

## **From therapy and enhancement to assistive technologies: an attempt to clarify the role of the sports physician**

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### **Abstract**

Sports physicians are continuously confronted with new biotechnological innovations. This applies not only to doping in sports, but to all kinds of so-called enhancement methods. One fundamental problem regarding the sports physician's self-image consists in a blurred distinction between therapeutic treatment and non-therapeutic performance enhancement. After a brief inventory of the sports physician's work environment I reject as insufficient the attempts to resolve the conflict of the sports physician by making it a classificatory problem. Followed by a critical assessment of some ideas from the U.S. President's Council on Bioethics, the formulation of ethical codes and attempts regarding a moral topography it is argued that the sports physician's conflict cannot be resolved by the distinction between therapy and enhancement. Instead, we also have to consider the possibility that the therapy-based paradigm of medicine cannot do justice to the challenges of the continuously increasing technical manipulability of the human body and even our cognitive functions as well. At the same time we should not adhere to transhumanist ideas, because non-therapeutic interventions require clear criteria. Based on assistive technologies an alternative framework can be sketched that allows for the integration of therapeutic and non-therapeutic purposes. After a thorough definition of standards and criteria, the role of the sports physician might be defined as that of an assistant for enhancement. Yet the process of defining such an alternative framework is a societal and political task that cannot be accomplished by the sports physicians themselves. Until these questions are answered sports physicians continue to find themselves in a structural dilemma that they partially can come to terms with through personal integrity.

## Introduction

We can distinguish sports physicians in general from team doctors and so-called health-care professionals such as physiotherapists. Here I will not go into the further distinctions between sports doctors and team doctors and the other health specialists involved, since ultimately the sports physician treating an athlete as individual patient faces the same conflict situation as the team doctor or specialist.<sup>1</sup> The sports physician, who I take as my primary example here, plays a central role in questions of doping insofar as he or she provides medical supervision and counseling for the athletes. If the athletes do not illegally stock up on substances, the sports physician is a possible source for those substances and methods that are prohibited by the WADA regulations and that thus can be classified as doping and sanctioned accordingly.<sup>2</sup> As in the case of legal medical treatment, the complexities of pharmacological application usually ask for medical supervision to achieve the desired effects. Hence the sports physician can have a very precarious role that will only get more acute in the future with the increasing development of biotechnological procedures and applications. In the following I will clarify the difficulties for the physician's self-understanding that result from the broader topic of enhancement. Besides the common response of reacting to these difficulties with an ethical code, we also have to consider the possibility that the therapy-based paradigm of medicine cannot do justice to the challenges of the continuously increasing technical manipulability of the human body and even our cognitive functions as well.

The challenge of the priority of the therapy-based paradigm follows from the need to not only evaluate the risks and benefits of human enhancement technologies but also to place the issue of their use in the broader context of the values that determine what we regard as a worthwhile development of human well-being.<sup>3</sup> The sports physician's dilemma then serves as a starting point to clarify our concept of human augmentation in general and helps to identify an alternative framework for biotechnological intervention in humans. It is important to note that the formulation of such a framework is a delicate undertaking as the step towards a transhumanist concept of enhancement is easily done. But, as I try to show, such a step that subordinates the attention for all the dangers and risks of enhancement under the idea of universal scientific progress does not follow necessarily. Instead, the ethical attention for the vulnerability of human beings and the often unclear perspectives regarding future technological developments may also lead to a position that complements therapy by enhancing intervention – an approach based on assistive technologies that is not exclusively based on a therapeutic imperative and thus allows for enhancing.

