Mastering and appropriately applying each of these intensity monitoring systems has the potential to dramatically improve your training and, therefore, your racing.

Measuring Workload

Now that you have three systems for monitoring intensity, it's possible to quantify workload. Recall from the previous chapter that workload is the combination of frequency, duration, and intensity of training. Knowing workload allows you to keep track of and compare weekly training

多系统训练

个人感知发挥（RPE），心率以及功率，每种讯息都能帮助认真的车手在训练和比赛时测量强度。RPE 提供主观但是全面的骑车时的整体感觉；心率提供心血管系统的工作状态，并且根据经验可以估计身体的运动负荷；功率计记录了身体的输出功率，这更多地反映了运动能力，而不是身体感受到的生理压力。对于训练来说，这些信息都很有价值。

综合运用这三种信息就象是从三维而不是一维或两维的角度看一副立体画——训练也会变得更有趣。不管你是否用数字表达，RPE 应该是所有训练中综合测量强度的方法。在无法严密监视心率和功率的比赛中你应该多运用这种方法，RPE 是你“压箱底”的本事——是所有强度监测方式的最高手段，所以你必须学会熟练运用。心率监测最好在稳定状态的训练，特别是在乳酸盐极限阈值之下的训练中使用。对于长距离有氧骑行或恢复性训练来说心率表特别有用。在间歇训练，爬山或冲刺，以及所有无氧训练时重点监视功率。我发现骑手们用功率表进行训练后比赛成绩会有显著提高。毫无疑问这会是自行车训练的发展方向。掌握并适当地运用上述每种测量强度的方法很有可能极大地改善你的训练，以及比赛。

测量训练量

现在你已经有三种测量强度的系统了，可以开始计算训练量。回想一下前面一章所说的，训练量是频度，持续时间和训练强度的综合。了解了这个概念，你就能跟踪和比较每周的训练对身体施加的负荷，这对于避免过度训练是很有用处的。如果你了解什么样的训练能够给

stress loads placed on the body. Such information is valuable for avoiding overtraining. It also helps in planning daily workouts if you know how much stress training is likely to produce. In turn, this allows you to determine how much and when recovery is needed. It also makes periodization of training more effective (see Chapter 7 for details on periodization).

The following are three workload-measuring methods, one based on each RPE, heart rate, and power.

RPE

At the end of a training session, assign an average workout RPE using the 6 to 20 scale. Then multiply this RPE value by the number of minutes in the session. For example, if a 60-minute session including intervals had an average RPE of 14, the workload for this day is 840 ($60 \times 14 = 840$).

Heart Rate

Using a heart rate monitor with a time-by-zone function, it's possible to know how many minutes were spent in at least three zones (with a three-zone monitor, all five zones may be observed by switching zones during the ride). By multiplying each of the zone's numeric identifiers (Zone 3, for example) by the number of minutes spent in each zone and then adding them up, workload for a week or any other period of time may be determined.

For example, if you completed a 60-minute ride that included 20 minutes in Zone 1, 25 minutes in Zone 2, and 15 minutes in Zone 3, the cumulative workload is 115. Here's how that number was determined:

$$\begin{array}{r} 20 \times 1 = 20 \\ 25 \times 2 = 50 \\ 15 \times 3 = 45 \\ \hline \text{总和} \quad 115 \end{array}$$

Power

The Tune Power-Tap offers a quick way of monitoring workload – session kilojoules, recalled as "E" (for energy) and displayed in units called kilojoules (kJ) on the Power-Tap. This is a measure of energy expended. One kilocalorie

身体施加什么样的压力，你就可以为每天的训练量定计划了。反过来，这些信息也能帮你确定何时需要休息以及如何恢复。这也使周期性训练更加地有效率（第7章详细介绍周期性训练）。

下面介绍3种测量训练量的方法，分别基于RPE，心率和功率。

RPE

每次训练结束以后，使用6—20的强度级别概括本次训练的平均个人发挥感知度，然后用这个数字乘以训练的分钟数。比如，60分钟的间歇训练，平均RPE为14，则今天的训练量就是840（ $60 \times 14 = 840$ ）。

