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Working Paper

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Diskussionsbeitrag, No. 372

Provided in Cooperation with:

School of Economics and Management, University of Hannover

Suggested Citation: Strulik, Holger (2007) : Riding high: success in sports and the rise of doping cultures, Diskussionsbeitrag, No. 372, Leibniz Universität Hannover, Wirtschaftswissenschaftliche Fakultät, Hannover

This Version is available at:

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Riding High – Success in Sports and the Rise of Doping Cultures

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Leibniz Universitat Hannover, Discussion Paper No. 372

ISSN 0949-9962

August 2007

Abstract. This article develops a socio-economic model that analyzes the doping decision of professional athletes. In their decision to use performance enhancing drugs athletes do not only evaluate the costs and benefits (in terms of potential rank improvement). They also take into account peer-group approval of using drugs. Peer-group approval is modelled as a lagged endogenous variable that depends on the share of drug using athletes in the history of a sport. This way, the model can explain multiple equilibria as “doping cultures”. Besides the comparative statics of the equilibrium (how can a doping culture be eliminated?) the article also investigates how the doping decision is affected by standards set by the respective leader in a sport, e.g. Olympic qualification marks, and by the taste of victory, i.e. the disproportionate public veneration of winners.

Keywords: sport, doping, approval, social dynamics, weak athletes, super-heroes.

JEL: A13, D71, K40, L83, M50.

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I never cheated.
(Jan Ullrich)

*I may have used the spray a bit more than usual,
but I haven't done anything illegal.*
(Alessandro Petacchi)

*So I did it, but I didn't feel totally guilty about it
because everybody else seemed to be doing it.*
(Frankie Andreu)

1. INTRODUCTION

This article was heavily inspired by the confessions of drug using professional cyclists in the run-up of the year 2007 Tour de France and the following “scandals” during the event. Reading the athletes’ arguments for their doping activities in the press I got the idea for a socio-economic model that explains individual behavior as part of a doping culture. Although I frequently refer to cycling and the Tour de France as examples and introduce each section with quotes of confessing (or denying) cyclists, I hope that the proposed theory is general enough to cover also many other sports in which doping is prevalent.

So far, a small economic literature has tried to rationalize the use of drugs in sports.¹ There, two players compete in a game theoretic situation with only two outcomes: winner or loser. From this literature the current article differs in at least two respects. It considers the behavior of many athletes competing about the ranking in their sport. And it investigates the role of socially dependent preferences.

The fact that there are many athletes implies that all those who are not winners, i.e. are not finishing the season on top of the ranking in their sport, are not losers. The observation that they continue to compete is sufficient to prove that they get something (utility, prestige, money) out of their rank. For example, even if a tennis player knows for sure that he will never win the Wimbledon tournament because other players are just too strong he nevertheless competes because being number 20 (or number 100) in the world is still a goal worthwhile aspiring.

This way, the analysis encompasses a richer set of real sport situations. In the case of Wimbledon, for example, the individual match is indeed between just two players but the ultimate goal of each player is not to win only this particular match but to appear high in the world

¹Berentsen (2002), Berentsen and Lengwiler (2004), Haugen (2004), and Kräkel (2007). Some ideas developed in the present article were already present in Bird and Wagner (1997) but have not been formally investigated there.

rankings. In other words, in every sport season a tennis player competes with virtually every other professional tennis player although he is not fighting on the court for real with all of them. His decision whether to try to improve rank through the use of performance enhancing substances (in short, drugs) will thus probably not depend on the expectations about the doping activities of one particular opponent at this year's Wimbledon tournament but on the overall doping attitude within the community of professional tennis players.

Secondly, the consideration of many athletes – in fact we will consider all professional athletes in a sport – allows to address a particular phenomenon that receives a lot of press coverage and attention of other sciences but has so far not been investigated in the economic literature: the possibility of a doping *culture*. A doping culture can occur because preferences of athletes are interrelated. Each individual decision on drug use will not only depend on the rank that could be achieved therewith but also on the degree of peer-group approval or disapproval received from fellow athletes.

While the term “doping culture” was created from the news press it appears to be indeed quite appropriate against the background of thorough definitions of “culture” in sociology and anthropology. A sports community produces its own rules, own language, a code of practice, which is considered to be “normal”, it shares a common code of honor as well as common symbols (the gold medal, the yellow jersey). Technically speaking, sports communities may be even better described as *semi-autonomous fields*, a term developed in legal anthropology (Moore, 1973), i.e. as communities that develop their own rules embedded in the general rules of conduct of society at large. Nevertheless we will use the term culture here because it is by far the more familiar one.

In many countries it is illegal to prescribe and sell performance enhancing drugs but doping itself is not against the law. Doping athletes must thus not feel guilty from a legal perspective. Doping is forbidden by rules of athletes' organizations and the World-anti-doping-agency (WADA). These organization generally define doping as the “presence of prohibited substances in an athlete's body” but in order to make the general definition manageable they have drawn up so-called negative lists of substances.² If the use of drugs on the list is detected, the deviant athlete is punished with a temporary ban from competition (of two years in many sports). This

²In this article “drug use” is meant as a convenient simplification of “forbidden performance enhancing behavior” and may thus be thought of encompassing activities like blood doping that involves strictly speaking not the intake of chemical substances, i.e. drugs.

means also that athletes who use performance enhancing substances that are not or not yet on the negative list must not feel guilty for violating the rules of their sport. However, irrespective of whether the drug they use is forbidden or not-yet-forbidden, athletes may feel ashamed for cheating vis a vis their competitors. But then, if “everybody” is doping why should they stay clean?

This article argues that the awareness of doping fellow athletes affects the individual doping decision not only through its anticipated effect on ranking, i.e. through a standard game theoretic channel. Beyond that, the decision to use drugs is influenced by learning from and encouragement by peers (Sutherland and Cressy, 1974). If sufficiently many athletes are doping, the use of drugs may become a norm. Of course, such a doping norm is, if it exists, only operative within the athletes’ community. A doping norm, or doping culture, among professional athletes of a sport can be perfectly compatible with a different and probably directly opposed norm of the dominant culture, i.e. the general public, the spectators, and the journalists. The dominant culture may, in fact, despise “dirty athletes”.³

A rejection of society’s hostile attitude against doping is possible because in many sports professional athletes form closed communities. This allows them to produce and sustain their own norm for themselves and their activities. In the case of cycling, for example, Wieting (2000) has analyzed the sociology of the Tour de France and has observed that “there are two (rather than one) normative frameworks: one of the racers themselves and the other of the surrounding society.” This way, drug use can become widely approved within the group of athletes until it is seen as an essential prerequisite for success. This notion is taken one step further by Coakley and Hughes (1998). They argue that drug use by professional athletes should not be conceptualized as negative deviance but as *positive* deviance. It expresses an overconformity to key values in sport, most notably the value attached to winning.

An indication for the misconception of doping athletes as amoral cheaters is that there are frequently quite strong norms at work besides the official rules of the sport, norms that are approved by the society at large. At the Tour de France, for example, an unwritten rule dictates that competitors do not take advantage of a technologically related delay of a former champion. With respect to drug use there is the so called “first rule of the peloton” that dictates to never

³Athletes are aware of the fact that the dominant culture evaluates their behavior according to a different norm. Usually they thus deny the use of drugs even if there is no threat of punishment (anymore), for example, after they have finished a successful career. The “confessing cyclists” is a relatively recent phenomenon that will be discussed in the conclusion.

name fellow riders if caught doping.⁴

For many sports it is not just the doping issue where official rules and athletes' norms do not match. In soccer and ice hockey, for example, it is perfectly okay – if not a must – to play foul if this is the only way an otherwise certain goal against the own team can be prevented. In this case, of course, deviance from the rule is also approved by the group of spectators, at least by those who are supporters of the foul-playing team.

