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Visions beyond Control: The Role of Art in Exploring Dual-Use Bioethics Education for Scientists

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In the wake of the anthrax attacks in the US in 2001, the Biological Weapons Convention has increasingly focused its efforts on reducing the risk of bioterrorism. One of the questions that received particular attention was how to prevent the misuse of benign biological research for malign purposes. The argument is that modern biological research is rife with research that is dual-use in nature, i.e. that it can be used either for benign or malign purposes. Over the last decade, the debate has increasingly focussed on the role and responsibility of the scientific community in addressing this issue. Education in dual-use ethics has been considered as one of the major factors that can help with the dual-use problem. However, even general science ethics education is limited at the moment and presents a challenge to any lecturer. In discussing the views of Martin Heidegger and Richard Rorty's interpretation of Heidegger, this article argues for the use of art and bioart as educational vehicles to help scientists explore their roles and responsibilities with regard to their own research and its dual-use nature.

Keywords: Bioart; Biosecurity; Dual-Use Bioethics; Education; Heidegger; Rorty

Introduction

A Short History of Dual-Use

In 2001, directly after the events of 9/11, the US was hit by another terrorist attack: the use of the US postal service to deliver anthrax letters. These letters resulted in the deaths of five and sickening of 17 people (FBI, 2013) and the economic costs were estimated at around 320 million US$ (Schmitt & Zacchia, 2012). The discussion of how to deal and potentially prevent this type of terrorism has reached as far as a review of the work and education of scientists. The way that science education is linked with the anthrax attacks comes in the form of the Biological and Toxin Weapons Convention (BWC), which is signed in 1972. After the anthrax letters, the "Committee on Research Standards and Practices to Prevent the Destructive Application of Biotechnology", also called the Fink Committee, worked between April 2002 and January 2003 to produce the Fink Report. (NRC, 2004). The committee itself comprised of a mix of academics from the natural sciences, security studies, and law. Its aims were threefold:

1) Review the current rules, regulations, and institutional arrangements and processes in the United States that provide oversight of research on pathogens and potentially dangerous biotechnology research, within government laboratories, universities and other research institutions, and industry.

2) Assess the adequacy of current US rules, regulations, and institutional arrangements and processes to prevent the destructive application of biotechnology research.

3) Recommend changes in these practices that could improve US capacity to prevent the destructive application of biotechnology research while still enabling legitimate research to be conducted." (NRC, 2004: p. 2).

The Fink report led to a discussion within the BWC of how to deal with the problem that benign research could be misused for malign purposes, e.g. bioterrorism. The label used to express this concern was "dual-use", which had previously been used to designate technology that had both military and civilian uses (Selgelid, 2009). In its new version though, the terms had appropriated a normative element.

Responding to the Challenge of Dual-Use

After publication of the Fink report in 2004, the States Parties to the BWC started to discuss this problem and search for a solution. This search is still going on and a major candidate has been dual-use bioethics education of scientists. For example, at the Seventh Review Conference in 2011 (Review Conferences take place every five years) States Parties agreed on an International Process 2012-2015 that included a "[r]eview of developments in the field of science and technology related to the Convention." (BWC, 2011). This review includes the following two agenda items:

"1) voluntary codes of conduct and other measures to encourage responsible conduct by scientists, academia and industry;

2) education and awareness-raising about risks and benefits of life science and biotechnology."

