

Frequently Asked Questions

- *What does your finding tell us about mate selection among humans?*

In many animals, we see that females consistently prefer some males over others. Although in our own species there is of course a substantial amount of individual variation in what we find attractive, also we consistently find some faces more attractive than others.

For such a preference to evolve, females that express this preference have to gain some kind of benefit, for example because the preferred male is a better father for her offspring (for example by bringing more food), or because he provides them with good genes.

In this study, I tested whether one of those benefits might be that a women would get a partner with better endurance performance. Although endurance is very difficult to asses directly, there is something in the face that signals this. This is not unlike female deer assessing the quality of a male by looking at the size of his antlers, or to take an Australian example, fairy wren females judging a male on the basis of his plumage.

So far most studies looking at male attractiveness in humans have focussed on masculinity, with the idea being that more masculine males are both more attractive and have higher testosterone levels, and are therefore stronger. Instead I chose to look at endurance, as there is good evidence that in our evolutionary past high endurance performance may have been particularly beneficial (also see below).

On the whole, my study shows four things:

- 1) Even when presented with a relatively homogeneous set of male faces (all Caucasian, between the age of 20-30, very well trained, not overweight), some faces are consistently found to be more attractive than others.
- 2) Some of this variation is associated with their performance during the Tour, which shows that facial attractiveness signals, among others, endurance performance.
- 3) This suggests that there must have been an evolutionary advantage (i.e. better survival, more offspring) to having a high-endurance partner, suggesting that there is more to a good partner than lots of muscles and testosterone.
- 4) Although this benefit may not exist any more, it shows that some of our behaviour is a relict of our evolutionary past (also see below).

- *Why would an evolutionary biologist study attractiveness in cyclists?*

Evolutionary biologists are interested in variation, between individuals, populations and species, and they try to find out how this variation is generated and how it is being maintained.

In my research I take a very pragmatic approach to the choice of study organism, which has resulted in publications on birds, insects, fish, and mammals, including humans. Besides an evolutionary biologist, I am also a runner and a cyclist, and follow the Tour de France and all the other big cycling races. This study allowed me to combine both interests.

I am using ideas and analytic methods from evolutionary biology and apply them sports data, trying to explain variation in performance and attractiveness. This study shows that

evolutionary biology and sports, i.e. evolutionary fitness and physical fitness, may have more to do with each other than we often think.

- *Why study attractiveness and fitness?*

In a wide range of species, females show clear preferences when it comes to the choice of their partner. We try to understand how these preferences have evolved. Sexual selection theory proposes that external male features like antlers or plumage coloration signal to a female whether he will be a good father to her offspring, and/or whether he will provide them with good genes. By choosing a high-quality male as partner, a female will gain benefits in terms of a higher reproductive success, or what evolutionary biologists call fitness.

Although it may not be obvious what it is in a male face that makes him attractive, we can test whether his facial attractiveness is correlated with some aspect of quality. There are good reasons to believe that one of these aspects of quality is his endurance performance.

- *Why endurance? Isn't it all about strength?*

Sure strength is important, as it might help you scare off your neighbor if he makes advances on your wife, but when it comes to hunting, endurance might bring you much more. Before humans invented spears and bow and arrow, strength alone would have brought you very little. Although you might be able to knock out a gazelle, it will have run off well before you got the chance to raise your fist. However, when we can keep track of the animal long enough and prevent it from catching its breath, on the long run one would be able to outrun it. Such chases would have gone on for hours on end, day in day out and would require a lot of endurance. By choosing a mate with high endurance, a woman would have gotten a man who would bring home plenty of food for her and her kids.

- *What about sprinters?*

Although not everyone may be aware of it, but cycling is actually a very tactical sport. Each team has a leader, whose aim it is to finish as high as possible in the general classification, and he is supported in this by several helpers (domestiques). Additionally, there are riders who specialize in sprint finishes or big climbs.

I was here interested in obtaining a measure that captured variation in endurance and the ability to perform at high level over the full three weeks of the race. Therefore I chose to base it on a rider's performance during the prologue (a short time trial on the first day, two longer time trials in the second and third week, and finally the total of all stages (minus the time for the time trials). This means that riders that performed consistently well across the whole race received the highest performance score. This performance correlated well with their final placing.

