

Concept Paper

Competition, Gender Equality, and Doping in Sports in the Red Queen Effect Perspective

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Abstract: The nature of sports is characterized by a strong competitive component that generates inequalities among athletes at different levels, specifically in relation to gender, technology, and doping. These inequalities can be represented according to the Red Queen effect perspective, which has been previously hypothesized in other competitive environments (evolutionary biology and economics, for instance). The Red Queen effect considers each competitive environment to require a constant effort to maintain a position of competitive advantage in order reach the best result possible. Therefore, the aim of the current paper is to provide an innovative perspective for the understanding of competition in sports, identifying factors (i.e., physical appearance for gender equality, socioeconomic status of a sport team for technology, and antidoping rules for doping) influencing athletes' possibilities to win a competition. Concerning gender differences, the disparity between genders reflects a lower coverage in sports news, and media are more likely to focus on female athletes' physical appearance than their performance in sports. Therefore, women struggle more with increasing their visibility and in affirming their status as an athlete. On the other hand, the introduction of science and technological innovations in sports has generated economic interests in sport competitions, which reached superior performance levels compared to the past. Teams that cannot afford financial burdens of technological innovation risk being left out from sport competitions. Finally, doping creates a Red Queen environment since antidoping rules catch a small portion of athletes using performance enhancement drugs.

Keywords: red queen effect; gender equality; sport competition; performance enhancement drugs; innovation; technology



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1. Introduction

The founder of the Olympic Games, Pierre de Coubertin, summarized the spirit behind sport competitions within the following sentence at the 1908 London Olympics: "The most important thing is not to win but to take part" [1]. Across the following decades, its meaning dramatically changed into "faster (Citius), higher (Altius), and stronger (Fortius)", highlighting the importance of reaching the best possible result instead of mere participation. In line with this perspective, modern sports has become a field where technological superiority and ideological superiority compete with the desire to gain money and fame, which are barely related to the amateur spirit. At the same time, the development in areas such as information, communication, health, and material science induced a different

understanding of competition in sports. Porter [2] pointed out that competition is a main factor in order to be successful in any field, and, conversely, the absence of competition inevitably results in failure. In the sport environment, awards and opportunities provided by the sports industry keep competition alive [3]. During the last 30 years, developments in information and communication sectors have facilitated the acquisition of both written and visual information about any competition, method, diagnosis, or treatment all over the world [4–9]. Moreover, developments in the health sector have contributed to the diagnosis, treatment, and rehabilitation processes of the athlete's injuries, with shorter times for the athlete's recovery and adaptation processes under different environmental conditions [10–16]. These innovations increased the amount of economic rewards in terms of winning.

At this stage, all sport clubs and organizations that follow and have the possibility to implement the latest scientific and technological developments compete at the same level. Indeed, athletes or teams that cannot update themselves with this form of development are left out, with the risk of engaging in unethical actions such as doping. Moreover, the increase in sports economic value has worsened the position of female athletes, whose participation in sports is often hindered by cultural constraints, such as stereotypes and media representation of sports [17].

The competitive environments, such as the one described in biological evolution hypothesized by Van Valen [18] or the business environment [19], are usually framed in the Red Queen perspective, which points out the role of a continuous improvement to survive within that environment. The adoption of the Red Queen effect allows a deeper understanding of the dynamics existing within the environment, and specifically for sports, this effect may concern gender differences, technology, and doping.

The sports field is mainly interpreted with respect to masculinity, and this is particularly noticeable by the media representation of female athletes who are evaluated based on their physical appearance rather than their skills. Therefore, women invest more effort in order to be noticed for their skills.

In relation to technology, the different possibilities to access technological equipment and scientific knowledge reflect different possibilities to attain success in sports.

A previous study by Kayser and De Block [20] hypothesized that the Red Queen effect concerning doping is mainly generated by the World Anti-Doping Agency's (WADA) restrictions upon the use of doping substances. According to the authors, this effect would disappear if doping rules were relaxed.

Considering the Red Queen effect permits the identification of what factors are not under the athlete's control (i.e., physical appearance for gender equality, socioeconomic status of a sports team for technology, and antidoping rules for doping) that influence their possibilities within a competition [21–23]. Therefore, the current paper aims to frame inequalities arising in the sports sector by referring to the Red Queen effect, which allows the estimation of the contribution of environmental situations on athletic performance. The Red Queen effect has been associated with sports only concerning the doping phenomenon [20], but no studies were found about gender equality and technological disparities.

2. The Red Queen Effect in Sports

Inequalities in sports can be framed in a Red Queen Effect perspective, which usually arises in a competitive environment [24]. The Red Queen Effect concept was first used by the American evolutionary biologist Leigh Van Valen [25,26], taking inspiration from a dialogue between Alice and the Red Queen in the book *Through the Looking Glass*.

In the book, Alice met the Red Queen and started a race. The Red Queen left Alice behind in the run and told her to run faster. However, no matter how fast Alice ran, she could not reach the Queen as the objects around her were moving with her. In the end, when the Red Queen told her to stop, Alice complained that she had been running for a long period of time and, in her country, running that fast would have brought her somewhere else. The Red Queen responded that it was a slow country, and she had to run with all her

strength just to stay there; however, if she wanted to reach another location, she would have to run twice her speed.