In the first section I will offer a brief inventory of the sports physician's work environment. In the second section I reject as insufficient the attempts to resolve the conflict of the

sports physician by making it a classificatory problem. In the third I critically assess some ideas from the U.S. President's Council on Bioethics, the formulation of ethical codes, and a moral topography with the result that the sports physician's conflict cannot be resolved by the distinction between therapy and enhancement. At the same time this impasse shows a promising framework that at least could allow for a reasonable distinction of the role of the sports physician from non-therapeutic interventions in humans. In the fourth and final section I will discuss the sports physician's role in the broader context of the pros and cons of enhancement and sketch an alternative framework based on assistive technologies that does not draw exclusively on a therapeutic imperative and therefore allows for enhancement as not opposed, but complementary to therapy.<sup>4</sup>

### **1 Inventory: the work environment of the sports physician**

For the sports physician the realm of competitive sports is particularly pregnant with conflict and tension.<sup>5</sup> Although we can find aspects of sports medicine even in antiquity, it is in the previous years that the area of *high-performance sports medicine* (HSPM) has most intensively developed.<sup>6</sup> Insofar as these doctors work as part of a supervisory team for an athlete or a sports team, they have to mediate and balance diverse interests. Besides their focus on the health and well-being of the athlete they are treating in the role of doctor, they also have a close relation to the coach and the team administration. The traditional dual doctor-patient relationship expands to become a triad of doctor-patient-team<sup>7</sup>, and this brings with it a potential for conflict between the different interests and priorities. For example, whereas it is healthier in the long-term for an athlete with a knee injury to undergo a long knee-operation, the team's interest is in a short-term intervention and a quick recovery. In this case the athlete has to decide between playing (when it might be decisive for the season) along with the danger of later arthritis that the quick intervention means, or not playing with a healthier future. The doctor cannot and should not make this decision for the athlete, and can only inform him or her about the consequences of both alternatives. But it can also be in the interest of the team and the coach not to let the athlete decide autonomously. Hence this type of situation can present a conflict of interest for sports physicians if their success depends on the performance of the athlete or the team.<sup>8</sup>

In this context there have been various assessments of the situation of the sports physician.<sup>9</sup> Speed and Jaques take a rather naive approach to the potential for ethical conflict and argue for the continued scientifically-based development of HPSM. But there are also more skeptical voices that call just as strongly for an explicit ethical examination of the issue.<sup>10</sup> In this regard it is worth mentioning Steinacker's programmatic perspective. He sees the future of sports medicine in the "good sports physician"<sup>11</sup> whose model is a sort of

ideal type. The good sports physician conveys fascination and independence while developing himself from technical expert to well-meaning counselor and doctor “who is not oriented around short-term successes but rather particularly supports long-term prospects such as health, career, and the development of personality.”<sup>12</sup> Treating health problems without performance manipulation is a central point in this. Donike took a similar position 20 years earlier and saw the sports physician faced with a “difficult but thankful responsibility”<sup>13</sup> in that he has to “do justice both to the athlete’s desire for the greatest individual performance and the pressure from league administrators to observe the statutes and the rules of sportsmanship”.<sup>14</sup> Steinacker’s and Donike’s claims are interesting in that both show an explicit awareness of the problem and yet both see a possible solution in the personal integrity of the sports physician and the league administrators. Geiger takes a more critical stance to this in arguing for “placing the medical responsibility [of maintaining health] over and above the interests of an unreflective pursuit of performance”<sup>15</sup>, in order to restore to the sports medicine its holistic duties of prevention, diagnosis and therapy. He measures the success of sports medicine in how it leads to athletic success “via health as much as possible”<sup>16</sup>.

In summary, we have here a complex situation in which the distinction between a therapeutic treatment, i.e. a medically necessary treatment, and a performance-enhancing treatment, i.e. one that is not recommended for medical reasons, is not an appropriate one in the case of the athlete. For non-athletes the restoration of a normal state of health applies unambiguously, whereas for the athlete restoring performance includes necessarily enhancing performance, since the athlete restores their performance ability in order to increase it. Even if restoration and enhancement of performance might still be distinguished in the case of the athlete, restoration becomes inferior to enhancement; the former is only a means for the latter. Hence two mutually antagonistic realms meet here. The realm of increased athletic performance and the realm of medical therapy that at most includes a restoration of performance mutually exclude each other insofar as increased athletic performance is not a therapeutic goal in the true or classical sense. A classical therapeutic goal would be the restoration of a state of health that allows the athlete to play a sport or to train to increase performance but that does not directly promote such increase through enhancement. To resolve this difficulty, we would have to be able to state exactly when a medical intervention entails not just a restoration of performance but an increase in performance. We can see how such a classification of the work of the sports physician fails to lead us further if we look at an example of such an attempt.