It should be noted that although the individual time trial can probably be considered the 'purest' test of performance, domestiques and sprinters may be less motivated to give everything they during these stages. It will introduce some noise in the measure of performance I used here. On the other hand, the fact that they are a sprinter or a domestique is likely because they score lower in terms of endurance.

Although it would be very interesting to test whether we would also find a relationship between attractiveness and sprinting or climbing performance, pure sprinting or climbing performance are more difficult to quantify in a quantitative and objective manner. Although there are the polka-dot and green jersey for the winner of the climbing and points

classification, respectively, these are not necessarily won by the best climber and sprinter. Furthermore, both show severely skewed distributions.

- What about doping?

Unfortunately, no discussion of variation in performance in professional cyclists is complete without mentioning doping. The two most extreme scenarios, which are that either everybody is doping to the same degree or nobody is doping at all, are unlikely to affect any of the patterns shown here. In support of the latter, there are indications that professional cycling nowadays is a cleaner sport than it has been during the previous decades. Furthermore, there were only two positive doping cases during the 2012 race. Things get trickier if there is variation in whether or not riders are doping, and/or in the degree to which they are. However, also under this scenario the patterns observed here could only arise if either doping would increase one's facial attractiveness, or if attractive riders would be more likely to dope.

- Why do this study in professional cyclists, and not in a group of undergraduate students, like most other studies?

Although this would be interesting to do as well, there are two problems with this. First of all, it is very difficult to get a good measure of endurance in a group of untrained and unmotivated volunteers, and it would probably be impossible to get them to run for, say, ten hours, and see how far they get. Furthermore, there will be lots of variation in how much somebody trains, how healthy they eat, etc., and this may either create or obscure a relationship between attractiveness and performance.

- Our ancestors didn't have bicycles, so why did you not do this study in marathon runners?

Whereas a Tour de France rider sits on his bike for 90 hours or more, elite marathon runners complete the marathon in a bit more than two hours. Completing the Tour de France may thus be more similar to spending day in day out hunting down animals than is running a marathon.

Also, whereas almost all Tour de France riders are European and North-American, the top marathon runners are Kenian and Ethiopian, and it may be more difficult for European and North-American raters to judge their attractiveness. Unfortunately, it is much more difficult to recruit raters from African countries.

Although the marathon might be the most famous long-distance running event, there are actually quite a few running races in which participants cover distances of 100 kilometres and more, sometimes taking several days. Unfortunately however, participants in such races are much more heterogeneous. Furthermore, neither portraits nor data on for example height or weight are available for these races.

- But all these riders are exceptional athletes. Isn't there way to little variation in such a homogeneous sample?

Although all riders participating in the Tour de France are amazing cyclists, some are amazing sprinters, others are exceptional climbers or time-trialists. As a consequence, there is actually quite a lot of variation among in terms of endurance. This is very different from, for example, marathon runners, who are all good at exactly that, running a marathon.

- How did you determine which riders to select from the 2012 Tour, was it random?

The short answer is yes, it was random. The longer answer is that I initially made a short-list of all riders that started the race (198), and then removed all those that didn't finish (45), those that were wearing sunglasses, caps or beards (15), those that were not photographed from the

front (13), with 'unusual' haircuts or facial expressions (4), and where the lighting was different (8). Finally, for 7 riders I didn't have data on height and weight. This resulted in a set of 104 portraits that were as standardised as possible, and from these I randomly selected 80.

- How did you get the participants to rate their looks?

I created an online survey, in which participants saw a portrait of the rider, and they were asked to rate his attractiveness on a scale from 1 to 5, with 5 being the highest. I additionally asked whether the rater knew who the rider was. If the answer was yes, I excluded this rating. This is important because this way we can be sure that knowledge of how good they actually are didn't affect their perceived attractiveness. As an aside, this also showed that most people know very little about professional cycling, or at least about the riders, as the three best-known riders were known by 7.7%, 6.8% and 4.6% of the raters, and 59 out of the 80 riders were recognised by 1% or less.