This leads to the question of what “fair play” in sports is. In the philosophy of sports there exists a small literature that defines “fair play” as the *ethos of a sport*.⁵ While the rules of a sport distinguish the permissible from the impermissible, the ethos of a sport distinguishes the acceptable from the unacceptable. While the rules are written in a book, the ethos is based upon shared experiences of the athletes' community. This way, the social practice of a sport defines the norms of the game, i.e. the unwritten rules that are conceptualized as “fair play” by the participants.

In this article I develop a model that obtains (for one set of formal rules) two locally stable equilibria. One where the majority of professional athletes uses drugs and one where all athletes stay clean. The individual doping decision and the share of doping athletes in a each sport season depends on benefits and costs as well as on the peer-group approval (or disapproval) of drug use. Approval is derived from the doping history of a sport, i.e. the share of athletes that were using drugs in the past.⁶

The next section sets up the basic model and solves the individual decision problem. Section 3 discusses social equilibria, i.e. aggregate dynamics and steady-states for the share of doping athletes and the peer-group approval of doping. Evaluating the comparative statics we discuss the impact of economic and social changes on aggregate doping behavior. Afterwards we consider some plausible extensions of the basic model: asymmetric effects of doping and staying clean (Section 4), the influence of the taste for victory (Section 5), and the correlation of susceptibility to approval and training effort, i.e. ex post ability (Section 6). The final section concludes and

⁴Interestingly, the rule is also obeyed by confessing cyclists who have long finished their career, like, for example, Bjarne Rijs. The few who have violated the rule were severely punished with peer group disapproval and career downturn. Filippo Simeoni, for example, who has spoken out against Lance Armstrong admitted that “sometimes I've regretted having spoken because the omerta always wins out”.

⁵(D'Agostino (1981), Morgan (1981), Loland and McNamee (2000); see Sheridan (2003) for an overview.

⁶There exists a small economic literature that uses similar ideas to investigate the welfare state (Lindbeck, et al., 1999), out-of-wedlock childbearing (Nechyba, 2001), and occupational choice (Mani and Mullin, 2004). Of these the present article shares most with Nechyba (2001) from which it borrows the idea for a straightforward diagrammatic exposition of social equilibria.

discusses policies that could bring about a regime change from a doping culture towards an all-clean equilibrium.

A team assistant injected me with EPO in my room. The logic is you adjust your performance level to the rest, because everyone is doing it.
(Joerg Jaksche)

2. THE BASIC MODEL

Suppose ability of competitors in a particular professional sport is continuously distributed in the unit interval. Athlete i has talent $A(i) \in [0, 1]$. Let's suppose that the rank of athletes in competition, for example at the PGA if the sport is golf or at the Tour de France if the sport is cycling, is also continuously distributed in the unit interval so that athlete i has rank $R(i) \in [0, 1]$. Rank 1 is the highest rank and rank 0 the lowest. In an ideal world ability would map one-to-one into rank, i.e. $R(i) = A(i)$. Yet, there is the possibility of doping to improve rank.⁷ Doping is a binary choice, $d \in \{0, 1\}$. An athlete either uses performance enhancing drugs, here denoted by $d = 1$, or he stays clean, denoted by $d = 0$.

Given the possibility of doping, an athlete's rank depends not only on his ability alone anymore but also on the decision to use drugs or not and on the doping decision of his competitors. Let θ_t denote the share of competitors who are using drugs in season t . It is reasonable to assume that – given ability – an athlete's rank is positively influenced by the decision to use drugs but that this positive effect vanishes as the share of competitors who are also using drugs increases. One analytically convenient way to implement this notion is by letting rank of athlete i in season t , $R_t(i)$, be determined by the following function.

$$R_t(i) = A(i) \cdot \{1 + \alpha [d \cdot (1 - \theta_t) - (1 - d) \cdot \theta_t]\}. \quad (1)$$

Generalizations and extension of the rank function will be discussed later in the article. According to the rank function there are two situations in which rank equals ability. The first possibility is clean sports: athlete i stays clean and so do all other athletes, $d = \theta = 0$. The

⁷We ignore the possibility of doping in order to manipulate a competitor's rank negatively (poisoning); a possibility which is mainly popular in horse racing. Doping a competitor's horse is excluded from analysis because this behavior is certainly regarded as cheating by the riders' community and the present article focusses on behavior that is *not necessarily* regarded as "unfair" or "against the rules" by the athletes, i.e. behavior where there is potential for approval within the athletes' community. An activity similar to doping as understood in this paper is the "rank swapping" behavior of sumo wrestlers (Duggan and Levitt, 2002) which clearly needs approval among athletes to work over a longer period of time and is conceived as cheating by spectators and society at large.

other possibility is completely dirty sports: athlete i uses drugs and so do all others athletes, $d = \theta = 1$. In between these borders an athlete can improve his rank through drug intake. This is captured by the first term in braces. Yet, frequently professional athletes describe their decision on doping with a different twist. They emphasize that they would lose ranking-wise if they opt against doping because (many of) their competitors are using drugs. This side of the argument is captured by the second term in braces. The loss of rank of a clean athlete is the larger the higher the share of doping athletes in his sport.

The parameter $\alpha \geq 0$ measures the general power of drugs, i.e. the possibility to manipulate rank. In the limiting case of $\alpha = 0$ using drugs has no effect on rank. The value of α characterizes the sport under investigation which may range from golf, which is generally associated with a low value of α , to cycling, which is currently possibly associated with the highest value of α .⁸

There are also costs of using drugs. We subsume individual costs in a parameter, c . These costs include the actual monetary costs of the drugs (which athletes frequently pay out of their personal budget) and the expected costs of losing one's job if being detected as a doper (losing the licence to compete in tournaments for a while, losing attractive advertising contracts). Costs may also include the fear of consequences later in life, like illness and premature death, caused by the unhealthy use of chemical substances.

In bearing these costs it helps if an athlete observes that many other athletes are also using drugs, i.e. if there is approval of doping by his peers. Let S_t denote the level of peer-group approval in season t . The magnitude of S_t is given to the individual athlete but endogenously determined by the share of athletes who were doping in the past. The degree to which athletes are influenced by approval of their actions is individual-specific, also distributed within the unit interval, and denoted by $\sigma(i) \in [0, 1]$. We assume that rank and susceptibility to approval are independently distributed. Along a line from zero at the left to one at the right we thus have the self-assured athletes who are not much influenced by peer-group assessment of their activities at the left end and those who are highly influenced by approval at the right.

If only a few athletes are using drugs, doping may be disapproved also within the athletes' community. The marginal strength of disapproval is denoted by ϕ so that $\sigma(i) \cdot \phi$ reflects the "stigma costs" experienced by athlete i if he is the one and only in his sport who uses drugs.

⁸For example, it has been shown that injections of EPO provide enhancements in endurance performance by 5% or more (Sawka et al., 1996, Birkeland, et al., 2000). A value which just exceeds the average gap between the winner's time and that of the last-place finisher in the last 10 Tours de France, which was 4,75% (Lindsay, 2007).

The overall importance of approval or disapproval for utility (compared to rank and costs) is measured by the parameter $\beta > 0$. In sum, peer-group approval of doping – which may turn to disapproval if negative – experienced by athlete i in season t is given by $\beta \cdot \sigma(i) \cdot (S_t - \phi)$. Sometimes we will also consider a reference case in which social influences play no role at all, i.e. $\sigma(i) = 0$ for all i . Comparing both cases enables us to assess the role of peer-group approval in sports and explaining the phenomenon of a doping culture.