## 2 The relation between medicine and sports medicine – more than a classificatory problem

Edwards and McNamee explicitly describe the ambivalence in which sports medicine finds itself and come to the conclusion “that sports medicine is not medicine”<sup>17</sup>. Their argumentation rests on a “class inclusion claim”<sup>18</sup> and can be summarized as follows: medicine has the mandate to relieve suffering.<sup>19</sup> Yet alongside this responsibility, sports medicine *essentially* follows the mandate to increase performance; hence sports medicine cannot belong to the class of medicine, since the former has a necessary attribute that the latter categorically excludes. Moreover the authors reject a possible expansion of the concept of health to include the realization of biological potential, which would include performance increase in the sense of enhancement, by showing that such an expanded concept of health would have implausible consequences.<sup>20</sup>

However, the argument is ultimately not convincing in that it ignores the actual contradiction found in the work of sports physicians. The practice of sports medicine contains a potential for ultimately ethical conflict precisely because of its ambivalence, in that the entirety of the sport physician’s work relies on medical knowledge that is then applied in a context that is not strictly therapeutic, i.e. a context in which a person suffers involuntarily. An athlete suffers willingly, as his physical complaints are occasioned by his athletic activity. Hence we find a voluntarily induced therapeutic context, which, as I already suggested, differs from the typical treatment situation in that the athlete aims at increased performance despite a physical limitation.

Hence the alleged degradation of sports medicine to “those practices such as areas of cosmetic surgery that are performed for no therapeutic purpose”<sup>21</sup> neglects the actual problem. What is decisive is the structural ambivalence of sports medicine *between* therapy and performance increase, since in the case of the athlete these two purposes of medical procedures diverge. Here the physician finds himself in an aporetic situation in which he is supposed to make a purportedly clear distinction in an area that is made unclear by his own action in enabling the athlete to continue training or competing.<sup>22</sup> The conservative definition of medicine as *relief of suffering* cannot solve this problem but rather solidifies it. The ethical nature of the entire conflict about sports medicine shows that it is not just a classificatory problem according to which sports medicine describes an “empty category, a class of no content”<sup>23</sup>. If we wish to do justice to the medical foundation and medical self-understanding of sports physicians in light of biotechnological innovations and the greater increase in performance this allows, it makes more sense to determine a new class of biotechnological intervention.

### 3 Attempts to solve the sports physician's dilemma

The U.S. President's Council on Bioethics, in its report 'Beyond Therapy', ultimately finds this contrast between the two idealized models of therapy and performance increase to be insufficient for a normative assessment of the spectrum of non-therapeutic effects of medically based interventions. The report summarizes the problem as follows: whereas therapy aims at restoring a normal state,<sup>24</sup> every type of performance increase involves striving to exceed the normal state, rendering the central and obligatory responsibility of medicine a marginal or extraordinary one – with the consequence that “gene therapy for cystic fibrosis or Prozac for major depression is fine; insertion of genes to enhance intelligence or steroids for Olympic athletes is, to say the least, questionable.”<sup>25</sup> The classic or paradigmatic model of medicine that restricts it to therapeutic intervention, i.e. the restoration of a normal state of health, thus proves to be an idealization and a distinction that is insufficient for the practice of sports medicine, since there are no sick or healthy people in the concrete treatment situations in sports but rather usually just healthy people with limitations relative to their activity that are to be corrected. Hence the textbook for sports physicians in Germany only lists those medical conditions that directly constrain athletic activity.<sup>26</sup>

The Council on Bioethics confronts this structural problem offensively and recommends expanding the insufficient distinction between therapy and performance increase by means of a progressive definition of intervention in humans. The conclusion that “we need to see the human person in more than therapeutic terms”<sup>27</sup> refers to a conception of medically based intervention no longer oriented around the prevalent healthy/sick dichotomy or around medicine and the paradigm of healing, one that stands “more in relation to human beings and *their* purposes”<sup>28</sup>. We can interpret this conclusion as the attempt to render the complex lifeworld relations less underdetermined than can quickly happen with the idealized classification, but on the other hand the fundamental conflict still remains unsolved.