This stress of the responsibility of the scientific community is equally mirrored in "The Netherlands Code of Conduct for Scientific Practice", which says that a "scientific practitioner is co-responsible… for the scientific and societal value of the research programmes in which he participates" (Association of Universities in the Netherlands, 2012). This code of conduct has received a lot of attention recently because it is one of the few existing codes of conduct for scientists that discuss dual-use but also because a Dutch scientist, Fouchier, conducts one of the most controversial experiments in recent years (Enserink, 2011). It was controversial primarily because security experts considered the experiment, which was to make H5N1 transmissible between mammals as well as to make it airborne, to be highly dangerous to public security. Fouchier tried to publish the experiment in *Nature* with a complete materials and methods section. Security experts considered this section to provide a recipe for disaster for bioterrorist. What followed was a heated debate between politicians, security experts, and scientists (Enserink, 2011). The experiments by Fouchier were conducted even in the presence of the Dutch code of conduct, which was first established in 2004. The discussion about the Fouchier experiments highlighted a lack of awareness on both sides of the aisle: scientists hardly had any awareness, lack alone training, in dual-use bioethics while the security community had hardly paid attention to the problematic nature of putting the responsibility of the societal impact of research and technology onto the scientific community. The lack of awareness of the scientific community to dual-use has been highlighted in previous studies (Minehata, 2010; Rappert, 2010; Walther, 2013; Minehata & Walther, 2014). Similarly, it has been previously noted that the nature of the responsibility of the scientific community for the societal impact of their research and technology is rather complicated and not as straightforward as the security community would like to think (Ehni, 2008; Kuhlau et al., 2008; Miller & Selgelid, 2008). This tug of war between the two communities—one warning about the danger and risks of research and the other defending their rights to do science because it promises great advances in the future—is indeed unhelpful. This paper will explore society's relationship with science and technology using Heidegger's work on "The Question Concerning Technology" to show how an ethics education of scientists that includes a dual-use component might be improved as well as to show how the dialogue between the security and science community could be enriched.

Heidegger's Questioning of Technology

In his "Question Concerning Technology", German philosopher Martin Heidegger tries to understand man's relationship with technology. As is generally the case when reading Heidegger, one has to be prepared to venture forth together with him onto a journey. Heidegger explicitly makes this point in the beginning of 'The Question Concerning Technology', in which he remarks that "[I]n what follows we shall be questioning concerning technology." (Heidegger, 1977: p. 3) Which to him means to "build a way" and thus we need to "pay heed to the way" rather than to ponder on "isolated sentences and topics." (Heidegger, 1977, p. 3) The first steps on this journey concern the difference between technology and the essence of technology. While technology may be readily apparent in our everyday lives, its essence is actually hidden and cannot be found in any particular technology. Heidegger argues that "everyone knows the two statements that answer our question" (Heidegger, 1977: p. 4), i.e. the question of what technology is: "Technology is a means to an end" and "Technology is a human activity" (Heidegger, 1977: p. 4). While Heidegger thinks these statements are indeed correct, he does not believe them to get us any closer to the true essence of technology, which once we understand what it is allow us to enter into a free relationship with technology. If technology is an instrument, Heidegger argues that we need to understand its cause in order to get at its essence. By way of an analysis of the four causes (causa materialis, causa formalis, causa finalis, causa efficiens) that philosophy has "for centuries… taught" Heidegger arrives at the question of responsibility. Each of the four causes, while different, still belongs together in their responsibility to "bring something into appearance" (Heidegger, 1977: p. 9). To be responsible means to set something on its path towards presence, towards its arrival. All four causes combine to "let what is not yet present arrive into presencing" (Heidegger, 1977: p. 10). This step into presencing from that which is not presencing is *poiēsis*. *Poiēsis* brings forth. For Heidegger, *poiēsis* manifests itself in *physis*, where that which is coming forth is already imbedded in itself, for example a blossom starting to bloom, as well as in the activity of the artisan and the artists. Of course, that which comes forth into presence has already got to be in the thing itself. "Bringing forth comes to pass only insofar as something concealed comes into unconcealment" (Heidegger, 1977: p. 11). Revealing in Greek is *aletheia*, which has been translated by the Romans as *veritas* and we call "truth", which Heidegger assumes to mean the "correctness of an idea." (Heidegger, 1977: p. 12)