Choosing $d \in \{0, 1\}$ athlete i maximizes his net utility which consists of rank minus costs of doping plus utility obtained from peer-group approval (or disutility caused by disapproval). Thus athlete i in season t maximizes

$$A(i) \cdot \{1 + \alpha [d \cdot (1 - \theta_t) - (1 - d) \cdot \theta_t]\} - d \cdot c + d \cdot \beta \cdot \sigma(i) \cdot (S_t - \phi). \quad (2)$$

If athlete i decides to stay clean and selects $d = 0$ he receives utility $A(i)(1 - \alpha \cdot \theta_t)$. Utility of a clean athlete is thus increasing in his ability and decreasing in the share of doping athletes whereby the magnitude of the loss through this depends on α , the power of drugs in his sport. If athlete i decides to use drugs and selects $d = 1$ he receives utility

$$A(i) \cdot [1 + \alpha \cdot (1 - \theta_t)] - c + \beta \cdot \sigma(i) \cdot (S_t - \phi).$$

Comparing utilities, the athlete decides to stay clean if

$$A(i) \leq \frac{c - \beta \cdot \sigma(i) \cdot (S_t - \phi)}{\alpha}. \quad (3)$$

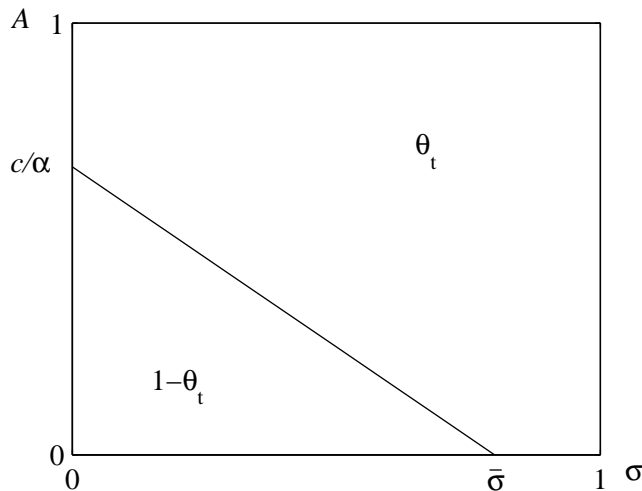
Let us first consider the reference case where peer-group approval plays no role for anybody, i.e. $\sigma(i) = 0$ for all i . Then, all athletes with ability lower than c/α stay clean. In other words, it are the high-ability athletes who are tempted to use drugs in order to further improve their rank. The overall share of doping athletes – if unaffected by peer-group approval – is thus given by $\theta = 1 - c/\alpha \equiv \theta_u$. It is decreasing in costs and increasing in benefits. For a positive solution it has to be the case that benefits exceeds costs.

Turning towards the case with socially interdependent preferences, we are tempted to conclude from (3) that peer-group approval of doping will increase the share of doping athletes. Interestingly, this is not generally true. Even if there is no stigma cost of doping (i.e. $\phi = 0$) there can be fewer doping athletes in social equilibrium. In order to derive this and other interesting results analytically we confine the analysis on uniformly distributed ability $A(i)$ and

susceptibility to approval $\sigma(i)$.⁹

Condition (3) evaluated with strict equality constitutes the separator between clean and dirty athletes. From (3) we see that athletes with the lowest σ stay clean if $A < c/\alpha$. With increasing σ the ability-threshold decreases until athletes are doping irrespective of ability when $\sigma = c/[\beta \cdot (S_t - \phi)] \equiv \bar{\sigma}$. This situation is shown in Figure 1. Note that high-ability athletes are now no longer necessarily identified as dopers (as it was the case without peer-group approval). Self-contained high-ability athletes, found in the upper left corner in Figure 1, may stay clean. Identified as potential drug users are athletes that are *simultaneously* of high ability and high susceptibility to approval of their actions.

Figure 1: The Separator between Clean and Drug-Using Athletes



Athletes are distinguished by ability $A \in [0, 1]$, with $A = 1$ denoting the highest ability, and by susceptibility to peer-group approval $\sigma \in [0, 1]$, with $\sigma = 1$ reflecting the highest susceptibility. The share of drug using athletes in season t is θ_t .

In order to focus the analysis on interesting cases we make the following assumption that entails a restriction of values for parameters.¹⁰

ASSUMPTION 1.

(i) *There exists at least one drug using athlete if preferences are independent from social stigma*

⁹All arguments made in this article are generally independent from the assumptions about distribution functions and many would be re-enforced by bell-shaped distribution functions. A uniform distribution, however, allows for analytical solutions and diagrammatic expositions of equilibria.

¹⁰Most of the results would hold true anyway but Assumption 1 spares us inconvenient case differentiations for their derivation.

and peer-group approval of doping. This requires $c < \alpha$.

(ii) There exist at least one drug using athlete if preferences are dependent on peer-group approval of doping and approval is at its maximum value ($S_t = 1$). This requires $c < \beta(1 - \theta)$.

Note that an all-clean sport is compatible with assumption (ii).

The area below the separator in Figure 1 gives the share of clean athletes. A static equilibrium in season t requires therefore that

$$1 - \theta_t = \int_0^{\bar{\sigma}} \frac{c - \beta \cdot \sigma \cdot (S_t - \phi)}{\alpha} d\sigma = \frac{\bar{\sigma} \cdot c}{\alpha} - \frac{\beta \cdot \bar{\sigma}^2 \cdot (S_t - \phi)}{2\alpha}. \quad (4)$$

Inserting $\bar{\sigma}$ and solving for θ_t we get

$$\theta_t = \theta(S_t) = 1 - \frac{c^2}{2\alpha\beta(S_t - \phi)}. \quad (5)$$

This shows that, given S_t , the share of doping athletes θ_t is decreasing in costs and stigma costs and increasing in effectivity and approval of doping.

You would have to be a fool or hypocrite to believe that anyone riding in a big race could manage simply on mineral water.
(Jacques Anquetil)

3. DOPING CULTURES

Peer-group approval itself is not a given constant but a lagged endogenous variable. It depends positively on the fraction of athletes who have used drugs in the past (and were either detected by public authorities or observed by their peers).¹¹ Let δ denote the time preference rate or rate of oblivion by which these occurrences are depreciated in mind so that approval is given by $S_t = (1 - \delta) \sum_{i=0}^{\infty} \theta_{t-1-i}$. Alternatively, this can be written as the period-by-period evolution of approval,

$$S_t = (1 - \delta) \cdot \theta_{t-1} + \delta \cdot S_{t-1}. \quad (6)$$

A social equilibrium is obtained where approval and thus the share of doping athletes stays constant, $S_t = \theta_t$. Insert this into (5) to obtain the following polynomial for the share of doping

¹¹All athletes are assumed to have the same correct information about S_t . We could have allowed athletes to make mistakes in assessing S_t for reasons that will become obvious below. Yet then we had to assume that all athletes make the same mistakes in order to keep the analysis analytically tractable and to get the same results.

athletes in equilibrium.

$$\theta_t^2 - \theta_t(1 + \phi) + \phi + \frac{c^2}{2\alpha\beta} = 0. \quad (7)$$

The polynomial allows for two positive solutions.

PROPOSITION 1. *If there is peer group approval of doping in sports according to the model described above, then long-run occurrence of doping requires that*

$$c \leq \bar{c} \equiv (1 - \phi) \cdot \sqrt{\frac{\alpha\beta}{2}}. \quad (8)$$

If condition (8) is fulfilled, then there exist 3 three social equilibria in sports:

$$\begin{aligned} \theta_t = \theta_{high} &\equiv \frac{1}{2}(1 + \phi) + \sqrt{\frac{1}{4}(1 - \phi)^2 - \frac{c^2}{2\alpha\beta}} \\ \theta_t = \theta_{mid} &\equiv \frac{1}{2}(1 + \phi) - \sqrt{\frac{1}{4}(1 - \phi)^2 - \frac{c^2}{2\alpha\beta}} \\ \theta_t = \theta_{low} &= 0. \end{aligned}$$

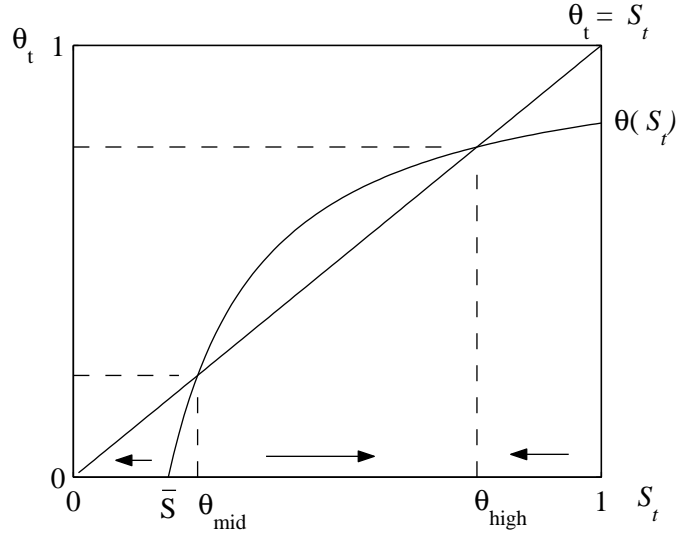
The equilibrium θ_{mid} is unstable. The equilibria θ_{low} and θ_{high} are locally stable.