Two other moves to get the conflict under control have to be mentioned. In a practical way the *therapeutic* role of the “classic” sports physician in increasingly complex treatment situations is to be determined by various codes that present the guidelines of medical activity to all affected, hence not just sports physicians but also patients and ultimately the public.<sup>29</sup> All in all these codes operate within the classical paradigm that sees the doctor, and hence the sports physician as well, as therapist. Even if questionnaires among sports physicians have shown that team doctors in particular assess their ethical obligation variously, still it is assumed on the whole that the doctor's activity can be determined by ethical principles. This includes the principles of patient autonomy, *beneficence*, *non-maleficence* and justice, which are also to some extent supplemented by considerations from virtue ethics.<sup>30</sup> Alongside such codes, Holm and McNamee also refer to the necessary in-

dependence of the sports physician from clubs and sports associations and call for forums in which sports physicians from various organizations can exchange experiences “in a non-judgmental setting”<sup>31</sup> for the purpose of professional and ethical reflection. Here I cannot conclusively assess whether the policy of codes can deliver the improvements hoped for. However, it is certain that with these codes the fundamental conflict remains.

In a more theoretical manner one can also outline a philosophically motivated “moral topography” between the poles of a traditional conception of medical intervention as the *relief of suffering* and “performance enhancement or the augmentation of natural abilities”<sup>32</sup>. This allows us to sound out the full spectrum of *possible* action on the part of the sports physician without setting any prior norms concerning what the sports physician should do and not do. However, every determination of the work of the sports physician is subject to the therapeutic imperative, so again we cannot resolve the fundamental conflict. We still assume a purportedly clear and normatively guiding distinction between therapy and performance increase that is not given in the case of sports, where sustaining performance diverges from increasing performance.<sup>33</sup>

It follows from this that the sport physician's dilemma cannot be resolved by the distinction between therapy and enhancement but rather by an institutional (political and societal) question. In a particular case the sports physician can continuously try to follow the ideal therapeutic imperative. If the doctor no longer can – due to whatever conflicts of interest – then he or she should reflect on this profoundly, i.e. consider whether it is still possible to reconcile the work as sports physician with the medical ethos. If the medical expert is explicitly committed to increasing performance, as in the case of HPSM, he or she is no longer acting as a doctor but rather as a biotechnician. It is impossible to preserve the medical ethos of the doctor and *at the same time* make complete use of the new biotechnological possibilities – unless the therapeutic imperative no longer holds unconditionally. The biotechnological intervention in the athlete can be seen as a prototypical situation representing the future in which we intervene in the bodily substratum with other than therapeutic objectives. As long as the field of possible biotechnological interventions is not publicly sanctioned from the outset, criteria of quality for the biotechnological optimization of performance should be publically formulated and it should be examined whether and to what extent a biotechnological intervention is defensible.

#### **4 Biotechnological intervention as assistance**

One further possibility to approach the sport physician's dilemma is to question the moral topography that is essentially based on the therapeutic imperative and the subsequent dichotomy of therapy and enhancement. The debate about the role of the sports physician

results from our holding fast to an ideal picture of an exclusively therapeutic intervention. So long as we hold the strictly therapeutic mandate to be irreducible, all non-therapeutic interventions will be automatically ruled out from the discussion. Yet in this way we rob ourselves of the possibility of further developing the interventions in humans. This would be all the more regrettable as the *absolute* irreducibility of the therapeutic responsibility to heal has yet to be justified concerning interventions in the human body and it is questionable whether it can be reasonably done. Above all the question arises as to why a therapeutic intervention should be the only defensible sort of intervention. Without wanting to champion transhumanistic ideas (which I am very skeptical of),<sup>34</sup> we should consider a class of biotechnicians who carry out interventions at least not merely guided by therapeutic goals.