- Can men judge the attractiveness of other men?

Several men wrote to me that they couldn't participate in the survey because they felt they were unable to judge the attractiveness of other men. However, looking at the ranking based on the mean attractiveness scores provided by female and male raters, I found an extremely close match between the two (the correlation was effectively 1). Men are thus very well able to judge the attractiveness of other men. This ability may in fact be quite important, as it would allow men to spot potential competitors.

- There appears to be a difference between women dependent on where they are in their menstrual cycle or whether they are taking the pill. Can you explain this and why it occurs?

This finding is in accordance with other studies that have found that women using the pill show a reduced preference for indicators of male quality. One explanation for this pattern is that the pill mimics the hormonal state of pregnancy, and if you are already pregnant, other characteristics may be more important in a partner (e.g. faithful, reliable). However, although this is a reasonable hypothesis, and my result is in accordance with this, it is extremely difficult to test directly.

Alternatively, women using the pill and those that don't may of course be different in other ways as well, and this may be responsible for the observed difference. This is a weakness of this and most other studies showing an effect of the pill.

- Does this mean the winner of the Tour should be the best looking?

I am by no means suggesting that it is all about attractiveness. Indeed, if you would want to predict who is going to win the Tour, it is best to look at their body mass index first, which is a better predictor of their performance. Similarly, there are many other variables (most of which are unknown) that contribute to attractiveness in addition to performance.

Nevertheless, good-looking riders do on average perform better: If we take the 10% best- and the 10% worst-performing riders, then the top 10% is on average about 25% more attractive. The other way around, the 10% most attractive riders finish on average 31st out of 80. The 10% least attractive riders finish around place 60 (out of 80).

- Does being good-looking give a rider an advantage in some way?

The mechanism that is mediating the association between performance and attractiveness remains so far unknown. Whether some aspect of the face that we are picking up on, or if it is about male-male competition is a question I really hope to address in the near future.

- *You talk about human endurance being a target for selection in early hominids. Why would there still be evidence of this trait in modern humans given foraging etc is no longer an important element in survival?*

As long as there is no selection opposing it, such an adaptation will stick around. Although past selection favouring high endurance performance is sufficient to explain the patterns we see nowadays, selection might have continued to act in a more indirect manner. It might for example have affected how long you can work on your land, and even nowadays, it might be associated with a more healthy lifestyle, resulting in fewer cardiovascular problems etc. However, the latter is pure speculation, but again something I would really like to look into in the future.

- *Who (name/s) was/were the most attractive (top ten)?*

1. Amaël Moinard
2. Yann Huguet
3. Maxime Monfort
4. Andriy Grivko
5. Michael Schär
6. Martin Velits
7. Christophe Riblon
8. Adam Hansen
9. Rui Alberto Costa
10. Manuel Quinziato

- *Could you please help me to understand and explain the correlation between attractiveness and performance with easier statistics?*

The result is easiest to understand from Figure 1A, in which I have plotted a rider's attractiveness against his performance. What you see there is that on average the riders that performed better (i.e. were faster) were more attractive. However, there is lots of variation on top of that, and for example the most attractive rider was only average in terms of performance.

I can summarise the relationship as follows: If we take the 10% best- and the 10% worst-performing riders, then the top 10% is on average about 25% more attractive. The other way around, the 10% most attractive riders finish on average 31st out of 80. The 10% least attractive riders finish around place 60 (out of 80).

- *What do you want the public to learn from this study?*

First of all, that it is interesting to look at our own species through evolutionary eyes. Furthermore, this study shows that despite our extensive culture, biological principles still apply to us. I also hope I have brought evolutionary biology a bit closer to the general public and that I have made people think about attractiveness in a different way. Finally, I may have made cycling a bit more interesting to all those people that thought that is the most boring sport to watch on TV.

- *What makes a face attractive?*

Although I was able to show that some faces were on average rated as more attractive, unfortunately the photos I used were not standardised to measure what exactly it is in the face that makes it attractive. Several studies have suggested an important role for symmetry, with

more symmetric faces being more attractive, but there might also be other things that are important. I would really like to look at this in my future research.