心率

使用带时间和心率分区功能的心率表，至少有3个心率区间（这样通过骑行时切换不同区间就可以监测5个心率区间）并能记录每个区间的训练时间。用每个区间的标识数字（比如区域3）乘以该区间的训练分钟数然后加总，就可得到每天，每周或者任何时间段内的训练量。

例如，你骑行了60分钟，其中20分钟在区域1，25分钟在区域2，15分钟在区域3，那么累积训练量就是115。计算方法请参考下面的公式：

功率

Tune PowerTap提供了一种测量训练量的快速方法——训练能量，简称“E”，在PowerTap上以千焦（kJ）为单位，这是测量能量消耗的方式，1千卡=4.184千焦。训练中消耗的能

(kcal or calorie) is equal to 4.184 kJ. Energy used in training is a nearly perfect way of expressing workload.

量几乎是表示训练量的最完美方式。

Cumulative Workload

累积训练量

Whichever method you use, record your daily workload in a training log. By totaling the daily workloads, a cumulative workload for the week is determined. This number serves as an indicator of how difficult the week was. By comparing it with past weeks, you can quickly see what is happening to the stress load. In general, the cumulative workload should increase as the year progresses from the start of training season in early winter until the spring races. This should not be a straight-line progression, however. It instead follows a wave-like pattern that allows the body to gradually adapt and grow stronger. Figure 4.2 shows how the cumulative weekly workload advances through one portion of the training year.

不管你采用什么方法计算，你都要把每天的训练量记录在训练日志中。将每日训练量加总后，就能得到一周的累积训练量，这个数字能够反映这周的艰难程度。与前面几周的训练量相比较，你会很容易看出训练负荷的变化。一般来说，从初冬开始训练季直到次年春天开始比赛，训练量应该是慢慢增长的，但不是直线式的增长，而是波浪形的增长方式，这样就能够让身体逐渐适应并变得更强壮。图 4.2 显示了在某段训练年度中每周累积训练量是如何增长的。

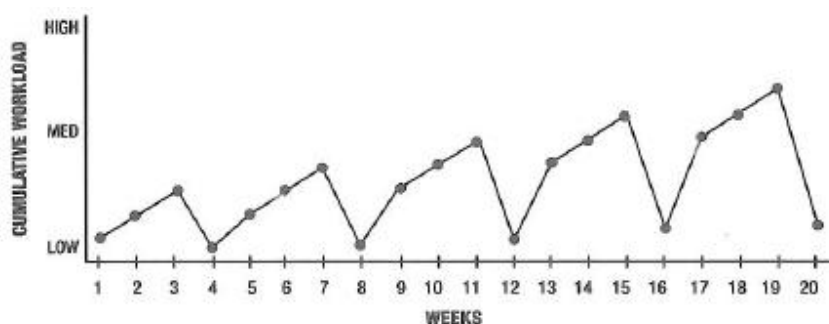


Figure 4.2 Example of weekly cumulative workload progression

图 4.2 每周累积训练量的增长方式示例

Unfortunately, there is no rule of thumb for determining what a given athlete's workload should be. It varies considerably with the individual, so experience is the best teacher. By comparing your weekly cumulative workloads with your training and racing performances, it's possible to plan optimal training patterns while avoiding overtraining. But always bear in mind that optimal workload is a moving target that is dependent on accumulated fitness, time of the training year, health, psychological stress and other variables. Cumulative workload history provides a better starting point for determining how you should train today and in the future than

不幸的是，没有什么简单方法能够确定运动员的训练量应该是多少，不同个体差别很大，所以经验才是最好的老师。通过对比每周累积训练量和你在训练与比赛时的表现，你有可能计划出最优的训练量并避免过度训练。但永远要记住最优的训练量不是固定的，而是随着身体素质的提高，训练年头，健康状况，心理压力以及其他变数而变化的。你可以参考过去的累积训练量的历史记录，并以此作为今天和将来训练的起点，这比光靠猜测来确定训练量效果要好些。

The Cyclist's Training Bible (3rd edition)
Chapter 4 INTENSITY

自行车训练圣经（第三版）
第 4 章 强度

does merely guessing.