The Red Queen effect has been used to explain many different behaviours from biology to military fields [27], but it is mainly related to evolution and economy. In evolutionary biology, this effect refers to a continuous development process based on species survival efforts [28–31], while from an economic perspective, it relates to competitive actions and moves among competitors [32–34].

The common denominator of both areas is that a continuous improvement is needed to survive. Moreover, in the sports field, athletes and organizations are required to invest in information, communication, and health technology in order to reach the best possible result.

3. Gender Inequalities in Sport Competitions and the Red Queen Effect

Gender equality matters can be observed through the Red Queen effect perspective, specifically concerning two aspects: media coverage and physical appearance.

Sports is a field strongly affected by gender disparities, especially concerning the media's portrait of athletes and sports news coverage. Media still frame some sports as masculine (such as football and basketball) and some others as feminine (e.g., gymnastics and figure skating) [35]. In this manner, the achievements of women in feminine sports and male achievements in masculine sports are emphasized, disregarding the results of women in masculine sports and vice versa [36]. According to a survey by Scully and Clarke [37], male athletes tend to participate in more popular sports (e.g., golf) that are, at the same time, framed as "masculine".

Notably, females encounter more barriers than males, since sports reveal to be an exclusionary environment characterized by discriminatory practices towards men, women, and gender-diverse people [38]. Moreover, apart from their performance, women in sports are judged on the basis of their physical appearance, their attractiveness, and their status of motherhood [39,40]. Specifically, media attention on female athletes is often focused on their bodies and their attractiveness [41,42]. Even concerning physical advantages, the general attitude is different in the case of male and female athletes. For example, the American swimmer Michael Phelps has a greater wingspan than his height, where usually these two measures should be equal, representing a greater advantage of the action of pulling in water. Caster Semenya is a female athlete who has, similarly to Phelps, a genetic advantage. In 2009, she improved her record times in track and field thanks to her body that, according to media, looks "too masculine". After 2009, she underwent a gender verification test proving that she is a woman, while in 2019, the Swiss Court ordered that she reduce her testosterone levels. Sport commentators and journalists rarely talked about the unfair advantage Phelps had in comparison to other swimmers, but they did focus on this advantage in Semenya's case [43].

However, the focus on physical appearance is equalized for males and females once popularity has been reached [44]. In other words, once an athlete becomes famous, public attention is directed at athletic performance and physical appearance for both male and female athletes.

Concerning the Red Queen effect, women seem to be less effective than men in competitive environments, even if they are able to perform the same task in a non-competitive environment [45]. Therefore, considering the sports environment, they are required to double their efforts with impressive performances in order to be considered as "skilled" and for obtaining popularity.

4. Technological Disparities among Countries

The access to scientific and technological opportunities overcomes these differences, and athletes experiencing these opportunities gain superiority compared to their competitors, even before the competition begins. Specifically, countries that can access science and technology for achieving sports efficiency are more likely to be successful in sports, while

countries that do not have the same economic availability tend to show less interest in innovation [46].

The United States, which is one of the most successful countries in sports, has been using science and technology for advances in sports. For example, the Oregon Project, funded by Nike to train long-distance runners, integrates the latest science and technology for improving athletes' performance. The program comprises measurements of the optimal intensity of athletes' heart, lung, brain, kidney, and liver values from athletic training programs; oxygen and blood tests following the development of aerobic capacity; personal nutrition programs; and vibrating platforms used to improve leg strength.

In 2018, runners that wore the Nike Vaporfly 4% won the 100 km marathon, half-marathon, and 15 km distance race, further breaking world records. Such an outcome was so impressive that Burns and Tam [47] proposed that, to preserve the spirit of the universality of the athletics, a regulation of shoe midsole thickness should be necessary. According to the authors, this action would maintain competitiveness at a foot-race level. These practices can create differences in competition for athletes from other countries who may not have such opportunities.

In a Red Queen effect point of view, countries without this economic opportunity struggle more compared to richer countries in entering a competition and in maintaining their position inside the sport business. Furthermore, technology itself is a field where the Red Queen effect exists [48], especially concerning the imitation process. We can, therefore, hypothesize that technological advances in sports may generate a Red Queen Effect concerning the employment increased funding in research and technology, where countries that do not have these possibilities are left out of the competition.

5. Understanding Doping According to the Red Queen Perspective

According to the Red Queen Effect, athletes need to be twice as good to enhance their performance levels. This means that they must deal with their own efforts and the efforts of the competitor athletes [27], but this comparison relates only the maintenance of their current positions, since staying in the same place is not an indicator of superiority [49]. Consequently, they may have increased possibilities to improve their performance, ranging from the latest findings of science and technology to the use of the prohibited substances. These actions are undertaken to achieve "equality" with their competitors and to compete and increase performance at all costs.