In typical Heideggerian fashion, at this point he stops to wonder about how a discussion of the essence of technology has led to *aletheia*. What is the relation between technology and *aletheia*? For Heidegger: everything. "Technology is a way of revealing." (Heidegger, 1977: p. 12) It reveals truth. Technology comes from *technikon*, which is that which belongs to *technē*. For the Greeks, *technē* included the activities of the craftsmen as much as those of the mind and the fine arts. Going back to Aristotle, Heidegger explains that *technē*, as a mode of *aletheuin*, "reveals whatever does not bring itself fourth and does not yet lie here before us, whatever can look and turn out now one way and now another" (Heidegger, 1977: p. 13). The importance of *technē* is not the production but in the revealing. However, one contention that Heidegger takes seriously is that this understanding of *technē* may only apply to the craftsmen in Ancient Greece, yet may not apply to modern technology. The craftsmen indeed employed technology in his craft to bring forth that which is hidden. A carpenter uses carpentry tools to make chair and in doing so reveal that which is the truth of the chair. This logic can hardly be applied to modern power plants for example. For Heidegger, this question is exactly the question concerning technology.

Modern technology, unlike in Greek times, depends on science for it to work. Modern physics enables progress and allows us to build new machines (for Heidegger, writing in the 40s, physics was still the main science that enabled progress; currently, it might be more than just physics that enables this sort of progress and enable technological progress). In what way can modern technology then be understood as a revealing? Heidegger argues that the modern revealing of technology is a challenging. It challenges nature, and demands something from it. For example, a modern power plant demands and stores the energy of nature in a way that a windmill was never capable of.

Modern technology unlocks the hidden energies of nature (e.g. coal) and exposes them. Eventually, Heidegger comes to the intermediate conclusion that the essence of technology lies in Enframing. (Heidegger, 1977: p. 23) Enframing, *Ge-Stell* in the original German, is "that challenging claim which gathers man thither to order the self-revealing as standing-reserve" (Heidegger, 1977: p. 19). The challenge claim is the challenge of nature as discussed earlier. Standing reserve, *Bestand*, is part of the ordering that comes to be in technology, e.g. how a hydroelectric plant orders nature to always be ready to provide power. The standing reserve is the "fundamentally undifferentiated supply of the available" (Heidegger, 1977: p. 24). In ordering things in this way, they also lose their status as objects because now they are merely seen as the provider of this intangible standing-reserve. The river Rhine, the example Heidegger uses, is both "dammed up into the *power* works" yet also an *art* work as in the poem "The Rhine" by Hölderlin (Heidegger, 1977: p. 16). Technology thus reveals the being as that which is ordered to be always available. Objects lose their character as objects and become mere standing-reserve to be utilized. This process is Enframing. However, even if we now know what the essence of technology is, the question concerning technology is yet untouched. We may know the essence of technology, yet nothing about this essence, do not know "the essence of what is being asked about" (Heidegger, 1977: p. 23).

But what is Enframing actually about? Enframing is nothing technological. It is not a machine. "It is the way in which the real reveals itself as standing-reserve" (Heidegger, 1977: p. 23). It neither happens exclusively through or in humans nor does it happen beyond human activity. Certainly, Enframing challenges man by putting him into the position to order as standing-reserve. To Heidegger, linking it back to *poiēsis*, *aletheia* and destining, two possibilities for man emerge: First, if man continuously pushes only that forward, which is an ordering, he will derive all his standards on this basis. This prevents the emergence of the second possibility, which is that man gets closer to the essence of that which is unconcealed, which would help him "experience as his essence his needed belonging to revealing" (Heidegger, 1977: p. 26). As the former holds sway, man is endangered because he will no longer be able to regards objects as objects but only as standing-reserve, which he orders. To Heidegger, man thus loses the ability and, more importantly, will to understand his own essence. Man is deluded by the Enframing of technology. By regulating and securing every thing as standing reserve, Enframing also does not allow for the thing to display its fundamental characteristics in its revealing. As we have seen in the Greek *technē*, it was truth that came to pass within *poiēsis*. It is this truth that becomes impossible to unconceal in Enframing. Yet, Heidegger does not leave us without hope. Putting faith in the poet, as usual for Heidegger it is Hölderlin, he cites:

"*But where danger is*, *grows The saving power also*" (Heidegger, 1977: p. 28).

