



# *Performance enhancement in sport “Gene doping”*





Should the use of performance enhancing drugs be permitted in sport?

1 = strongly disagree

2 = disagree

3 = agree

4 = strongly agree





## Drugs in sport: EPO

- Normal values: 1-19 (24) mU/ml

Do you think any of your athletes have taken EPO?

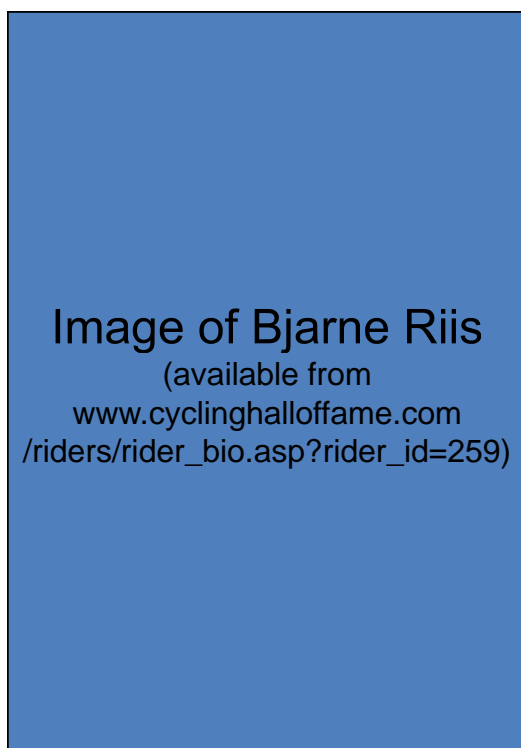
- Abdul
- Tom
- Ann
- Mary

Any alternative explanations?

- Altitude training
- Bacterial contamination- Belgian triathlete Rutger Beke (2005).
- Masking agents
  - Protease
- Recombinant EPO (1980s)- test 2000
- Continuous erythropoietin receptor activator (CERA)

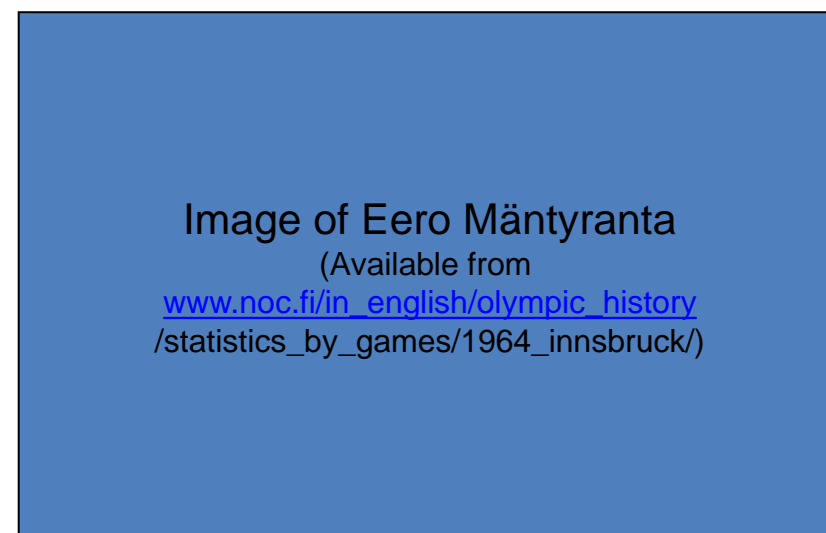


## The Telekom Affair



Bjarne Riis  
1996 Tour de France

## Eero Mäntyranta



7 medals (3G), from 4 Olympics  
Mutation EPOr gene



## Unbeatable world records

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Event	Record	2011 Best	Athlete	Nationality	Year
100 m	10.49	10.7	Florence Griffith	USA	1988
200m	21.34	22.2	Florence Griffith	USA	1988
400 m	47.6	49.35	Marita Koch	East Germany	1985
800 m	01:53.3	1.55.87	Jarmila Kratochvílová	Czechoslovakia	1983
1,500 m	03:50.5	4.00.06	Qu Yunxia	China	1993
Mile	04:12.6	4.29.59	Svetlana Masterkova	Russia	1996
3,000 m	08:06.1	8.46.84	Wang Junxia	China	1993
5,000 m	14:11.2	14.20.87	Tirunesh Dibaba	Ethiopia	2008
10,000 m	29:31.8	30.38.35	Wang Junxia	China	1993
100 m	12.21	12.28	Yordanka Donkova	Bulgaria	1988
400 m	52.34	52.57	Yuliya Pechonkina	Russia	2003
High	2.09 m	2.07m	Stefka Kostadinova	Bulgaria	1987
Long	7.52 m	7.19m	Galina Chistyakova	Soviet Union	1988
Shot put	22.63 m	21.24m	Natalya Lisovskaya	Soviet Union	1987
Discus	76.80 m	67.98	Gabriele Reinsch	East Germany	1988
Heptathl	7,291 pts	6880pts	Jackie Joyner-Kersey	USA	1988



## Gene doping

"the non-therapeutic use of cells, genes, genetic elements, or of the modulation of gene expression, having the capacity to improve athletic performance".