In order to derive a position that does not solely rely on the therapeutic imperative, I will take into account arguments for and against biotechnological intervention as enhancement. There are certain critical arguments against enhancement by means of biotechnological interventions. Regarding sports, Holm proposes game-theoretic reasons against a legalization of doping in order to make the world of sports a better one.<sup>35</sup> Regarding enhancement this argument can be seen as a focus on the potential abuse of enhancement techniques. Lenk goes even further in that he denies that our current concept of sports competitions allows for a use of enhancement practices.<sup>36</sup> In this vein Sherwin seeks to resist the development and widespread adoption of genetic enhancement and suggests a social policy in order to improve human well-being.<sup>37</sup> All these arguments combined with the recourse on the dichotomy of therapy and enhancement confirm the sports physician's dilemma.

Some of the arguments of proponents also recur on this distinction. Regarding the subjective nature of health, Scripko seeks to give enhancement a justified place in medicine that depends on the communication between physician and patient as well as on the critical assessment of new enhancing methods by physicians as their distributors.<sup>38</sup> Tamburrini does not accept a principle denial of genetic technology due to reasons of inequality of access,<sup>39</sup> whereas Jönsson even ascribes an emancipating effect to the creation of cyborg athletes that help to overcome gender based difficulties regarding the evaluation of athletes.<sup>40</sup> Finally, Miah denies that traditional medical ethics apply for sports ethics and concludes that gene-doping can form a part of enhancement within elite sports.<sup>41</sup> More important, in this latter position a different account of the relation between therapy and enhancement becomes apparent. The realms of healing and enhancing are not anymore conceived as contradictory. At the same time a transhumanist position like Jotterand's overshoots the mark in that he argues for an alteration of human existence in the light of



devices such as brain-computer interfaces and other nanotechnological developments.<sup>42</sup> But such a radical way of alteration of the human constitution to overcome the therapy-based paradigm does not necessarily follow.

Instead a moderate position is possible in terms of *assistive technology*.<sup>43</sup> Originally assistive technologies were used in a clinical setting to support the therapy of numerous medical conditions, e.g. stroke patients. The development of robotic technologies that support therapy is presently marked by “a significant shift away from assistive technology for people with disabilities toward robotic therapies, which use the technology to support and enhance clinicians’ productivity and effectiveness as they try to facilitate the individual’s recovery.”<sup>44</sup> Whereas assistive technologies were originally developed in order to support persons with limited abilities or disabled persons, there are also devices that are not restricted to a therapeutic context exclusively.

The development of so-called hybrid assistive limb (HAL) as a robot suit is not a priori confined to a therapeutic context.<sup>45</sup> HAL is a powered exoskeleton that senses the electromagnetic activity of the muscles and thereby controls assistive limbs that support bodily movements. Thus HAL helps people with limited abilities and at the same time supports healthy subjects by means of augmenting their abilities. For example, healthy people are able to carry about five times as much weight as they could carry unaided. The same device serves two different purposes without the problem of transferring a medical application into a non-therapeutic domain. The concept of assistance serves to conceptualize a kind of biotechnological intervention that is not exclusively based on the therapeutic imperative. On the one hand a device, such as HAL, is suitable for therapeutic purposes and underlies the criteria and standards of clinical use. On the other hand HAL as an assistive technology comprises a non-therapeutic use that still underlies medical precautions. In this way a non-therapeutic use does not immediately lead to a transhumanist alteration of human being in general, but to a support of human capacities. The crucial difference between (transhumanist) enhancement and assistance consists in the range of the biotechnological intervention: whereas enhancement is used to finally alter our being, assistance offers support of our biological and human condition without the strong impact of altering the human constitution into a transhumanist being.