So within the danger that is man's drive to order through Enframing with technology and thus the blocking of man's relation to the essence of truth, also, his own essence, something grows alongside that will be man's saving power. Heidegger argues that this saving power manifests itself in a granting. In the coming to presence of the essence of technology, man recognizes his own essentiality of being part of revealing. Man is necessary to any revealing of truth. While technology poses the danger to force upon us an ever more increasing ordering, against this danger we can hope for the growth of a saving power as well. But how does this saving power come about? Heidegger thinks it lies in the works of the artists to help us see. Going back to Ancient Greece again, Heidegger reminds us that it was not only technology as we understand it today that comprised *technē*. *Technē* was "the bringing-forth of the true into the beautiful." (Heidegger, 1977: p. 34) "[T]he *poiēsis* of the fine arts also was called *technē*" (Heidegger, 1977: p. 34). So Heidegger concludes:

"Because the essence of technology is nothing technological, essential reflection upon technology and decisive confrontation with it must happen in a realm that is, on the one hand, akin to the essence of technology and, on the other, fundamentally different from it.

Such a realm is art. But certainly only if reflection on art, for its part, does not shut its eyes to the constellation of truth after which we are *questioning*." (Heidegger, 1977: p. 35)

But where does this analysis of Heidegger leave us in regard to the question of dual-use? It is a bit premature to ask the question, yet I will get to it eventually. First, as we will shortly see, it is necessary to reread Heidegger in a pragmatic fashion using Rorty.

The Pragmatism in Heidegger

When reading Heidegger, and particularly his emphasis on essence and truth, one may get the impression that he appeals to some earlier ideas of Platonic forms. Specifically, Heidegger is concerned with our focus on technologies rather than the essence of technology. He believes that this concentration results in the aforementioned danger of being unable to unconceal, to find truth and find the essence of man, and rather taking the revealing as a challenging and ordering, i.e. Enframing, as the essence of technology. Yet what sort of thing is this essence? Unlike Plato, Heidegger believes this essence to be permanent. He asks "[d] oes the essence of technology endure in the sense of the permanent enduring of an Idea that hovers over everything technological, thus making it seem that by technology we mean some mythological abstraction?" (Heidegger, 1977: p. 31) It is not the permanent enduring of essence that endures but rather technology lets Enframing permanently endure. Since Enframing is the challenging forth as standing reserve and lets man order, Enframing grants man with a permanent enduring. Enframing lets man endure. It is within the permanent enduring of man that it only becomes possible for man to glimpse behind the mere ordering quality of technology and see truth. "Enframing comes to pass for its part in the granting that lets man endure—as yet unexperienced, but perhaps more experiences in the future—that he may be the one who is needed and used for the safekeeping of the coming to presence of truth" (Heidegger, 1977: p. 33). Going back to dual-use, we may wonder what happens if in that challenging forth as standing reserve, man loses the means to control that standing reserve. It is dual-use after all and not just a mono-use as control use. Technology thus may today also be said to inherently threaten that permanent enduring of man that Heidegger finds within technology. While this thought might be interesting in its own right, it will get us any further in a pragmatic way towards understanding or helping the question of dual-use. What helps is rather Heidegger's claim that the artist can find that higher essence behind technology, that thing that essences. "Once there was a time when the bringing-forth of the true into the beautiful was called

technē. And the *poiēsis* of the fine arts also was called *technē*." (Heidegger, 1977: p. 34)

Did Heidegger not just introduce a Platonic idea once again when he says that the fine arts can bring forth the true into the beautiful? Is this 'true' not some lofty thing that floats above all? This is now where one may read Pragmatism into Heidegger. While Okrent's 'Heidegger's Pragmatism' (Okrent, 1988) might be the more acknowledged interpretation of Heidegger as a pragmatist, it is the neopragmatism of Richard Rorty that will help to clarify and supplement Heidegger. The reason why it matters if Heidegger is a pragmatist is the following concern: If there is such a thing as an essence of technology that is primordial then all discussion of technologies will be subsumed by this original understanding of technology. It does not allow for a free understanding and reflection of technology, which is a prerequisite for any ethics education for scientists. The ontological would simply determine the methodological. So how does a neopragamtist like Rorty read Heidegger?