- Do you think the same might be true for everyday cyclists (e.g. guys who stay fit by cycling) and attractiveness?

I think most people would agree that exercising increases attractiveness. Indeed, I suspect that for many people it is the reason! Although at first sight this may sound obvious, this again raises the question why this is the case. It would be really interesting to see how various types of sports (strength versus endurance versus coordination) affect attractiveness.

- Do you think a similar correlation could be found if men rated female athletes?

It would be great to look at this in the future. If the pattern I found is really due to a female preference for male endurance, and this is the only driver, we would probably not expect to find a relationship in female endurance athletes. However, this is probably a rather simplistic view, and attractiveness may well correlate also with general health and 'fitness'. And who says women did all the choosing? So on the whole, I think we could expect a positive, a negative or no relationship, so it would be great to look at this.

- Could it be cyclists are more attractive than the general population?

Yes, it is quite likely that elite cyclists are more attractive than the general population. First of all, they are young men who work out a lot, spend a lot of time outside and who are generally healthy. This in stark contrast to the general population, which spends most of its time sitting inside an office, doesn't get enough exercise and eats unhealthy. Furthermore, fame, wealth and success make you more attractive, and at least the more famous riders tick all these boxes.

Although at first sight this may sound all very obvious, the interesting question is WHY we find these characteristics attractive. It is the latter question that I as an evolutionary biologist am trying to answer.

- But maybe they are not more attractive, they are just perceived to be more attractive!

The important thing to keep in mind here is that attractiveness is not a trait by itself. Instead, it is the result of a preference for a particular trait (for example a six-pack in men or high cheekbones in women). So there is no difference between being attractive and being perceived as attractive!

For example, there is nothing inherently attractive in a bird with a long tail. However, in some species females find males with long tails more attractive than males with short tails, because long tails go together with other positive characteristics of that male. For example, this male may have good genes that he will pass on to his offspring, or he may be a particularly good father. Hence, females that show a preference for long tails (i.e. find long tails attractive) will on the long run have more offspring than females that prefer short tails. As a consequence, a preference for long tails evolves. If for whatever reason it were the males with the short tails that were of better quality, females would find short tails attractive! This scenario is what evolutionary biologists call sexual selection, and it has been studied in many species, from fruit flies to red deer, as well as in our own species.

- How can we explain the fact that we tend to find well-trained people more attractive?

For such a preference to evolve, females must gain a benefit in terms of reproductive success from choosing such a partner. Although this may not be the case any more, it is likely that in our evolutionary past such benefits were there, with fitter males being able to bring home

more food to their family and being better able to protect you and your children. Of course they didn't care about having a partner that was a good soccer player, but at least some of the things that make for a good soccer player (strong, fast and healthy) also make for a good husband and father!

So how do you recognise the perfect husband? In the case of the cyclists, this might be quite easy as you already have a lot of information about them. Simply the fact that they made it to this level means a lot. But what if you meet a stranger in the street? Here we tend to pay a lot of attention to the face, which suggests that there are certain facial characteristics which are signalling some aspect of quality.

- But what if it is the other way around? Could it be that more attractive people are more successful at elite sports?

It is not either-or, but rather a two-street. Attractiveness is correlated with athleticism because both are associated with the same characteristics. Studies have shown that more attractive people are treated preferentially (they earn more money etc.) and they may have more self-confidence, which may give them an advantage when it comes to sports. However, it doesn't answer the question why we find some people more attractive than others, and why would treat them differently.

- Where can I read more about this study?

The original paper is open access and can be found here:

<http://rsbl.royalsocietypublishing.org/content/10/2/20130966.abstract>

Popular articles have appeared, among others, in

The Economist: <http://www.economist.com/news/science-and-technology/21595889-new-study-suggests-link-between-cyclists-looks-and-their-performance-hot>

Outside Magazine Online: <http://www.outsideonline.com/news-from-the-field/Are-Better-Athletes-Better-Looking.html>

New York Times: <http://www.nytimes.com/2014/02/06/sports/cycling/cycling-study-says-hearts-race-with-the-riders.html> (appeared in print on February 6, 2014, on page B13 of the New York edition)