1. Introduction

This handout is based on chapter 6 ("Unintended Bad Consequences", pp.171-183, 183-5, 189§6, 193-4, 197-203) of Allen Buchanan's 2011 book *Beyond Humanity? The Ethics of Biomedical Enhancement.*

The bio-conservative might

(i) *agree* that our current stage of enhancement is the result of a long history of technological advancement and this is continuous with emerging enhancement technologies,
(ii) *agree* that biomedical ETs have the potential to increase productivity, and thereby allow us to increase well-being
(iii) *agree* that there are no conclusive reasons that outweigh an evaluation of the pros/cons of the potential goods and risks involved with the use and development of ETs, but still
(iv) *reject* the claim that we should use/development enhancement technologies as *the risks outweigh the benefits*.

In other words, the bio-conservative might argue that once we adopt the balancing approach to debate over biomedical ETs what we find is that there are more risks than benefits and the most troubling risks are associated with **unintended bad consequences**.

Buchanan thinks that this is the "most serious consideration weighing against the enhancement enterprise" (*Beyond Humanity*, p.171).

> **Risk**: the potential for being subjected to a certain set of physical, biological, psychological, moral, and social harms.

In previous chapters, other harms have been a subject of discussion. In this chapter, Buchanan focuses on **biological harms** especially those associated with the intentional modification of human germline cells or *intentional genetic modification* (IGM).

WHAT IS INTENTIONAL GENETIC MODIFICATION?

By "intentional genetic modification", Buchanan likely means an array of practices that go by the following names: "genetic engineering", "gene cloning", "recombinant DNA technology", "genetic modification", and "new genetics". These terms refer to the practice of directly manipulating an organism's genome (its genetic material in its DNA or RNA for viruses) using various forms of emerging biotechnology. There are roughly three methods for intentionally manipulating an organism's genome.

M1: the removal of genetic material out of an organism or the introduction of genetic material into an organism by various practices, e.g. recombinant nucleic acid techniques.
M2: selective breeding and various means of "artificial" selection

Various organisms are the result of genetic engineering.
E1: GloFish[i] are a genetically designed fluorescent fish, intended as a pet.
E2: Knockout mice are mice where a gene is engineered to not express its normal function. These are often used to discover the function of various genes.
E3: Various genetically modified crops are manipulated to better resist cold, to fight off insects and fungi, to increase the nutritional value of food, and to grow faster.

There are two reasons why IGM is thought to be morally problematic but other forms of enhancement are not.

(1) The unintended bad consequences are *more serious*
(2) The unintended bad consequences are *irreversible*

In thinking about these two claims, it is necessary to ask "for *whom* are these consequences more serious or irreversible?"

Buchanan considers two answers: (i) the individual getting the enhancement and (ii) the human species. But, he claims that the seriousness and irreversibility to the species is overplayed for at least two reasons:

R1: The risk to the species won't be to the species as a whole as many individuals will choose not to be enhanced, e.g. religious groups, individuals with ethical options, countries that adopt legislation against enhancements, very cautious people
R2: Given how human beings reproduce, we don't have to worry about *enhanced individuals* "contaminating" non-enhanced individuals. It isn't as though enhancements will spread like air-borne diseases or the enhanced will infect the unenhanced like zombies infect human beings.

2. The Balancing Approach & Cost-Benefit Analysis

In an earlier chapter / handout, we discussed the *Balancing Approach to the Ethics of Enhancement:*

> **The Balancing Approach to the Ethics of Enhancement:** in order to determine the permissibility of ETs (whether it is morally acceptable to develop / use a particular ET), we ought to *balance* the pros/cons or risks/benefits. We do this by considering various ETs in the light of what we value, in light of human well-being, in light of the harms and risks we run in using these technologies, and then "try to make an impartial, factually-informed, all-things-considered judgment about what to do, or at least to try to identify a range of morally acceptable options (*Beyond Humanity*, p.59)

In this chapter, he expands on this method a little more and associates it with **cost-benefit analysis**.

WHAT IS COST BENEFIT ANALYSIS?

Cost-benefit analysis (CBA) is commonly confused with cost-effectiveness analysis or with the general method for making *financial* decisions that proceeds by evaluating activities in terms of their benefits (calculated in terms of a unit of currency) subtracted by their costs (again in terms of a unit of currency). But, CBA is a broader method.

CBA is a systematic process for estimating the strengths (pros) and weaknesses (cons) of various decisions, whether these be financial transactions or some other practical decision.

