Why burst of physical activity is good for your health: a possible explanation

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Recent research showed that a short burst of high physical activity is good for your health. It has a much better effect than the same amount of activity spread over time. In this talk, we provide an explanation for this empirical fact.

Let us formulate the problem in precise terms. Let us denote the overall amount of physical activity by D_0. How we do it can be characterized by a function $D(t)$ that describes how much activity has been done by time t. We start at time $t = 0$, when the activity-so-far is 0: $D(0) = 0$. At each moment of time, we can only add more activity. So this function is (non-strictly) increasing: if $t \le t'$ then $D(t) \le D(t')$. At the end of the session, we should have $D(t) = D_0$. In these terms, selecting an appropriate schedule means selecting a (non-strictly) increasing function $D(t)$ for which $D(0) = 0$ and $\lim\limits_{t\to\infty} D(t) = D_0$.

There are many such functions, which of them should we choose? Informally, we should select the best of these functions. The question is how we describe "the best" in precise terms.

Usually, "the best" means that some objective function attains the largest (or the smallest) possible value. However, this is not the most general way of describing optimality. For example if you have two different schedules that have the same health effect, it is reasonable to use this non-uniqueness to optimize something else. The only thing we can say about such more general optimization settings is that we should be able, for any two alternatives a and b, to decide whether a is better than b (we will denote it by $a > b$), or b better than a ($b > a$), or a and b have the same quality (we will denote it by $a \sim b$). These relations $a > b$ and $a \sim b$ should satisfy natural consistency requirements. E.g., if a is better than b and b is better than c, then a should be better than c. When the optimality criterion is final, there is exactly one alternative which is optimal with respect to this criterion.

There is no fixed unit of time relevant for this process. So, it makes sense to require that the optimality criterion will not change if we use a different measuring unit to measure time: if $D(t) > D'(t)$, then, for every $\lambda > 0$, we should have $D(\lambda \cdot t) > D'(\lambda \cdot t)$. It turns out that under this condition, the optimal function $D(t)$ has the form $D(t) = D_0$ for all $t > 0$. This result explains the empirical fact that the burst of physical activity indeed leads to the best health results.

References

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