The key text for working on this question is Rorty's article 'Heidegger, Contingency, and Pragmatism' published in his 'Essays on Heidegger and Others'. (Rorty, 1991) While Rorty believes that Heidegger may indeed be read as a pragmatist, the latter is certainly not a happy one. To Heidegger, western philosophy with its origin in Plato necessarily leads to a nonmetaphysical, technocratic pragmatism. His critique of this sort of pragmatism, which is intend on its will to master, we have already seen in his the 'Questions Concerning Technology' as his fear of Enframing being the essence of technology. To anyone familiar with Plato it might seem surprising to read the claim that pragmatism is the logical conclusion of Plato. For Heidegger the road goes as follows: Plato asked how we and the world need to look like in order for us to have certainty, evidence, and clarity. (Rorty, 1991: p. 29) Eventually we have come to the conclusion that the only things we can have certainty of are our beliefs and desires. The will to master becomes our meaning of life. Once we have imposed our beliefs onto the world, we can be sure of its cosmology. Nietzsche may be seen as an epitome of this acceptance of what thinking is good for: mastering. Rorty adds that it is ironic that Plato, who wanted to go beyond the marketplace, e.g. the cave analogy, eventually leads philosophy towards the marketplace. (Rorty, 1991: p. 31) While Plato started with questions of "How can you know?" and "What is your evidence?" he actually paved the road for scepticism. By granting the sceptic power, he eventually pushed philosophy away from looking at truth in a representational view as correspondence with reality to less ambitious claims. Via Kant and eventually Nietzsche, we arrive at Dewey who asks us to replace 'truth' and 'rationality' with 'satisfaction' and 'growth'. Rorty believes that Heidegger, despite his disregard, realizes his place within this tradition and subscribes to its suppositions. If pragmatism is the final outcome, then one may as well be a "self-conscious, rather than a repressed and self-deceived, power freak." (Rorty, 1991: p. 32) The choice is between Platonism, the self-deceived, and pragmatism, the power freak: Heidegger chooses the latter. This choice for pragmatism Rorty, alongside Okrent whom Rorty draws on in his analysis, finds in Heidegger's 'Being and Time'.

Being, unlike Plato's eternal, for Heidegger only exists as part of *Dasein*, the Being-in-the-world or more literally, the Being-there (somewhere or in some place in the world). Thus, there is no power relation between the two (Being and Dasein) but it is a "fragile and tentative codependence." (Rorty, 1991: p. 33) In Heidegger's own words: "Being (not entities) is something which 'there is' only in so far as truth is. And truth is only in so far and as long as Dasein is. Being and truth 'are' equiprimordially." (Rorty, 1991: p. 33) To Rorty, this Heidegger view is the same as the standard pragmatist arguments against any conceptual scheme. The conceptual scheme that, for example, positivism finds in a unified science which would then grant us certainty and truth. In the absence of such a scheme, all that we have is contingency. The contingency of our human projects as situated in time. Yet, as philosophy has tried to capture some sort of eternal essence, or rather, has asked us to try to do so, we consider the fleeting and transitory as negligible. For Heidegger in particular, he wants to defend *words* against *thought*. Philosophy does not pay tribute to words but its efforts are targeted towards thoughts and concepts, which are supposed to capture truth. Words have become mere vehicles. As Rorty writes: "Philosophers know that what matters is literal truth, not a choice of phonemes, and certainly not metaphors. The literal lasts and empowers. The metaphorical… is impotent." (Rorty, 1991: p. 34) Heidegger believes he needs to defend the poet against the philosopher. To him, words do matter. We of the West have been using the metaphor that led us down the path to the philosopher and her quest for certainty to be found in thought. Yet there was no more need to use that metaphor instead of another one. There is no "external choreographer" (Rorty, 1991: p. 36) who determines the moves of our projects. Just us. There is only our contingency and with it we have to accept Heidegger's claim that "Only as long as Dasein is… is there Being." (Rorty, 1991: p. 36) But what is Being if it is not like Plato's Ideals? Does it fulfil any function?