Step #1: *identify* all of the **costs** (the magnitude of harm and the probability of it occurring) and **benefits** (the magnitude of good it will produce and the probability of it occurring)
Step #2: weigh the costs (harms and their likelihood) against the benefits (good and their likelihood)
Step #3: consider whether there are any alternative proposals or *ways to reduce risk* that would allow us to reap the same benefits without running the risk of harm.
Step #4: choose the project that produces the greatest amount of benefit and least amount of harm

Test Example:

Take the proposal of town X, which plans to convert a plot of land into a public park. Currently, there is only one park in X and this park is pay-to-play.

Step #1:

Step #2

Step #3:

Step #4:

E1: It is 2035 and military weaponry has become increasingly miniaturized and accessible to the public. U.S. Government officials are worried that individuals may wish to use said technology for nefarious purposes, e.g. to blow up hospitals and orphanages, etc. A biotechnology firm called *Forever Friendly* has recently isolated the gene tied to aggressive and violent behavior and created a procedure for "knocking out" the gene responsible for certain forms of "aggressive" behavior. The U.S. government is considering offering a small incentive (e.g. $10,000) to people who, before birth, undergo genetic engineering where this gene is "knocked out." In addition, they will pay for the procedure free of charge. Some things to keep in mind: (i) US military spending was 820 billion dollars in 2014 (let's assume that it has risen to 1 trillion dollars), (ii) let's assume that there are 8 billion people in the world in 2035. *According to a cost-benefit analysis*, should the U.S. offer this program?

One objection we considered earlier was that there was/is some **conclusive reason against biomedical enhancement** that would make such an approach unnecessary. We now turn to two additional objections:

> **O1:** The Balancing Approach requires everything be quantified in terms of a single measure
> **O2:** The Balancing Approach is too narrowly focused. It weighs the overall costs of an ET vs. the benefit, *but we are also concerned about the* ***distribution*** *of these costs and benefits*.

Buchanan replies to these objections by saying that the Balancing Approach is not meant to be a kind of formal / financial cost-benefit analysis:

> I have emphasized in earlier chapters, it is equivalent to talk about pros and cons. In this broader, less formal sense, looking at costs and benefits is commonsensical—a matter of trying to articulate the full range of considerations that count in favor of or against a course of action or a policy, and then attempting to make an all-things-considered judgment about what to do (*Beyond Humanity*, p.175).[ii]

So, Buchanan thinks that when we assess the various pros/cons of a biomedical technology, it isn't a quantitative procedure and we aren't dealing with a single value like *pleasure* / *money*, but we are trying to take into account the **diverse factors** that weigh for or against the use of an ET.

In addition, **step #3** of the cost-benefit analysis suggests that we should search for ways to *reduce* risks. So, one of the key ideas in the discussion of ETs is that *if we accept the idea of cost-benefit analysis*, how should we go about thinking of alternatives to IGM in the form of risk reduction. In other words, we need a practical method of assessing and dealing with risk.[iii]

3. Methods of Assessing Risk

Buchanan identifies three main strategies for coping with risk (see *Beyond Humanity*, p.179)

> **Strategy #1:** Prohibition Model: the complete prohibition of risky behavior
> **Strategy #2:** Master Risk-Reduction Principle Model: the use of a single risk-reducing principle that can be applied in every scenario, e.g. the precautionary principle
> **Strategy #3:** Cautionary Heuristic Model: the use of a plurality of cautionary guidelines that are sensitive to changes in our knowledge about risk and encourage use to gain more information in our assessments of risk.

3.1. Strategy #1: Prohibition

Let's distinguish between two different approaches to complete prohibition:

> **APPROACH A**
> (1) Distinguish between IGM modifications and non-IGM modifications.
> (2) Completely prohibit IGM modifications because they are wrong.

