Reply to Gore, Ashenden, Sharpe, and Martin

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DELTA EFFICIENCY CALCULATION IS NOT ABSOLUTELY WRONG AND A SECONDARY MEASURE

TO THE EDITOR: It is an absolute overstatement for Gore et al. (4) to state that the calculation of delta efficiency is wrong in Coyle (1). Regardless, it should first be recognized that the conclusions of Coyle (1) were not based on delta efficiency but rather on gross efficiency. Simply, the paper expressed efficiency primarily as the power output this individual could achieve when cycling at an oxygen uptake ($\dot{V}O_2$) of 5.0 l/min. It increased 8%. There is no question about this measure or the calculation of gross efficiency.

The calculation of delta efficiency is not wrong because one valid equation was used consistently for each of the four time points reported (1) and thus the absolute statements of Gore et al. (4) are inaccurate. However, Gore et al. (4) are correct to point out that the equation used in this paper (1) is not the equation referenced, as in earlier studies (2, 6, 8). The calculation of delta efficiency used (1) did force the regression line through the origin, but this does not invalidate this calculation. Granted, large fluctuation in the origin could theoretically add variability, but realistically should have little influence on shifting the slope of this subject because efficiency was calculated when $\dot{V}O_2$ was very high (i.e., 3–5 l/min). It seems, at least to me, unreasonable to imply that removal of one testicle or a 4-kg fluctuation in body weight would greatly and permanently influence the cost of unloaded cycling or that the effects of chemotherapy would greatly alter resting metabolic rate (RMR) 8 mo later in a manner that invalidates these calculations. Gore et al. (4) should also realize that their recalculations of delta efficiency using one selective method for 1993 and another for 1999 is questionable, for obvious reasons, as well as being potentially biased.

Gore et al. (4) concluded that "there exists no credible evidence to support Coyle's conclusion that Armstrong's muscle efficiency improved." This is based erroneously on their argument that the calculation used for delta efficiency is without merit. It also assumes, incorrectly, that gross mechanical efficiency provides no information related to muscle function. Granted, delta efficiency has conceptual advantages over gross efficiency, which is the main theoretical point made by Gaesser and Brooks in 1975 (3). However, Gaesser and Brooks (3) did not provide data indicating that gross efficiency provides no information about muscle efficiency but instead indicate that much variability is experienced, given their low work rates. More recently, we directly measured muscle fiber composition in cyclists and reported that the percentage of type I fibers was significantly correlated with "both" gross and delta efficiency (2, 6). This provides evidence, which has been verified by others (5, 7), that gross efficiency is indeed related to muscle fiber composition and mechanical properties.

The constructive upshot of this exchange is to recognize that the calculation of delta efficiency in Coyle (1) was forced through the origin, yet it does not invalidate this measure. Regardless, delta efficiency was a secondary measure in Coyle (1), and the calculation is now appropriately referenced.

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