## **5 Conclusion**

The investigation of the sports physician's role showed that the distinction between a therapeutic and a performance-enhancing treatment is not an appropriate one in the case of the athlete. The case of the classificatory problem makes explicit a conceptual bias: the conservative and exclusive definition of medicine as relief of suffering cannot solve the

sports physician's dilemma but rather solidifies it. Further attempts that explore biotechnological interventions beyond therapy show a new direction, but still remain in the current framework. Even if guidelines of medical activity or codes help the sports physician to stay within the boundaries of therapy, the need to extend the classical twofold moral topography occurs as the absolute irreducibility of the therapeutic responsibility to heal has not yet been justified.

In the search for an alternative understanding of the sports physician's activity, the current critique of enhancement measures in sports medicine proved to be only of a restricted relevancy as it is confined to the classical dichotomy of therapy and enhancement. Some arguments made by proponents of enhancement measures in sports at least point to a promising outcomeway. Without following transhumanist claims it is important to reconceptualize the developmental framework of research in biotechnological interventions. A third pole in the moral topography and a related type of intervention besides therapy and enhancement can be seen in assistive technology.

Whereas transhumanistic jargon overhastily propagates a naive optimization of humans that lacks any comprehensible methodology, we should also not reject biotechnological intervention a priori, i.e. on the basis of an incontrovertible therapeutic imperative. This plea for not exclusively therapeutic biotechnological intervention goes hand-in-hand with the demand for a broad reconception of the criteria of validity and resulting criteria of quality for interventions in humans. The concept of assistance offers a further pole in the moral topography to embrace therapeutic and medical related criteria without confining to these. Criteria regarding enhancement also apply. The further methodological challenge lies in the question how to complement therapeutic and medical constraints by enhancement constraints. In a constructionist way, these questions are not solely to be investigated in an ethical vein, but at a methodological level either: it is crucial to investigate the technological and scientific development in order to identify basic conditions for ethical issues as modifications of the scientific framework allow to render the issues of ethical debates. Regarding the sports physician, it cannot be her task to define her role, i.e. if she acts as a traditional agent of health care or as an assistant for enhancement.<sup>46</sup> We should not weigh down the doctor with fundamental methodological and ethical questions, since these have to be decided in the broader context of scientific development and societal norms respectively. Yet, until these questions are answered sports physicians continue to find themselves in a structural dilemma that they partially can come to terms with through personal integrity.

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## **Notes**

<sup>1</sup>On the distinction between sports doctor and team doctor see Anderson (2009), p. 1079.

<sup>2</sup>Cf. Grüneberg (2010).

<sup>3</sup>Cf. De Melo-Martín (2010) for placing the debate on enhancement technologies in a broader context than a mere evaluation of risks and benefits.

<sup>4</sup>There are further methodological issues that I cannot discuss in the present paper. Roughly speaking, my investigation is not primarily based on common western ethical categories such as autonomy, non-maleficence, beneficence, and justice and an ethical assessment, but focuses on the process and the foundations of scientific development itself. In terms of a constructionist approach reflections on the ethical consequences and risks and benefits of biotechnological intervention are to be complemented by a concept of an alternative framework that captures ethical issues and that is also instructive for scientific research and the technical development of new methods; cf. Floridi (2011) for a constructionist approach and Miah (2007) and De Melo-Martín (2010) for the claim to integrate philosophical and scientific research.

<sup>5</sup>In the following I focus on competitive sports at the highest level, since this is where the problem presents itself most clearly. But the same decision conflicts can also occur in amateur sports. It also applies for army doctors. Cf. Gibson (2006) for bioethical issues regarding spaceflight.

<sup>6</sup>HPSM is an "integrated model of medical care of the high-performance athlete, focusing on the maintenance and optimization of health, well-being and competitive sporting performance under circumstances of high physiological and psychological stress" (Speed and Jaques (2011)).

<sup>7</sup>Cf. Dunn et. al. (2007).

<sup>8</sup>Cf. *Devitt and McCarthy (2010), and Anderson (2007)*.

<sup>9</sup>For a game-theoretic analysis of the sports physician's role see Søren Holm (2007).