O1: Buchanan notes that this is a hard view to hold because individuals typically accept IGM if it has a *therapeutic application*.[iv]

APPROACH B
(1) Distinguish between therapeutic IGM modifications and enhancement IGM modifications
(2) completely prohibit enhancement IGM modifications because they are wrong because:
(2.1) something is intrinsically wrong with enhancement IGM, e.g. undermines human freedom, destroys some aspect of human characters, is indicative of a crazed psychology, etc. OR
(2.2) the risks of enhancement IGM are *always* greater than the risks of therapeutic IGM OR
(2.3) some cases of enhancement IGM might be acceptable but we ought to avoid their use since (i) we are prone to misjudge whether a particular ET is safe or not (ii) the safest route is to avoid error by not using enhancement IGM at all.[v]

Buchanan has addressed versions of (2.1) in previous chapters, thinks that (2.2) is implausible and says that (2.3) turns on two issues that require closer analysis:

Issue 1: to what extent do we underestimate the risks associated with enhancement ETs?
Issue 2: how great are the potential benefits of enhancement ETs

To some extent, Buchanan does not address these issues directly. What he does instead is consider the risks/benefits of **IGM** versus its alternative: **UGM** (unintentional genetic modification, i.e. genetic modification through evolution without human intervention).

So, here is what the argument looks like:

ARGUMENT AGAINST PROHIBITION OF ENHANCEMENT IGM

P1	We can only assess the risks of enhancement IGM by contrasting it against enhancement UGM
P2	If we think that we ought to prohibit enhancement UGM, then we are saying that the risks / benefits of enhancement UGM outweigh the risks /benefits of enhancement IGM.
P3	But, the risks / benefits of enhancement UGM do not outweight the risks / benefits of enhancement IGM.
C	Therefore, we ought not to prohibit enhancement IGM.

The key premise is **P3**. In considering the option of strict prohibition on enhancement IGM, one might argue that the human organism is like the work of a Master Engineer who (through evolution) has carefully crafted human beings such that any intentional modification to *part* of that creation will have *negative* impacts on other parts or the functioning whole. But, Buchanan argues that evolution is *unlike* the work of a Master Engineer in two respects:

Respect #1: organisms are not finished products but constantly evolving, the environment is changing and we are changing with it and always in danger of being destroyed
Respect #2: nature does not *design* anything, the human being is just the result of a multitude of different adaptation that happened over time.

One of Buchanan's key points is that evolution is not the result of a design or the work of a master engineer. It is rather the result of a *tinkerer*: "it tinkers with organisms in response to immediate need, co-opting existing structures in *ad hoc* fashion to meet new fundamental demands" (*Beyond Humanity*, p.184-5). In saying that nature is a tinker, what he is stressing is that the way that organisms are built are *not optimal* and they seem to reflect a kind of *callousness*. He supports this claim by pointing to roughly **9** ways in which there is *sub-optimal* engineering in nature. We will consider two:

(1) Post-reproductive Life: Buchanan claims that nature seems to care nothing for the traits you have once you are past your reproductive years. I think another way of putting this is that there isn't any evolutionary benefit / advantage for human beings to be designed to have a *good* quality of life as they become elderly as opposed to a *bad* quality of life. In terms of natural selection, all that matters is fitness in the environment and reproductive success. *Such a design is not the work of a benevolent or master engineer.*
(2) Various bacteria are capable of rapid generation and "lateral" transmission of genes (i.e., they can exchange genes without engaging in sexual reproduction). By contrast, human generation is *slow* and transmission of genes is not lateral. Buchanan says that this gives microbes (disease causing organisms) an advantage over human beings, implying that it is a matter of time before they kill their hosts. *Such design is not the work of a benevolent or master engineer.*

These, and other factors, aim to undermine the confidence we have in enhancement UGM and provide a prima facie case for enhancement IGM. And, **it seems to support that certain forms of IGM outweigh UGM in a cost-benefit analysis**.

CDQ: What other ways is nature's design *not optimal*? Think of a concrete way where the design of human beings falls short and *not simply in some trivial way* but in a way that is critical for our happiness and survival. What does this say about the idea of Nature being a Master Engineer?

3.2. Strategy #2: Master Principle

If we ought not have blanket prohibition on enhancement IGM, then we need a way to think about evaluating risks / benefits. One way to consider which enhancement IGMs are acceptable is to adopt a *single master principle*. One example of such a principle is the "precautionary principle". There is some discussion by Buchanan of what is *meant* by the precautionary principle (see *Beyond Humanity*, pp.200-202), but we will use the following two formulations:

Strong Precautionary Principle (SPP): Before a potentially dangerous activity is undertaken, the individual who plans to undertake said activity must *prove* that it is not harmful, that the harms involved are negligible, or very unlikely to occur.
Weak Precautionary Principle (WPP): Before a potentially dangerous activity is undertaken, lack of scientific certainty about those dangers may not be used as a reason for postponing an investigation into these dangers to a future date.