Schematic of how genes are inserted into deactivated  
virus's then injected into muscles

Available from <http://sgugenetics.pbworks.com/w/page/38371765/Gene%20Therapy>



What would you alter to increase sporting performance ?

- 187 genes known to be linked to athleticism



Follistatin transgenes  
EPO-blood production

*“Schwarzenegger mice”*  
IGF-1: Muscle function

Images of muscles of control & Schwarzenegger mice  
Available from  
[www.nature.com/nature/journal/v387/n6628/pdf/387083a0.pdf](http://www.nature.com/nature/journal/v387/n6628/pdf/387083a0.pdf)

Video of Mighty mice  
Available from  
<http://www.youtube.com/watch?v=5hfXUVReySs>

*“Mighty mouse”*  
PEPCK-C





Do you think it is right to use genetic techniques to improve our athletic or sporting performance

1 = strongly disagree

2 = disagree

3 = agree

4 = strongly agree





Do you think that it is right to use genetic techniques to cure disease?

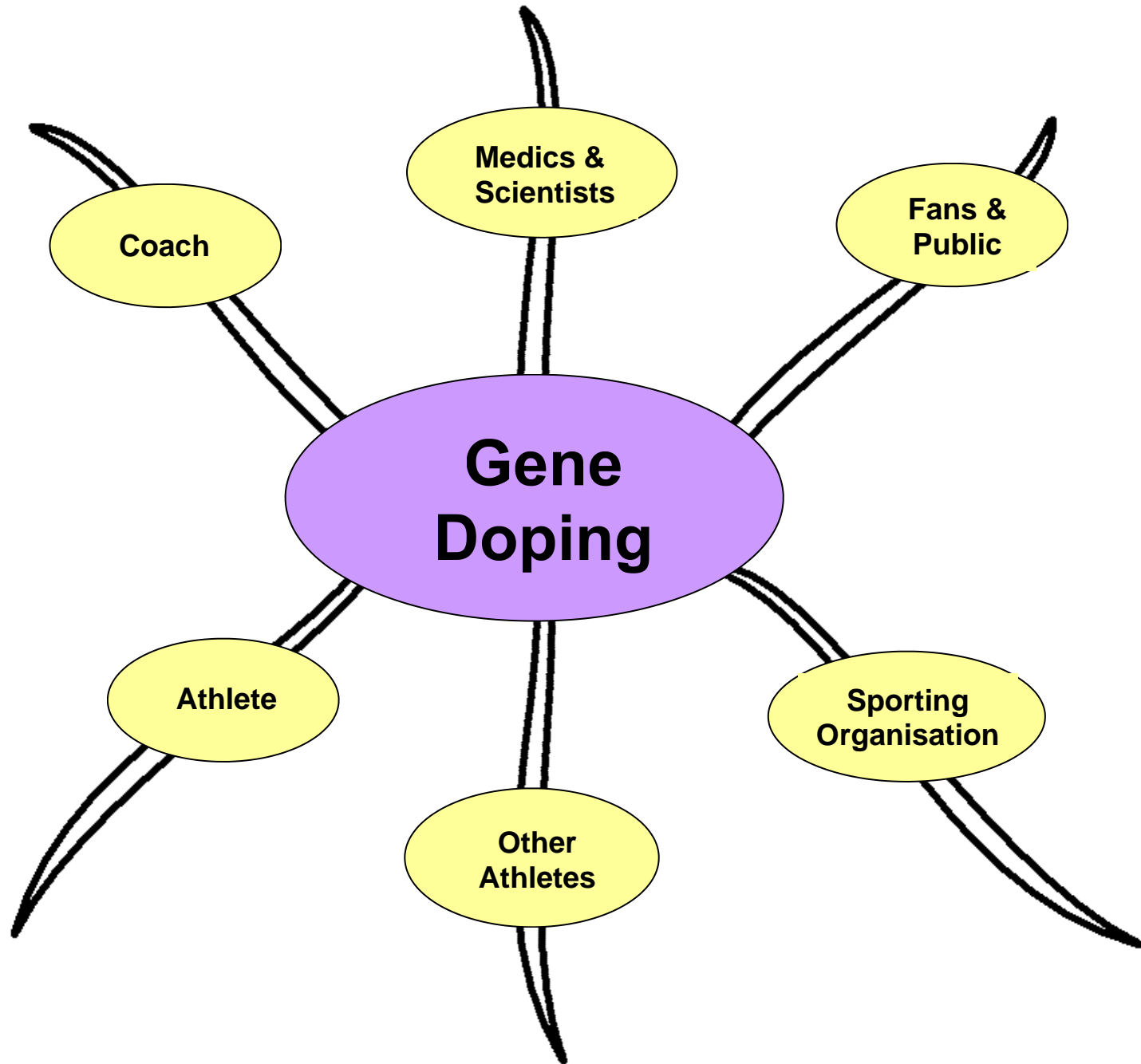
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Performance enhancement in sport

*Any questions, comments or  
final thoughts?*



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## Mighty Mouse: The world's strongest mouse

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Humorous gene doping video available  
from <http://www.youtube.com/watch?v=6dRSsnbvfVY>