<sup>10</sup>Cf *notes 3 and 4*.

<sup>11</sup> Steinacker (2008), p. 3 [my translation]. Beyond the context of sports Steinacker sees prevention as another central field of work in sports medicine; cf. Steinacker (2001).

<sup>12</sup>Ibid.

<sup>13</sup>Donike (1977).

<sup>14</sup>Ibid.

<sup>15</sup>Geiger (2007).

<sup>16</sup>Geiger (1994).

<sup>17</sup>Edwards and McNamee (2006).

<sup>18</sup>Ibid., p. 104.

<sup>19</sup>Ibid., p. 105.

<sup>20</sup>Cf. *ibid.*, p. 109.

<sup>21</sup>Ibid., p. 106.

<sup>22</sup>In their examination of the connection between the interventions of sports medicine and athletic success, Emrich et al. refer to the two areas of responsibility for the sports physician, which "cannot always be resolved without conflict": the restoration of performance short-term so as to allow further training and the increase in performance when possible conflicts with the long-term preservation of the athlete's health beyond his or her athletic career. (Emrich et. al. (2004))

<sup>23</sup>Edwards and McNamee (2006), p. 107.

<sup>24</sup>For example, the WADA bases its guidelines on such a normal state, as seen by its reference to a "state of normal health" (World-Anti-Doping-Agency (2008), p. 13).

<sup>25</sup>U.S. President's Council on Bioethics (2003), p. 14.

<sup>26</sup>Cf. Dickhuth and Badtke (2007).

<sup>27</sup>U.S. President's Council on Bioethics (2003), p. xvii.

<sup>28</sup>Ibid., p. 13, note.

<sup>29</sup>Such codes are published by all medical and sports medicine associations; cf. Anderson (2009). In the following I do not refer to any specific code.

<sup>30</sup>Devitt/McCarthy (2010), pp. 176f. and for a more comprehensive treatment of the approach of ethical principles see Wiesing (1995).

<sup>31</sup>Holm and McNamee (2009)

<sup>32</sup>McNamee (2007), here p. 191.

<sup>33</sup>Cf. Grüneberg (2010).

<sup>34</sup>Cf. McNamee and Edwards (2006) for positions on transhumanism. It is not the case that I would deny the principal perfectibility of human being, but the often blind adhere to scientific progress renders transhumanist positions in a dubious manner.

<sup>35</sup>Cf. Holm (2007).

<sup>36</sup>Cf. Lenk (2007).

<sup>37</sup>Cf. Sherwin (2007).

<sup>38</sup>Cf. Scripko (2010).

<sup>39</sup>Cf. Tamburrini (2007).

<sup>40</sup>Cf. Jönsson (2007).

<sup>41</sup>Cf. Miah (2007).

<sup>42</sup>Cf. Jotterand (2008), p. 17. There are further ethical issues regarding the implementation of enhancement technology in research and development that would imply preclinical testing on non-humans which might cause severe problems: how to deal with research animals that have enhanced cognitive capacities close to that of humans? (cf. Rosoff (2011)) Cf. Chan (2009) for biotechnological interventions in animals.

<sup>43</sup>Cf. Krebs et. al. (2008), and Krebs (2011), for ethical considerations Perry, Beyer, and Holm (2009).

<sup>44</sup>Krebs et. al (2008), p. 63.

<sup>45</sup>Cf. Sankai (2010). Another example is the "Emotion Reader", cf. Gruebler and Suzuki (2010), a wearable interface for reading facial expressions that can be used in therapeutic contexts (providing biofeedback to patients during rehabilitation or analyzing smile behavior of autistic children) as well as in non-therapeutic human-human communication (e-learning, distance communication, and computer games). Further applications include human-robot interaction based on human affective feedback, cf. Gruebler et al. (2011).

<sup>46</sup>Cf. Wiesing (1995), chap 6 on the limits of the doctor's responsibility. Also Murray suggests to discuss non-therapeutic biotechnological intervention in a broader societal and institutional context; cf. Murray (2009), p. 513.

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