The history of doping in sports starts from the human growth hormone (HGH), which is one of the most-used prohibited substances. This substance was first used in the treatment of patients with a non-functioning pituitary gland or whose body does not produce growth hormones by itself. Similarly, erythropoietin drugs were first produced for the treatment of anaemia due to kidney failure, according to the World Anti-Doping Agency (WADA). Later on, these drugs were discovered by athletes, who employed them for performance enhancement purposes [50]. After these drugs were slowly forbidden, other drugs were experimented with and consumed; for this reason, the WADA list, containing all substances that enhance performance, is constantly updated. Starting from the second half of the twentieth century, by determining which substances are used for enhancing sports performances, new doping test technologies have been developed [50].

Currently, almost hundreds of doping agents and different methods have not been defined as prohibited substances or methods [51]. This race between athletes and WADA resulted in a determination of doping control tests, methods, and rules. From the athlete's side, problems in accessing scientific and technological possibilities and inequalities stemming from physiological differences can push athletes to use prohibited substances because antidoping programs are considered ineffective and inefficient by athletes, and the penalties are inadequate [52]. However, even though athletes try to improve, their competitors will continue their development in order to protect their place. As a result, athletes will only be able to maintain their place.

Moreover, some of strategies identified with the word “doping”, in the meaning of “performance enhancement”, are not considered as unethical compared to other methods. Specifically, performance-enhancing strategies that do not imply the assumption of the use of a substance (i.e., haematology, nutrition, environmental factors, sports equipment, and technology) are barely taken into account when establishing fairness in competitions [53]. The so-called “Technological Doping” [54] raises many questions about equality and fairness in sports and highlights impossibilities in preventing the use of unfair technology to increase performance. For example, one of the first technological doping cases took place at the Union Cycliste Internationale (UCI) Cyclo-Cross World Championship. It was later noticed that one of the cyclists gained superiority thanks to an engine hidden inside their bicycle [3]. As observed by Ganse and Degens [55], human performance in sports seems to be declining compared to the 1980s. The authors maintain that this decline might be related to stricter regulations and punishments concerning doping. It is well-known that, in the 1980s, a massive use of performance enhancement drugs might have produced an increase in athletic performance. This trend could change by an increase in sport equipment technology, as suggested by Negro et al. [56].

According to the Red Queen Effect, self-development and learning in a field does not provide a continuous advantage, since this advantage is constantly lost [57]. Kayser and De Block [20] specifically analyzed the phenomenon of doping according to the Red Queen effect. They maintain that a Red Queen effect concerning doping exists only because the WADA system only detects a small portion of athletes using drugs to enhance their performance. According to the authors, if all athletes participated in doping, a uniform upward shift would occur. Consequently, no Red Queen effect would occur if the doping rule is relaxed.

6. Discussion

Sports is a field where inequality is a recurring feature, which can be examined with several points of view. The current paper aims to identify these inequalities and to frame them in the Red Queen effect perspective. This is the first study in the literature in which the concepts of the Red Queen Effect and sports are managed together, except for one study about doping by Kayser and DeBlock [20]. The importance of this paper consists in providing a new perspective about sport environments, framed as a competitive environment, where athletes need to adapt and take care of aspects that are not under their strict control but still influence and impair their possibilities in winning a competition. Competition is one of the main features of sports, and scientific and technological developments contribute to the rise of new meanings in sports. Thanks to this interest, awards and rewards in sports have highly increased. On the other hand, inequality in sports has increased in line with rewards, and ethical violation developments have brought competition levels to another dimension. Despite this, economic interest has been one of the most critical tools that enabled sports to become an industry. In this scenario, accessibility to technological equipment and scientific knowledge decreases for poor countries that risk of being left out from the competition [58].

The Red Queen Effect highlights that being successful in sport does not depend only on sports performance itself. It emphasizes the adaptations that athletes must implement in order to ensure their participation in a particular sport. One of these adaptations can be represented by doping. The doping phenomenon is a problem that stands in a “grey zone”: From one side, society asks for “natural and fair” sport competitions; however, on the other side, in many sports, it is not physiologically possible to reach highest performances through nutrition, technology, and a supportive team, as maintained by Negro et al. [56]. In relation to this, the authors suggest that the correct use of technology can be considered as an opportunity to integrate the human physiology of movement with safe methods without inducing side effects on the athletes’ health. In this manner, the Red Queen effect would be reduced, and athletes can safely improve their performance. Furthermore, the harshness

of antidoping rules that identify specific types of substances as illegal may magnify the problem instead of solving it [20].

Concerning gender inequality, the accessibility to sports is not equal between genders, as females struggle more than males in practicing certain types of sports [59]. This is mainly related to media coverage and the media portrait of female athletes. Specifically, from one side, their physical appearance is considered more important than their performance in sports. From the other side, media representation covers a large portion of male athletes' achievements and a small portion of results from female athletes, inducing the idea that sports are more suitable for men. In this sense, the Red Queen effect may represent the effort that women undertake while trying to affirm their position in a specific sports domain. In fact, they need to double their efforts in order to be accepted compared to men athletes.

Future research may use this framework to estimate the extent to which inequalities in sports impair athletes' chances of winning, also focusing upon differences between individual vs. group sports.

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