Proof. The solution of (7) is θ_{high} and θ_{mid} . Since $\theta \in [0, 1]$ is a real number, the radicand has to be non-negative, which requires (8) to hold. For stability consider the $S_t - \theta_t$ diagram in Figure 2. Equilibria are found along the 45-degree line where $\theta_t = S_t$. Note that S_t is rising above the 45-degree line and falling below according to the evolution of peer-group approval described in (6). The share of doping athletes in a period t is given by the concave curve displaying the $\theta(S_t)$ curve according to (5). This curve hits the abscissa at $S_t \equiv \bar{S} = \phi + c^2/2\alpha\beta > 0$, cuts the 45-degree line from below at θ_{mid} and then again from above at θ_{high} . Thus the equilibrium θ_{high} is locally stable and the equilibrium θ_{mid} is unstable. If θ_t happens to be below θ_{mid} the social dynamics converge towards the origin, which is clean sports ($\theta = \theta_{low} = 0$). \square

PROPOSITION 2. *Given any initial share of doping athletes θ_0 in the first sport season $t = t_0$, the possibility that doping occurs at a social equilibrium and the share of doping athletes in such an equilibrium increases with decreasing personal costs of doping (c), increasing effect of doping on rank (α), increasing importance of approval (β) and decreasing stigma costs (ϕ).*

Proof. Calculate the comparative statics of θ_{high} and θ_{low} with respect to c, α, β , and ϕ . \square

Figure 2: Social Dynamics of Doping



$S_t \in [0, 1]$ denotes peer-group approval of doping in season t evolving according to (6). The share of drug using athletes is given $\theta(S_t)$ according to (5). Arrows indicate the direction of motion of S_t over time.

Doping can be eradicated if either benefits become too low or if costs become too high (e.g. introduction of strong legal punishments). In the fight against doping it helps if stigma is high or the general importance of approval is low. Diagrammatically, the comparative statics show that if one manages to shift the $\theta(S_t)$ function sufficiently much to the right (by lowering α or β or by increasing c or ϕ) the equilibria θ_{mid} and θ_{high} cease to exist. Expressing the same thing negatively, if doping in equilibrium exists, a small increase of costs or a small reduction in effectiveness will probably not manage to eliminate it. Needed are changes that are sufficiently drastic to render equilibrium θ_{high} non-existent.

Interestingly, the dependence of preferences on peer-group approval of doping can help to prevent doping as an equilibrium solution. To see this, note that without peer-group approval there are always some athletes who take drugs if $c < \alpha$. Thus, using (8), we can prove the following proposition.

PROPOSITION 3. *If*

$$(1 - \phi) \cdot \sqrt{\frac{\alpha\beta}{2}} \leq c < \alpha, \quad (9)$$

then there is doping in an equilibrium with ordinary, socially independent preferences but no doping in an equilibrium with socially dependent preferences.

If the condition holds, costs are sufficiently high to prevent doping in an equilibrium with peer-group approval but low enough to encourage doping by some athletes in an equilibrium without approval. Note that condition (9) can hold true even if there is no stigmatization of doping at all ($\phi = 0$). The intuition for the result is that also highly able athletes are influenced by peer-group approval. Suppose we are in a doping equilibrium. Triggered by a sufficiently high increase of its costs (according to (9)) some athletes start to stay clean. Initially these are mainly athletes of inferior and intermediate ability. Their staying clean reduces peer group approval of doping in the next period, which causes some further athletes to abandon drugs. With costs kept on the higher level but peer-group approval reduced, some further athletes are motivated to try their sport without drugs in the period after next period, which further reduces approval and a domino- or bandwagon effect (Granovetter, 1978) sets in.

Socially dependent preferences, however, also amplify the doping problem, if it occurs. If we observe doping under socially dependent preferences then we are at (or move towards) an equilibrium where a higher share of athletes uses drugs than without peer- group approval. To see this imagine the period where the first use of performance enhancing substances was observed. Let's call this period t_0 . By the logic of the evolution of approval (5) there was no approval of the activity before it occurred, i.e. $S_{t_0-1} = 0$. Thus in t_0 athletes decided independently whether to use drugs or not. And a share $\theta_u = (1 - c/\alpha)$ did it. Because we are observing doping today, several periods afterwards, the situation at t_0 must have been such that θ_{mid} was smaller than θ_u which ensures convergence towards the social equilibrium with doping θ_{high} . In the Appendix it is shown that if θ_{mid} is smaller than θ_u then θ_{high} is larger than θ_u , which proves the following proposition.

PROPOSITION 4. If doping occurs in a long-run equilibrium with peer-group approval, then the share of doping athletes is higher than it would be without approval.

In other words, the social dynamics have aggravated the problem of doping. Initially only athletes of highest ability used substances to further improve their ranking. Yet the peer-group approval generated by their activities caused some less able but highly influenceable athletes (the intermediate- A -but-high- σ athletes) to use drugs as well and a bandwagon effect towards the θ_{high} equilibrium set in. The next result demonstrates the absolute proportions of the doping problem under socially dependent preferences.

PROPOSITION 5. *If doping occurs in a long-run equilibrium with peer-group approval, then a majority of athletes is using drugs.*

Proof. Obvious from inspection of θ_{high} in propositions 1. □

Note that this renders a really strong result. If doping is an equilibrium outcome then the majority of athletes is doping irrespective of restrictions on parameter values, i.e. irrespective of the benefits with respect to rank that may be gained and irrespective of costs. Of such an equilibrium, where approval from a majority of doping athletes is responsible for it to be sustained over the long-run (i.e., technically, for its local stability), we speak as a doping *culture*. To use drugs has become the norm, it belongs to the ethos of the sport.

Maybe we have the impression that doping exists in a particular sport and peer-group approval matters but nevertheless the share of drug using athletes appears to be low and certainly not larger than 50 percent. The model explains this by transitional dynamics (see Figure 2). In this case athletes are either on the way towards the all-clean equilibrium or on the way towards the θ_{high} equilibrium, but still far enough away so that, right now, doping seems to be a problem for only a minority of athletes.

Finally, inspect (1) to note that the minority of clean athletes is accepting large losses in rank when a majority of fellow athletes is doping. The recognition of this fact has motivated the model's extension of the next section.

If I don't take this now I may end the year with such poor results that my contract won't be extended.
(Bert Dietz)

4. THE WEAK-ATHLETE ARGUMENT

This and the next sections consider some generalizations of the basic model. Here, we discuss disproportionate effects of doping and not-doping. Although last section's modelling of symmetric effects of doping and not-doping on rank may be appropriate for many sports there are some general rules in some sports and some situations in other sports that produce asymmetric effects. This is particularly true when the best performers in the field set standards that imply cut-off thresholds for all other competitors.

A strong variant of such a threshold rule exists in cycling at the Tour France (and other stage races). At each racing day the stage winner sets a cut off value on arrival time for all competitors.

Riders that arrive x minutes later than the winner are excluded from the competition at further stages, i.e. in our notation they are automatically assigned with rank zero irrespective of their original ability. In particular, sprint specialists who could compete for high rankings (the Green Jersey) at later stages on flat land are threatened by elimination during the mountain stages.