If we think that SPP is correct, then we should not make use of enhancement IGM until we can show that the harms are negligible. If we think that WPP is correct, then we can make use of enhancement IGM but we cannot say "oh, well we don't know the dangers so we can put off investigating them to a future date." WPP is at least compatible with simultaneously engaging the enhancement project and investigating the harms enhancement IGM involves.

O1: If our concern is avoiding harm caused by human beings, then SPP does not seem correct for enhancement IGM may be necessary to avoid other harms, e.g. global warming, nuclear explosions, car accidents, etc.

CDQ: What are the benefits / weaknesses of SPP and WPP? If you had to choose one of the two, which would you prefer and why?

3.3. Strategy #3: Cautionary Heuristics Model

Buchanan claims that problems with blanket prohibition and using a single master principle suggest that we need a different way to deal with the potential harms of enhancement IGMs. He suggests a *cautionary heuristic model*. While he only sketches this model, he think it is better advice than vague statements like "we need to go slow" or "be cautious" (these sorts of suggestions are true, but practically useless.

Unfortunately, Buchanan isn't very detailed here (see pp.198-199) but here is my best take on the 7 guidelines he proposes

SEVEN GUIDELINES FOR MINIMIZING RISK IN THE ENHANCEMENT ENTERPRISE	
1	Target genes at "shallower ontogenetic depths". What he likely means is let's focus on genes that play a role in the later development of the human being (embryo to adult). That is, take two genes X and Y. If X codes for characteristic *a* and Y for *b*, and *a* is developed earlier than *b*, then we should focus our enhancements at *b*.
2	Focus on enhancing people above the norm but not to a superhuman level.
3	Try to make enhancements containable to the enhanced individual.
4	Focus on modularized capacities. What he means here is that if we understand the human being as a set of parts, let's focus on parts / functions that are isolatable. Rather than enhance the circulatory system to increase strength, just enhance the muscles in the arms or legs.
5	Try to focus on *reversible* enhancements. If we have the choice between designing a baby to be super smart by altering their genetic structure and implanting a chip, choose the later as it appears to be reversible or detachable.
6	Try not to change *how the entity develops* (avoid messing with morphology)
7	Avoid letting biomedical technology go beyond biomedical science by ensuring that any biomedical intervention is only when (i) we know what role the trait we are modifying plays in the body and (ii) we have a clear understanding of the genes that give rise to these traits.

CDQ: Buchanan thinks that if we adopt the Balancing Approach (cost-benefit approach), we ought to adopt his **cautionary heuristics model**. Is he right? How might we add to his list of seven guidelines?

[i] Image from GloFish Fluorescent Fish. Copyright © 2014 Yorktown Technologies, L.P. http://www.glofish.com/images/ GloFish® fluorescent fish are covered under one or more of the following United States Patent Numbers: 7,834,239; 7,858,844; 7,700,825; 7,135,613; 7,442,522; 7,537,915; 7,150,979; 7,166,444, 8,153,858; 8,232,450; 8,232,451; and 8,378,169, as well as other pending applications.

[ii] That costs / benefits need not be weighed in terms of monetary value is supported by various introductory treatments of CBA, e.g. Tevfik F. Nas in his *Cost-Benefit Analysis: Theory and Application*, Nas writes "[i]t is important to note that costs and benefits are measured in terms of social utility gains and losses rather than cash or revenue flows, and external costs and benefits are invariably included in the evaluation" (p.2)

[iii] This takes us back to our discussion of risk in Charles Perrow's *Normal Accidents* and the dangers of technology in David E. Nye's *Technology Matters* (ch.9).

[iv] For example, Sandel (who thinks that ET is wrong because (i) it is indicative of a desire for mastery over nature and (ii) it can lead to a lack of appreciation for the gifts of nature) contends that "[m]edicine intervenes in nature, but because it is constrained by the goal of restoring normal human functioning, it does not represent an unbridled act of hubris or bid for domination" (*The Case Against Perfection*, p.101). Similarly, Habermas distinguishes between the use of new biomedical procedures for therapeutic purposes as we can assume that the individual would consent to such a modification. He writes that "[a]s long as medical intervention is guided by the clinical goal of healing a disease or of making provisions for a healthy life, the person carrying out the treatment may assume that he has the consent of the patient preventively treated" (*The Future of Humanity*, pp.51-52).

[v] Drawing from Perrow's *Normal Accidents*, we might say that enhancement technologies are subject to normal accidents, that biomedical technologies are applied to complex systems, and that some bad consequence is *inevitable* and *unpredictable*