Rorty believes that Heidegger actually never gives a proper account of what Being is. Sure enough, he uses it frequently (it is one of the three words in the title of his major work: *Being and Time*), yet he never fully explains it. Rorty thinks that Being is something beyond our ability to handle, something that resists "the technical interpretation of thinking." (Rorty, 1991: p. 36) Heidegger uses it to point towards the "difference between inquiry and poetry, between struggling for power and accepting contingency" (Rorty, 1991: p. 36). Rorty argues that "What is Being?" cannot be answered correctly just like the question "What is a cherry blossom?" To extend the analogy further, for Heidegger the West, or rather the West's understanding of the world is just one cherry blossom among many other blossoms (Rorty, 1991: p. 37). One "cluster of "understanding of Being" alongside other clusters" (Rorty, 1991: p. 37). Going back into the realm of language, any Being is one form of a final vocabulary, which we need to use. We are subjected to final vocabularies because there is no metalanguage with which to understand all other vocabularies. Being is therefore never "the same thing under all descriptions, but something different under each" (Rorty, 1991: p. 38). But if Being is not the same under all descriptions, then why make the claim that it is the poet who will understand the essence behind technology, the essence and truth of man? Why favour the vocabulary of the poet over the one of the scientist?

Heidegger and the Solidarity of Rorty

As we have seen thus far, Heidegger reluctantly agrees that Plato's questioning needs to be overcome. At the same time though, he is nostalgic for the Greeks ability to see poetry and the arts as disclosing truth. Heidegger thinks that they enjoyed a

sort of special relationship with Being, i.e. that they were better a being ontological and understanding Being in their time. Rorty takes issue with this nostalgia of Heidegger. This nostalgia explains Heidegger's positive predisposition towards poetry as helping us towards understanding our Being and his rejection of technocracy, which is so pre-eminent in his 'Question Concerning Technology'. He sees salvation as contained within poetry not because poetry gives the true account of Being but because it opens up the possibility of Being as multifaceted. Technology is just one metaphor but Heidegger fears that it dominates and denies the existence of alternative metaphors. As Rorty puts it: "No petal on a cherry blossom is more or less a petal than any other." (Rorty, 1991: p. 39) But is our age really as forlorn and devoid of alternative possibilities of metaphors as Heidegger believes it to be?

The two charges that Heidegger makes against our current age are its contingency and its belatedness. The West's, it is primarily our West that Heidegger and Rorty discuss, contingency manifests itself in its basic presupposition that our final vocabulary is so obvious and inescapable. We have become self-deceived. But what does it mean if this vocabulary is belated? Rorty argues that this judgement is normative and the only normative sense that he can find in Heidegger is that "an understanding of Being is more primordial than another if it makes it easier to grasp its own contingency" (Rorty, 1991: p. 43). By this analysis, the Greeks were less belated because "their understanding of Being in terms of notions like *arche* and *physis* was less self-certain, more hesitant, more fragile, than our own supreme confidence in our ability to manipulate beings in order to satisfy our own desires." (Rorty, 1991: p. 43) The result of this is that we have become less able to hear words differently, less able "to imagine alternatives to themselves." (Rorty, 1991: p. 43) For Heidegger, a step towards less belatedness would be to willingly suspend verficiationism. We should stop asking questions like "What is Being?" or "What is a cherry blossom?" (Rorty, 1991: p. 44) Stop the urge to ask question about the truth or finding the right answer. As long as we retain these questions we subject ourselves to a single final vocabulary that we do not dare or dream of questioning. For Heidegger, it is the questioning of the Thinkers and Poets that allows for a freeing up of Dasein and the creation of open spaces that surround present day social practices. This latter thinking is supposed to let Being be, which creates freedom. Yet Rorty asks: Do you not utilize language when you let beings be? Is this disclosing not achieved only in language? And since this is the case, how can any "language-user be less free, less open, less able to let Being and being be, than any other?" (Rorty, 1991: p. 45) "[H]ow can any understanding of Being be preferable to any other, in the mysterious sense of being "more primordial"?" (Rorty, 1991: p. 45)