Among the confessing professional cyclists in 2007 the argument that they do not want to end as Tour drop outs was sometimes uttered as the motivation – if not as the justification – for their use of performance enhancing drugs. Actually, they would prefer to stay clean but because of the challenge set by an incredibly strong (and possibly drug using) stage winner they have to give in and join the collective of dirty athletes.¹² In many other sports the phenomenon occurs not as a general rule as in cycling but is situation-dependent. For example, nationally, the best athlete in a sports field sets a threshold value for participating at the Olympic Games. In all these cases a drug using winner, an athlete of anyway high ability, executes a disproportionately high threat on the career of clean athletes (even if they not aspiring to win but only to participate).

In order to capture the asymmetric effects of a doping culture on rank we introduce the parameter λ into the rank function (1).

$$R_t(i) = A(i) \cdot \{1 + \alpha [d \cdot (1 - \theta_t) - \lambda \cdot (1 - d) \cdot \theta_t]\}. \quad (10)$$

The doping motivation brought forward by athletes is reflected by a value of $\lambda > 1$. The larger λ , the larger the rank loss if an athlete stays clean relative to the rank gain of a doping athlete. Inserting (10) into (2) and comparing utility we get the result that an athlete stays clean if

$$A(i) \leq \frac{c - \beta \cdot \sigma(i) \cdot (S_t - \phi)}{\alpha [1 + \theta(\lambda - 1)]}. \quad (11)$$

One sees that the right hand side decreases as λ rises. A season t snapshot thus confirms the “weak athlete argument”: the higher the threat of rank loss λ and the higher the share of doping athletes θ_t , the lower the ability threshold that has to be crossed in order to enter the club of doping athletes.

In order to obtain the equilibrium share of θ_t we evaluate condition (11) with equality as separator between clean and drug-using athletes and proceed as explained in detail in the last section. We integrate the right hand side from zero to $\bar{\sigma}$, set it equal to the share of clean

¹²From 1948 to 1999 the average speed at the Tour de France raised from 32.4 km/h to 40.3 km/h. Interestingly, during the same period the variation of performance decreased tremendously. The share of riders managing to stay in the race and complete it in Paris raised from 20 percent to 70 percent.

athletes, $1 - \theta_t$, and solve for θ_t . This provides

$$\theta_t = 1 - \frac{c^2}{2\alpha\beta [1 + \theta_t(\lambda - 1)] (S_t - \phi)}. \quad (12)$$

In a long-run equilibrium we have $S_t = \theta_t$. Inserting this into (12) we get a polynomial of third degree in θ_t .

$$\theta_t^3 \cdot (\lambda - 1) + \theta_t^2 \cdot [2 - \lambda - \phi(\lambda - 1)] - \theta_t \cdot [1 + \phi(2 - \lambda)] + \frac{c^2}{2\alpha\beta} = 0. \quad (13)$$

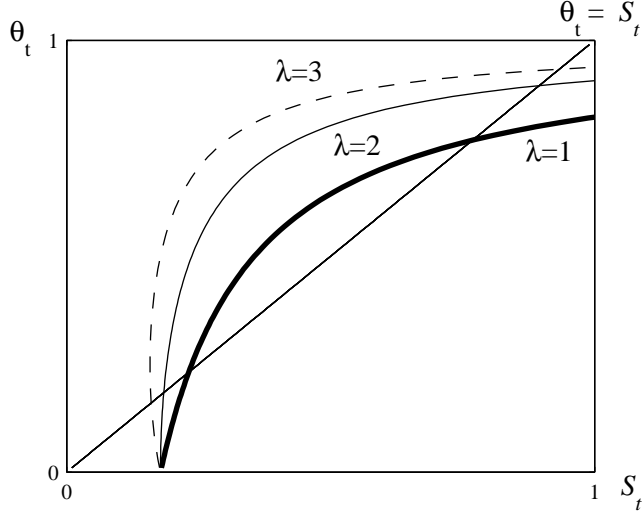
In general, solutions can no longer be conveniently discussed analytically. Before we consider the analytical solution of a special, limiting case and some numerical solutions we briefly return to the benchmark case without peer-group approval. Setting $\beta = 0$ in (11) and noting that without peer-group approval the low ability athletes define the separator between clean and drug-using athletes with critical ability $A(i) = 1 - \theta_t$, we see that the equilibrium solution for θ_t solves a polynomial of second order. This opens up the possibility of two equilibria for θ_t even without reliance on socially dependent preferences. It provokes the question whether peer-group approval is really essential in order to obtain the results of this article. Maybe it is enough to assume asymmetric effects of doping and staying clean to get a qualitatively similar results? However, this can be ruled out (proved in the Appendix).

PROPOSITION 6. Asymmetric effects on gaining rank through doping and losing rank through staying clean are not enough to produce two positive doping equilibria.

In other words, even if there are asymmetries, we still need peer-group approval to explain the results derived in Section 2 and 3. Turning towards equilibria with peer-group approval, Figure 3 shows numerical solutions of $\theta(S_t)$ -curve, as implicitly determined by (12), for alternative values of λ . Again, equilibria are identified at intersections with the identity, $\theta_t = S_t$. Recall from last section that the equilibrium at the first intersection from the left, θ_{mid} , is unstable and the second intersection θ_{high} is locally stable.

Figure 3 exemplarily visualizes a result that can be generally confirmed in numerical experiments. Increasing λ lowers the critical share of doping athletes θ_{mid} above which the social norm converges towards the doping equilibrium, and it increases θ_{high} , the share of doping athletes in long-run equilibrium. The intuition is straightforward. A rising λ increases the incentive for some lesser athletes to use drugs to prevent rank loss. This fact, which holds true for any

Figure 3: Doping Equilibria: The Impact of Relative Rank Loss from Staying Clean



Parameters are $\alpha = 0.45$, $\beta = 1$, $c = 0.4$, $\phi = 0$ and $\lambda = 1$ (thick line), $\lambda = 2$ (thin line), and $\lambda = 3$ (dashed line). Equilibria are obtained at intersections with the $\theta = S_t$ -line.

initial value of θ_t increases the share of doping athletes next season and increases peer-group approval of doping. Peer-group approval then feeds back and other athletes jump on the doping bandwagon. In the limit we get the following result.

PROPOSITION 7. *For $\lambda \rightarrow \infty$ the social equilibria converge towards*

$$\theta_{low} = 0, \quad \theta_{mid} = \phi, \quad \theta_{high} = 1.$$

Proof. For $\lambda \rightarrow \infty$ the polynomial (13) converges towards

$$\theta_t \cdot [\theta_t^2 - \theta_t \cdot (1 + \phi) + \phi] = 0.$$

The solutions are $\theta_t = 0$, $\theta_t = \phi$, and $\theta_t = 1$. □

For rising λ we end up in a doping equilibrium θ_{high} at which *every* athlete uses drugs irrespective of the benefits and costs of doping. Moreover, if there is no stigma cost for the first doper ($\phi = 0$ and thus $\theta_{mid} = \theta_{low} = 0$), then the all-doping solution is almost always attained irrespective of the initial share of doping athletes. The only remaining other possibility is the all-clean equilibrium, which coincides with θ_{mid} and becomes unstable.

Inspect (10) to verify that in the all-doping equilibrium rank is obtained according to ability

just as in the all-clean equilibrium. The social system thus ends up in an equilibrium where *every* athlete is worse off than in an all-clean equilibrium. Athletes get their rank according to ability and nevertheless bear the costs of doping. This result renders the conclusion that the athletes' community itself – not only spectators and politicians – should be in favor for a drastic reform of the rules and norms of their sport, a reform strong enough to allow the system to return to an all-clean equilibrium.

If it takes 10 to kill you, I'll have nine.
 (Tom Simpson, who actually died during the Tour 1967)

5. THE TASTE FOR VICTORY

It has been frequently argued that the unequal distribution of honors (and money) is at the root of all evil in professional sports. For example, in the Olympic games there is just one gold medal and only three medals altogether for any discipline. Already the fourth in competition returns home with empty hands, more or less just as every other a participant. If the olympic motto “participation is everything” was ever a social norm it is long gone and replaced by “winning is everything” if not by “winning is the only thing”.¹³

We discuss disproportionate effects from the aspiration to stay on the top by modifying the utility function so that an agent i gets utility $R(i)^\gamma$ out of his rank, $\gamma \geq 1$. The higher γ the higher the disproportionate effect of rank. For $\gamma \rightarrow \infty$ utility converges towards a step function, where the winner receive a utility value of one and all others athletes receive no utility at all, i.e. preferences converges towards the case where indeed “winning this the only thing.”

