Science & technology | Archers and heart rates

How to measure how stress affects athletes' performance

Pick a sport where they don't move much, and study skin flushing

How much stress is good for an athlete? Surprisingly, since modern, professional sport of all sorts now seems to be in the hands of number crunchers trying to extract another zillionth of a percent of performance from their charges, no one knows. The reason is that, to avoid decrements in performance of equal and opposite magnitude, top athletes are rarely willing to carry even the tiniest monitoring devices when in competition. And when they are not in competition such measurements would be

meaningless.

However, two behavioural economists, Lu Yunfeng of Nanjing University, in China, and Zhong Songfa of the National University of Singapore, think they have found a way around this—at least for athletes whose disciplines do not require them to move a lot.

Dr Lu was inspired to investigate the matter when watching the 2020 Olympic games on television. He noticed that in the archery contests, competitors' heart rates were shown to viewers as they stood at the mark and shot. Heart rate is well known as an indicator of psychological stress, so he saw this as an opportunity to investigate the relation between stress and performance. To this end, he recruited Dr Zhong, who has a long history of working on stress and behaviour.

When they dug into the matter, the two researchers found that 122 of the 128 archers in the games had agreed to have their heart rates measured. The trick was that, since competitors were stationary, their heart rates could be monitored remotely by a technique called photoplethysmography, which registers

changes in the reflectivity of skin caused by flushing when the heart pumps, and correlates well with more conventional measurements such as electrocardiograms. Altogether, they were able to match heart rate to score for 2,247 shots.

As they report in a paper in Psychological Science, heart rates during the competition varied tremendously between archers. A few hearts pumped at just over one beat per second while one competitor's raced along at more than three. The average was 138 beats per minute.

Overall, archers with higher heart rates had lower scores and those with lower rates, higher ones. The average rate for a toxophilite who hit inner gold, or ten-ring (a bullseye, to non-cognoscenti), for a score of ten, was 134.2 beats per minute. It was 135.7 for outer gold (nine-ring). And for eight-ring, the inner red, it was 137.9. Overall, Dr Zhong and Dr Lu calculated that each extra heartbeat per minute resulted in a 0.004-point decrease in score.

These findings support the notion that the performance of even some of the world's most elite athletes declines as they

experience increased stress. Whether that is peculiar to those who need a steady aim to win, or also applies to athletes who have to run around as they compete, remains to be seen. ■

科学与技术丨射手与心率

如何测量压力如何影响运动员的表现

挑选一项他们不怎么运动的运动，并研究皮肤潮红情况

多大的压力对运动员有好处？令人惊讶的是，由于现代的各种专业运动现在似乎都掌握在数字计算者的手中，试图从他们的收费中再提取百分之一的性能，所以没有人知道。原因是，为了避免同等程度的成绩下降，顶级运动员在比赛时很少愿意携带最微小的监测设备。而当他们不在比赛中时，这样的测量是没有意义的。

然而，两位行为经济学家，中国南京大学的陆云峰和新加坡国立大学的钟松法，认为他们已经找到了解决这个问题的方法--至少对于那些不需要经常运动的运动员来说。

卢博士在电视上观看 2020 年奥运会时受到启发，开始研究这一问题。他注意到，在射箭比赛中，当选手们站在标靶上射击时，他们的心率会显示给观众。众所周知，心率是心理压力的一个指标，因此他认为这是一个研究压力和表现之间关系的机会。为此，他聘请了在压力和行为方面有长期工作经验的钟博士。

当他们深入研究这个问题时，两位研究人员发现，参加比赛的 128 名弓箭手中有 122 人同意测量他们的心率。诀窍在于，由于参赛者是静止的，他们的心率可以通过一种叫做光脑图的技术进行远程监测，这种技术可以记录心脏抽动时因脸红而引起的皮肤反射率的变化，并与心电图等更传统的测量方法很好地相关。总的来说，他们能够将心率与 2,247 次射击的得分相匹配。

正如他们在《心理科学》杂志上所报告的那样，在比赛期间，弓箭手的心率有很大的不同。一些人的心脏以每秒刚过一拍的速度跳动，而一位参赛者的心脏则以超过三拍的速度飞驰。平均为每分钟 138 次。

总的来说，心率高的弓箭手得分较低，心率低的弓箭手得分较高。嗜毒者击中内金，或十环（对非认知者来说是牛眼），获得 10 分的平均心率为每分钟 134.2 次。外金（九环）是 135.7 次。而八环，即内部红色，是 137.9。总的来说，钟博士和陆博士计算出，每分钟多一次心跳就会导致分数下降 0.004 分。

这些发现支持了这样一种观点，即即使是世界上最优秀的一些运动员的表现也会随着他们经历的压力增加而下降。这是否是那些需要稳定的目标才能获胜的人所特有的，或者也适用于那些必须在比赛中奔跑的运动员，还有待观察。■