As we have already seen, Heidegger thinks it is the progression of technical mastery that makes us less primordial. However, do we really need to fear that technology silences all other questioning? Rorty thinks that Heidegger is afraid because it is the ease with which we can hear the words of the technological vocabulary—words of mastering and Enframing. The poet and the artists have become merely aesthetics and are not given the benefit that they can open up Being, open up new vocabularies and create new beings. But are we really faced with an either or? Rorty does not think we have to choose and will be caught in a final vocabulary but that we in our modern Western society allow us to understand and hear the original silence which we then fill with our vocabularies. We can be aware of the silence and our filling of it. We can do so as Dewey has suggested. In Rorty's words: "He wanted to combine the vision of a social democratic utopia with the knowledge that only a lot of hard work and blind luck, unaided by any large nonhuman power called Reason or History, could bring about that utopia into existence. He combines reminders that only attention to the daily detail, to the obstinacy of particular circumstance, can create a utopia with reminders that all things are possible, that there are no *a priori* or destined limits to our imagination or our achievement. His "humanism" was not the power mania which Heidegger thought to be the only remaining possibility open to the West. On the contrary, it put power in the service of love—technocratic manipulation in the service of a Whitmanesque sense that our democratic community is held together by nothing less fragile than social hope" (Rorty, 1991: p. 48).

Art, Ethics, and Technology

Reflecting on the dual-use debate in a Heideggerian fashion, one cannot help but realize that the debate within the political community is very much entrenched in their use of their final vocabulary. A vocabulary that puts faith in a technocratic approach with its goals of solving the dual-use problem. Dual-use has been characterised as a science problem, and it is to be solved by the science community. But it is also is a political issue and concern. The exclusive focus on using a technocratic vocabulary, which presupposes the ability to solve the problem, that there is a solution to it, is reminiscent of Heidegger's fear that we are increasingly unable to get out of our own final vocabulary, to be primordial, and hear the silence that any vocabulary attempts to fill. "To be primordial is thus to have the ability to know that when you seize upon an understanding of Being, when you build a house for Being by speaking a language, you are automatically giving up a lot of other possible understandings of Being, and leaving a lot of differently designed houses unbuilt." (Rorty, 1991: p. 46) There are no other vocabularies engaged in the dual-use issue but the techno-political one. We have not questioned this language as it appears obvious that we simply need to master this problem of dual-use, to find a technocratic answer to it. It appears absurd to even ask to consider other vocabularies as beneficial to the discussion. Yet, specifically dual-use, which is inherent in any technology and research, might be very well-suited to be talked about in different vocabularies. But how exactly would it look like if the arts, following Heidegger's belief that it is the arts that may constitute the saving power that Hölderlin believes inherent in any danger, were to utter a word. It is art as non-aesthetic that might provide a glimpse into this future—this future filled with a Deweyan social hope. A few examples might be helpful.

One of the fields where it has been tried to include the arts into actual curricula is in medicine. Medical Humanities focuses on using the arts to confront medical students with their presumptions about the profession. These presumptions usually include the view that medicine is a facts oriented science with little room for interpretation. While teachers of medical humanities claim that the humanities are well-suited to improve professionalism and improve doctor's performance, students tend to dismiss this topic as useless. The responses that Shapiro et al. cite, e.g. overcrowded curricula, lack of interest of students, does not expand medical knowledge, are exactly the same as those cited by Walther in his discussion of bioethics