In order to investigate how the taste for victory affects the incentive for athletes to use performance enhancing drugs and how this changes the doping culture we rewrite (2) taking the reformulated utility from rank into account.

$$\left(A(i) \cdot \{1 + \alpha [d \cdot (1 - \theta_t) - (1 - d) \cdot \theta_t]\} \right)^\gamma - d \cdot c + d \cdot \beta \cdot \sigma(i) \cdot (S_t - \phi). \quad (14)$$

Athletes compare the solutions of (14) for $d = 0$ and $d = 1$ in their decision whether to use

¹³Asked whether they would take a banned substance that guarantees them winning a competition without being caught only 3 of 198 American athletes of Olympic standard said that they would not do it. Asked whether they would take a drug that guarantees them winning every competition for five years without being caught but entails also certain death caused by the drug's side effects after the five year are over, more than half of the athletes still answered that they would do it. (Andrews, 1998).

drugs or stay clean. Proceeding as in Section 2 we find that athletes with ability

$$A(i) \leq \left(\frac{c - \beta \cdot \sigma(i) \cdot (S_t - \phi)}{[1 + \alpha(1 - \theta_t)]^\gamma - [1 - \alpha\theta_t]^\gamma} \right)^{1/\gamma}. \quad (15)$$

stay clean. Again, integrating the right hand side over σ from zero to $\bar{\sigma}$ and equating it with $(1 - \theta)$ provides the equilibrium share of doping athletes in season t .

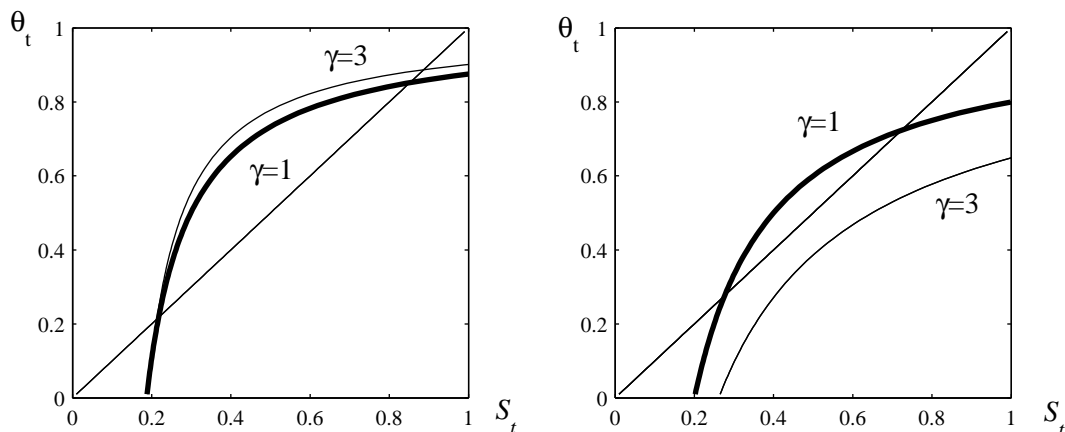
$$\theta_t = 1 - \frac{c^{1/\gamma+1} \cdot \gamma}{\beta(S_t - \phi)(1 + \gamma) ([1 + \alpha(1 - \theta_t)]^\gamma - [1 - \alpha\theta_t]^\gamma)^{1/\gamma}}. \quad (16)$$

Setting $S_t = \theta_t$ in (16) we get the long-run social equilibrium. Interestingly, a higher taste for victory does not necessarily lead to a higher share of drug-using athletes at the doping equilibrium. The direction of the effect depends on the general importance of peer-group approval given by parameter β . This is shown for two examples in Figure 4. Equation (16) is reflected by thick lines for $\gamma = 1$ and by thin lines for $\gamma = 3$.

The left panel in Figure 4 shows the case where approval plays a relatively important role for all athletes, $\beta = 3$. In this case a higher taste for victory – manifested in a rise of γ leads to a slightly higher share of drug-using athletes in the θ_{high} equilibrium. For the panel on right β is set to $1/2$ reflecting a case where the strength of peer-group approval is relatively small for all athletes. Now a higher taste for victory does not only reduce the share of drug-using athletes. It eliminates the doping culture entirely (there is not positive intersection with the identity line anymore).

For an intuition of the seemingly puzzling result recall that *ceteris paribus* it are the high-ability athletes who were most prone to use drugs. For the intermediate athletes a higher taste for victory (increasing γ) further lowers the utility that they derive from their rank. They probably will not win the gold medal even in the most favorite case, i.e. if they dope and others stay clean. But if peer-group approval of doping is large they use drugs if they get something out of a good intermediate position. This situation is shown in the left panel of Figure 4. On the other hand, when peer-group approval does not matter much and going for the gold (or winning the Tour) is all that counts, the incentive to use drugs decreases for all those who know that they won't get the first rank anyway. Now, with a lot of intermediate athletes staying clean, peer-group approval of doping deteriorates. As a result we either have less doping in equilibrium or a bandwagon effect towards a completely clean athletes' community sets in – as in case of showed in the right panel of Figure 4.

Figure 4: Doping Equilibria: The Impact of the Taste for Victory



The left panel shows a situation where peer-group approval plays a strong role. Parameters are $\alpha = 0.45$, $\beta = 3$, $c = 0.4$, $\phi = 0.2$ and $\gamma = 1$ (thick line) and $\gamma = 3$ (thin line). Equilibria are obtained at intersections with the identity, i.e. where $\theta = S_t$. The right panel shows a situation where peer-group approval plays a smaller role. Parameters are $\alpha = 0.8$, $\beta = 1/2$, $c = 0.4$, $\phi = 0$ and $\gamma = 1$ (thick line) and $\gamma = 3$ (thin line).

Summarizing, the results suggest that a high taste of victory, i.e. disproportionately high honors and income for those at the top of a ranking, does not necessarily aggravate the doping problem. On the contrary, taste for victory can even be beneficial because it reduces the incentive for weak and intermediate athletes to “do everything they can”. Their abstention from doping reduces peer-group approval and through that the share of doping athletes in equilibrium. The resulting bandwagon effect can be so strong that even the high-ability athletes give up using drugs.

When you know that 5,000 kilometers away, the president of the republic and the prime minister of your country are following the Tour stages, it's difficult to lose morale and motivation. And then, there are all those Kazakh flags on the side of the road.

(Alexandre Vinokourov)

6. “SUPERHEROES”

Although last section's result that taste for victory can reduce or eliminate a doping culture sounds plausible within the setup of the model, we may nevertheless perceive it as too good to be true. Over the last decades monetary rewards for winning have increased continuously in many sports causing a relative devaluation of the lower and middle ranking positions. Yet, the doping problem has if anything gotten worse. Maybe something is missing in model. In

this section we discuss a final modification of the setup, which renders the all-clean equilibrium non-existent. The result comes in two variants. In the severe variant there exists only a θ_{high} equilibrium in which a majority of athletes is doping whereas in the “mild” variant there exists also a locally stable θ_{low} equilibrium at which a minority of athletes (larger than zero) is using drugs.

In order to derive these results we replace the assumption that ability and susceptibility to approval are independently distributed by the assumption that they are positively correlated. I can offer no proof for this to be true, only a motivating argument. For that we distinguish “ability ex ante”, i.e. talent, and “ability ex post”, i.e. the sum of talent and training effort. It could then be that those athletes who are most prone to peer-group approval with respect to their doping decision are the same ones that are most prone to public approval with respect to their training decision. In short, those who get the most out of public celebration are those who train hardest. Simplifying, and in order to really make the point, we consider a one-to-one correspondence between ability and susceptibility to approval. One notion of this assumption could be that all competitors share the same ex ante talent and the more utility an athlete gets out of cheering spectators at the medal ceremony or appearances in newspapers and tv shows the higher is his training effort.