and dual-use bioethics education in neuroscience (Shapiro et al., 2009; Walther, 2013). And again similar to science ethics education, the proponents argue that the skills acquired in medical humanities will make better doctors. As Shapiro et al. write: "systematic integration of humanities perspectives and ways of thinking into clinical training will usefully expand the range of metaphors and narratives available to reflect on medical practice and offer possibilities for deepening and strengthening professional education" (Shapiro et al., 2009). Yet this notion that the arts will be useful as a means to an end, i.e. to make better doctors, is contested as Macneill points out (Macneill, 2011). If the arts are just means to an end, they lose their ability to be critical (Rees, 2010). The arts become a tamed animal that has already succumbed to the mastery of science-based knowledge, reminiscent of Heidegger's concern about the enframing of technology. In order to show that art can do more than just be a tool, Macneill uses the examples of the performance artists Stelarc and Orlan to question one of the fundamental tenets of modern medicine: the body as a machine where the machine breaks down and the doctor's duty is to restore it to its prior state and function (Macneill, 2011). Both Stelarc and Orlan have subjected their body to technological or surgical augmentation. By doing so, they confront our concept that "individual corporeality is intrinsic to identity" (Macneill, 2011). Stelarc's projects comprised the attachment of a prosthetic arm to his biological one, which could then either be remotely controlled via the internet (project title: THIRD ARM) or the machine itself prompted the movement of his body (project title: MOVATAR). His body thus became the agent of an external entity. Orlan has had her physical appearance surgically altered in operations that were broadcast live and where the surgical room was transformed into a baroque theatre stage. Medical assistants were dressed in designer costumes, poetry readings and music was performed, and the room was draped with large bowls filled with grapes. For Jane Goodall, these performances are scandals. Scandals understood as providing "a trap or stumbling block, metaphorically interpreted as a moral snare causing perplexity and ethical confusion" (Goodall, 2000). Similarly, Zylinska and Hall point out that the performances are good because they are both controversial and raise a debate and also fail to offer a grand and totalizing narrative with which to understand them (Zylinska & Hall, 2002). Stelarc and Orlan's work both offer variations of the theme of the body and the posthuman body. As Macneill points out though, it is not just the particular controversy about the body that makes them interesting as cases for art that is critical. One can look at their work and discuss the pain that is included in these bodily modifications. Thus it is not the concept of the post-human, the obsolete body, but the "meaty and suffering body" that can equally raise a debate (Macneill, 2011). While Stelarc and Orlan are primarily interested in the body, other modern artist are equally challenging in other areas. For example, Macneill cites the work of Eduardo Kac, who developed the transgenic Glow-Bunny Alba, which is a green fluorescent bunny made with DNA from jellyfish (Macneill, 2011). Or the work of Julia Reodica, who cultivated her own vaginal cells to produce a series of hymen in order to create a debate about modern sexuality, the female body and the emphasis placed on women's virginity (Macneill, 2011). Macneill and Ferran positively discuss the interplay of bioethics and bioart in their article on art installations at the World Congress of Bioethics in Rijeka, Croatia, in 2008 and the 2010 World Congress on Bioethics in Singapore (Macneill & Ferran, 2011). These ensuing relationships can be seen as part of a trend towards a bioculture as envisioned by Davis and Morris already in 2007 (Davis & Morris, 2007). Their hope is to have the humanities and the sciences share in a more thorough exchange on their respective forms of interpretation and allow for an easier bridging between these two hitherto disparate cultures, as C. P. Snow claimed in his analysis of 'The Two Cultures' (Snow, 1959). Of course, these examples are not exhaustive of the works in modern art and bioart. But they show how art can be used to question our preconceived notions about science and technology, which might help to engage students in science education about their chosen subject and offer them perspectives that are alien to how the subject is portrayed and taught in its classical curriculum.

Conclusion

It is presumably not a bold statement to say that teaching ethics to science students presents a challenge to most lecturers (Johnson, 2010). Up to now, ethics teaching has mostly covered aspects of how to conduct research responsibly. The dual-use issue presents an additional new challenge in requiring science students to think about the societal impact of their research, i.e. it requires them to challenge the notion that all research is eventually good and benign. While it is debatable if science is indeed primarily responsible for the results of their work, as proposed by the security community, initiatives and pushes by the States Parties to the BWC will put pressure on science educators and curricula to include some form of dual-use bioethics education. By drawing on Heidegger and Rorty, this article has tried to show different perspectives on how we can understand technology and how art can help to break out of a purely technocratic analysis of science and technology. Art, and particularly bioart, may help to challenge the perception of science by science students and thus enable them to be more critical about their role and the role of their field in question of security for society.

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