Setting $\sigma(i) = A(i)$ in (15) we find that athlete i stays clean in season t if

$$0 \geq \{A(i) \cdot [1 + \alpha(1 - \theta_t)]\}^\gamma - [A(i) \cdot (1 - \alpha\theta_t)]^\gamma - c + \beta A(i) \cdot (S_t - \phi) \equiv F(A(i)). \quad (17)$$

It is straightforward to show that $\partial F/\partial A(i) > 0$. It are, no wonder, the high-ability athletes who are most prone to use drugs. Since, given S_t , the incentive to dope is monotonously increasing in ability, condition (17) evaluated with equality provides the cutoff value for the share of clean athletes. Setting $A(i) = (1 - \theta)$ in (17) evaluated with equality we get the following implicit function that determines the share of doping athletes as an implicit function of peer-group approval.

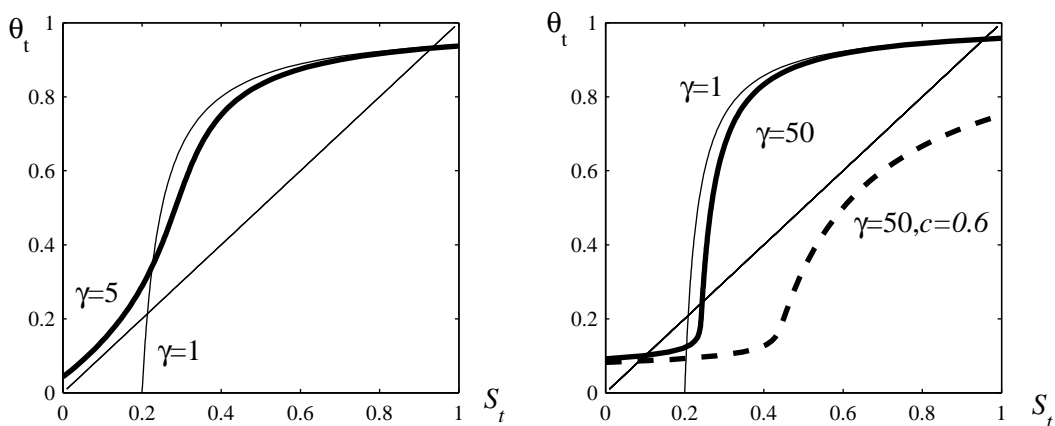
$$0 = \{(1 - \theta) [1 + \alpha(1 - \theta)]\}^\gamma - [(1 - \theta)(1 - \alpha\theta)]^\gamma - c - \beta(1 - \theta)(S_t - \phi). \quad (18)$$

Figure 5 draws the associated $\theta(S_t)$ -curve for two different scenarios. Again, social equilibria are found at intersections with the identity line. Thin lines show solutions for a model without special taste for victory ($\gamma = 1$). In that case the one-to-one correspondence between ability

and susceptibility to approval is the only deviation from the basic model. As before we observe a locally stable doping culture θ_{high} and a locally stable all-clean equilibrium. Focussing first on the left panel we consider a “medium” increase of the taste for victory reflected by a change of γ from 1 to 5. As a result, the intermediate equilibrium disappears and the θ_{high} equilibrium becomes globally stable. Only the very weak athletes who don’t compete about high rankings stay clean. A majority of high-ability and intermediate athletes uses drugs.

Intuitively, assuming a correlation between ability and susceptibility to approval has disabled the bandwagon effect. Recall that the social dynamics towards an all-clean equilibrium in the previous sections required that there are some intermediate athletes and at least a few very good ones who give not much on peer-group approval of doping. Now the best athletes are also those who are the most susceptible to approval of doping and a doping culture can become self sustainable among a subset athletes. For example, if the costs of doping increase, some athletes get clean. These athletes, however, are the ones within the subset of previous dopers who had simultaneously the lowest susceptibility to approval *and* the lowest ability. For the doping decision of the remaining drug-using athletes they just don’t matter. The drug-using athletes can sustain their doping culture on their own.

Figure 5: Ability–Susceptibility Correlation and the Taste for Victory



Parameters for the left panel: $\alpha = 0.1$, $\beta = 3$, $c = 0.1$, $\phi = 0.2$ and $\gamma = 1$ (thin line) and $\gamma = 5$ (thick line). Parameters for the right panel: as for left but $\gamma = 50$ (thick line) and $\gamma = 50$ and $c = 0.6$.

Qualitatively, the results shown in the right panel of Figure 5 are more interesting, and perhaps also more relevant. Here, we have changed the value of γ from 1 to 50, i.e. “winning is almost everything”. We see that a new, locally stable equilibrium emerges where a minority of athletes

is using drugs. Only a minority attaches enough value to the approval of their hard training and competes about the highest rankings. A majority of athletes is not willing to make these efforts and displays lower ability. Having no chance to win the olympic medals anyway, they prefer to stay clean. The value attached to lower ranks in their sport, however, is large enough to stay in the game, i.e. to maintain a career as a clean, not winning professional athlete.

The minority that uses drugs is identified as the highly able athletes. They form their own subculture within the sports community. All of them are competing for the highest ranks, all of them are using drugs, thereby generating enough approval for doping in equilibrium to be sustainable. They are also executing the highest training efforts because they get the most out of public approval, i.e. celebration of their rank. Again, the situation is sustainable because they will indeed be those that appear frequently at the highest ranks in each season's tournaments thereby receiving the public approval they need for training hard and using drugs. They are the superheroes of their sport.

An experiment with costs of doping (visualized by the dashed line) shows that a large increase of c from 0.1 to 0.6 eliminates the θ_{high} equilibrium but has almost no effect on the θ_{low} equilibrium. Because such a policy would clearly eradicate doping completely in the basic model, we thus conclude that the existence of a superhero equilibrium aggravates the fight against doping. While the majority of professional athletes reacts on largely increasing costs (more controls, heavier punishment) with abandoning doping, a minority of superheroes resists.

The fact that at a superhero-equilibrium the athletes of highest ability are those who try to further push their rank whereas the weak and intermediate athletes stay clean has an empirically verifiable implication. If we look at results in absolute terms (for example, arrival time at a mountain stage at the Tour de France) we should be able to observe a clear structural break between the best athletes in the field and the rest. Interestingly, in the year 2007 this was indeed observed at the Tour de France. The French press spoke of "le cyclisme a deux vitesses", two-speed cycling: one subset of riders climbed the mountains at incredible speed and sometimes seemingly without visible effort, and the rest of the peloton was left behind.¹⁴ The fact that some of the "superheroes" were either disqualified for doping (Vinokourov) or taken out of the race by

¹⁴A similar phenomenon was observed twice before. In 1999, after the Festina scandal, when the french cycling association unilaterally implemented stricter anti-doping rules, and in 2002, after reliable tests for EPO doping became available after which (allegedly) a few high ability riders (i.e. the team leaders) turned towards the much more elaborate and expensive blood doping causing a huge gap between their arrival times and those of the rest of the peloton.

their sponsors for violating anti doping surveillance rules (Rasmussen) is of course not enough to prove the theory. If however, there is some truth in the theory the observance of a two-speed peloton is probably good news rather than bad. It indicates the switch from a θ_{high} equilibrium where a majority is doping (and less variety in speed is observed) to a superhero-equilibrium where only the most determined riders are using drugs.

Fortunately, in reality ex-ante talent sometimes seems to be unequally distributed. This section is thus over-emphasizing the general point it wishes to make. A high taste for victory (i.e. disproportionate public adulation of winners) can be helpful in reducing doping if ability is independently distributed, but it can be dangerous if ability is a function of effort and through this channel linked with susceptibility to approval. Doping equilibria are relatively unlikely (and veneration of winners is probably not dangerous) in sports where talent matters much as compared to training. For spectators preferring to cheer at non-doping winners it is thus probably safe to venerate the achievements of Lewis Hamilton or Michael Schumacher.¹⁵ Sports where a lot can be achieved through hard training, in particular, endurance sports (cycling, swimming, track and field) are good candidates for a doping equilibrium. Note that this result has been developed independently from the fact that doping is indeed more powerful to manipulate rank in endurance sports (a high a value for α). Social and physiological effects are thus reinforcing each other.

We've reached a kind of endgame. It won't be ethics that brings this whole thing to a halt. It'll be money.
(David Millar)

7. CONCLUSION

This article should be seen as an essay in positive theory. It has not tried to develop normative arguments against doping. For societies where medical improvements of the natural endowments of beauty, powers of concentration, or happiness are socially approved it could indeed be not that easy to find a waterproof moral argument against medical improvements of natural talent in sports.¹⁶ Instead, the theory developed here showed how social dynamics can move a sport into an equilibrium where a large majority is using drugs without getting much out of it ranking-

¹⁵Of course, in car racing there could be performance enhancing manipulation of cars.

¹⁶See, for example, Kayser et al. (2007) for a compilation of anti-anti-doping arguments.

wise. Not because of sudden moral qualms but because costly doping has become so inefficient, a situation is reached where it is in the *self-interest* of the majority of professional athletes to get rid of their doping culture.

In principle, athletes could release themselves from the doping equilibrium. This however requires a strong collective action, i.e. a drastic reduction of θ_t so that the system leaves the domain of attraction of the locally stable doping equilibrium.¹⁷ If the athletes are not managing to accomplish the collective effort on their own, informed consumers of sport events can actually help them. Getting the help of informed consumers may thus have been the ultimate motive behind the “confessing cyclists” phenomenon in 2007.

Never before was the awareness among cycling spectators so large as in the Summer of 2007 that they don’t want “Gladiator Class Sports” (Juan Antonio Samaranch), i.e. a sport where athletes manipulate rank through (controlled) doping. For example, after it became public knowledge that he was not present for anti-doping controls in the run-up of the race, spectators at large started booing at the man carrying the Yellow Jersey (the race leader). This behavior was unseen before although there was always doping in the Tour’s over 100 years of history.¹⁸ Somehow, consumers at large found that they want to be sure to enjoy and share the accomplishments of clean athletes. And consumer sovereignty seems to work. For example, the team sponsor took the booed upon race leader out of the competition, probably in fear of the monetary damage done by a presumed doping Tour winner.

If the concerted public action of athletes and spectators is not able to eliminate the doping equilibrium what could policy do? Besides the obvious of increasing the costs of doping the model suggests some further conclusions.¹⁹ If ability and susceptibility to approval are uncorrelated it could work to further increase the adulation of winners in order to reduce doping among the generally gifted athletes and through this channel peer-group approval of doping. If, on the other hand, ability and susceptibility to approval are correlated a disproportionate adulation of winners could have the effect of eliminating the possibility of an all-clean sport. In this

¹⁷A collective action was tried by eight French and German teams at the Tour de France 2007. They formed the so called “Movement for Credible Cycling”, subjected themselves to additional, voluntary anti-doping surveillance, and organized sit-down strikes against doping before the beginning of stages. Since, nevertheless, some riders of the “Collective” were caught doping, the idea was not a complete success, but it was a signal.

¹⁸“I took aspirin for migraine, chloroform for my knees, and a bottle of cocaine for my eyes”, said Henri Pelissier, Tour winner 1923.

¹⁹Currently, participants of the Tour de France had to sign a “code of ethics” agreeing to pay a year’s salary in addition to two years suspension from cycling. Obviously this was not enough to deter doping.

case it could be wise to downplay the role of winners by, for example, distributing money and tv appearances more equally among all ranks that professional athletes can achieve. This can surely more easily be implemented in the case of money than in case of public appearances. In any case it could be worthwhile to eliminate or to reduce standards for participation that are set by the best athletes in a sport. Certainly, this is easier to achieve in some cases (stage disqualification cut offs at the Tour de France) than in others (qualification marks for the Olympic games).

Finally, it could be useful to think of cycling not as a special, particularly rotten sport but as a precursor of the things to come.²⁰ Because it is simultaneously so easy and important to improve performance in cycling the social dynamics have carried the athletes' community close towards the θ_{high} equilibrium already. Other sports are much farther away from the "endgame" situation so that both demand from the side of athletes as well as pressure from the side of consumers to abandon a doping culture is yet to come. In the future, when there are drugs that improve motor activities as, for example, the golf swing, other sports will have the advantage to learn from the current developments in cycling.

²⁰The infamous Operacion Puerto is known because it led to the downfall of many popular cyclists but already there the Puerto lists included more names of soccer and tennis players than cyclists.

Appendix.

Proof of Proposition 4. For $\theta_u > \theta_{mid}$ it has to be true that

$$1 - \frac{c}{\alpha} > \frac{1}{2}(1 + \phi) - \sqrt{\frac{1}{4}(1 - \phi)^2 - \frac{c^2}{2\alpha\beta}}.$$

Since $f(\phi) = (1 + \phi)/2 - (1 - \phi)/2 = \phi$, and $f' > 0$ it is sufficient for the above inequality to be fulfilled that

$$1 - \frac{c}{\alpha} > \frac{1}{2} - \sqrt{\frac{1}{4} - \frac{c^2}{2\alpha\beta}}.$$

For that it has to hold that $\sqrt{\cdot} > -1/2 + c/\alpha$, which leads after a little algebra to the condition

$$1 - \frac{c}{\alpha} > \frac{c}{2\beta}.$$

For $\theta_u < \theta_{high}$ it has to be true that

$$1 - \frac{c}{\alpha} < \frac{1}{2}(1 + \phi) + \sqrt{\frac{1}{4}(1 - \phi)^2 - \frac{c^2}{2\alpha\beta}}.$$

Since $g(\phi) = (1 + \phi)/2 - (1 - \phi)/2 = 1$, and $g' = 0$ it is sufficient for the above inequality to be fulfilled that

$$1 - \frac{c}{\alpha} < \frac{1}{2} + \sqrt{\frac{1}{4} - \frac{c^2}{2\alpha\beta}}.$$

For that it has to hold that $\sqrt{\cdot} > 1/2 - c/\alpha$, which leads after a little algebra to the condition

$$1 - \frac{c}{\alpha} > \frac{c}{2\beta},$$

which is just the same as above. Thus if $\theta_u > \theta_{mid}$ doping is observed as a long-run phenomenon and $\theta_{high} > \theta_u$.

Proof of Proposition 6. Compare utilities without peer-group approval ($\sigma(i) = 0$ for all i), to see that athletes stay clean if

$$A(i) \leq \frac{c}{\alpha [1 + \theta_t(\lambda - 1)]}.$$

The condition with equality provides the separator between clean and drug-using athletes. Thus the equilibrium share of drug-using athletes solves

$$(1 - \theta_t) = \frac{c}{\alpha [1 + \theta_t(\lambda - 1)]}.$$

The two solutions are

$$\begin{aligned} \theta_1 &= \frac{1}{2}x + \sqrt{\frac{1}{4}x^2 + y} \\ \theta_2 &= \frac{1}{2}x - \sqrt{\frac{1}{4}x^2 + y}, \quad \text{where} \\ x &= \frac{2 - \lambda}{1 - \lambda} \end{aligned}$$

$$y = \frac{(1}{\lambda - 1)} \left(1 - \frac{c}{\alpha}\right).$$

Note that Assumption 1 together with $\lambda > 1$ guarantees that $y > 0$. Suppose $\lambda > 2$. Then $0 < x < 1$ and $y > 0$. Hence, $\sqrt{y + x^2} > x$ implying $\theta_1 > 0$ and $\theta_2 < 0$. Next suppose $1 < \lambda < 2$. Then $x < 0$ and $\sqrt{x^2 + y} > 0$. Hence $\theta_1 < 0$ and $\theta_2 > 0$. Thus there exist not two positive solutions smaller than one for $\lambda > 1$, which proves Proposition 5.

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