Julian Savulescu

Human Liberation: Removing Biological and Psychological Barriers to Freedom

In this article, the author is concerned with the psychological and biological barriers to freedom and the ways to overcome them. A number of constraints are examined, and the research scientists are conducting trying to unravel the genetic contribution to human physical and mental ability, performance and behaviour in the field of behavioural genetics. For example, scientists are trying to elucidate the contribution of differences in genetics to aggression and criminal behaviour, alcoholism and addiction, anxiety, personality disorders, psychiatric diseases, homosexuality, maternal behaviour, memory and intelligence, personality traits such neuroticism and novelty seeking, and sprint/endurance performance in sport. This knowledge may allow prediction of behaviour and ability, as well as opening the door to biological interventions to improve performance. But, as animal research has shown, it is clearly possible in principle to radically improve performance. The author's conclusion is that there are four ways to increase human freedom. Alter: 1. Natural environment; 2. Social environment; 3. Psychology; 4. Biology. We should consider all *options and make an active choice which reason supports. We should not privilege biological or psychological interventions over social change. But should consider them as all candidates for improvement.*

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Human Liberation: Removing Biological and Psychological Barriers to Freedom

Our biology and psychology present impediments to wellbeing, social justice, economic productivity, morality, human relationships, existence of humanity. We will soon be able to liberate ourselves from the constraints our biology and evolutionary origins impose on us

In this article, I would like to consider the issue of *freedom.* Freedom has many senses and meanings. It can simply mean the absence of constraints on action. For example, I am free to count cars as they pass. I am not concerned with this very broad notion of freedom. I will consider freedom in the *normative* sense – in the sense that matters morally or prudentially.

A person, A, is free to perform some action or to be in some way, X, in circumstances C if A rationally desires (or would rationally desire) to X in C and there are no barriers, J, to A Xing in C.

There are four kinds of barriers to freedom:

1. Natural
2. Social/cultural
3. Psychological
4. Biological.

Natural barriers include physical obstacles arising from nature. For example, I am not free to live in the clear mountain air, as I would like, and work in Oxford in virtue of the geography of England. Social barriers to freedom are the social institutions which constrain unreasonably action or ways of being. For example, limited maternity leave and child support arrangements can constrain the participation of women in work. Labour laws can result in the discrimination or exclusion of some people from work.

Questo è il testo della XXIII Conferenza "Fulvio Guerrini" organizzata dal Centro di Ricerca e Documentazione "Luigi Einaudi" (Torino, 25 marzo 2009). I testi delle prime venti Conferenze sono raccolti in due volumi: *Le libertà dei contemporanei. Conferenze "Fulvio Guerrini" 1984-1993*, Torino, Centro Einaudi, 1993, e *Le libertà dei contemporanei. Conferenze "Fulvio Guerrini" 1994-2005*, Torino, Centro Einaudi, 2005. Tutti vengono via via pubblicati su questa rivista.

Much has been written on the social barriers to freedom. Our laws, attitudes, social institutions and practices can severely constrain freedom. Communism, totalitarian or dictatorial regimes or the absence of law (in some African states) can profoundly limit freedom. But I am, in this article, more interested in the psychological and biological barriers to freedom. That is, states of our own biopsychological nature that limit how we can act and be, in ways that prevent us achieving what we do or would rationally desire.

BIOPSYCHOLOGICAL CONSTRAINTS ON FREEDOM

Many biological and psychological characteristics can profoundly affect how well our lives go. One example is impulse control. In the 1960s Walter Mischel conducted impulse control experiments where 4-year-old children were left in a room with one marshmallow, after being told that if they did not eat the marshmallow, they could later have two. Some children would eat it as soon as the researcher left, others would use a variety of strategies to help control their behaviour and ignore the temptation of the single marshmallow. A decade later, they re-interviewed the children and found that those who were better at delaying gratification had more friends, better academic performance and more motivation to succeed. Whether the child had grabbed for the marshmallow had a much stronger bearing on their SAT scores than did their IQ[1]. Impulse control has also been linked to socioeconomic control and avoiding conflict with the law.

Impulse control is what some philosophers call an «All Purpose Good», that is, a good for a person no matter what that person's plan for life or particular way of being or context. Self control is valuable whether you want to be philosopher, doctor, builder, entertainer or soldier. Other examples of all purpose goods include

- Memory
- Self- discipline
- Foresight
- Patience
- Sense of humour
- Optimism.

COGNITIVE CONSTRAINTS ON FREEDOM[2]

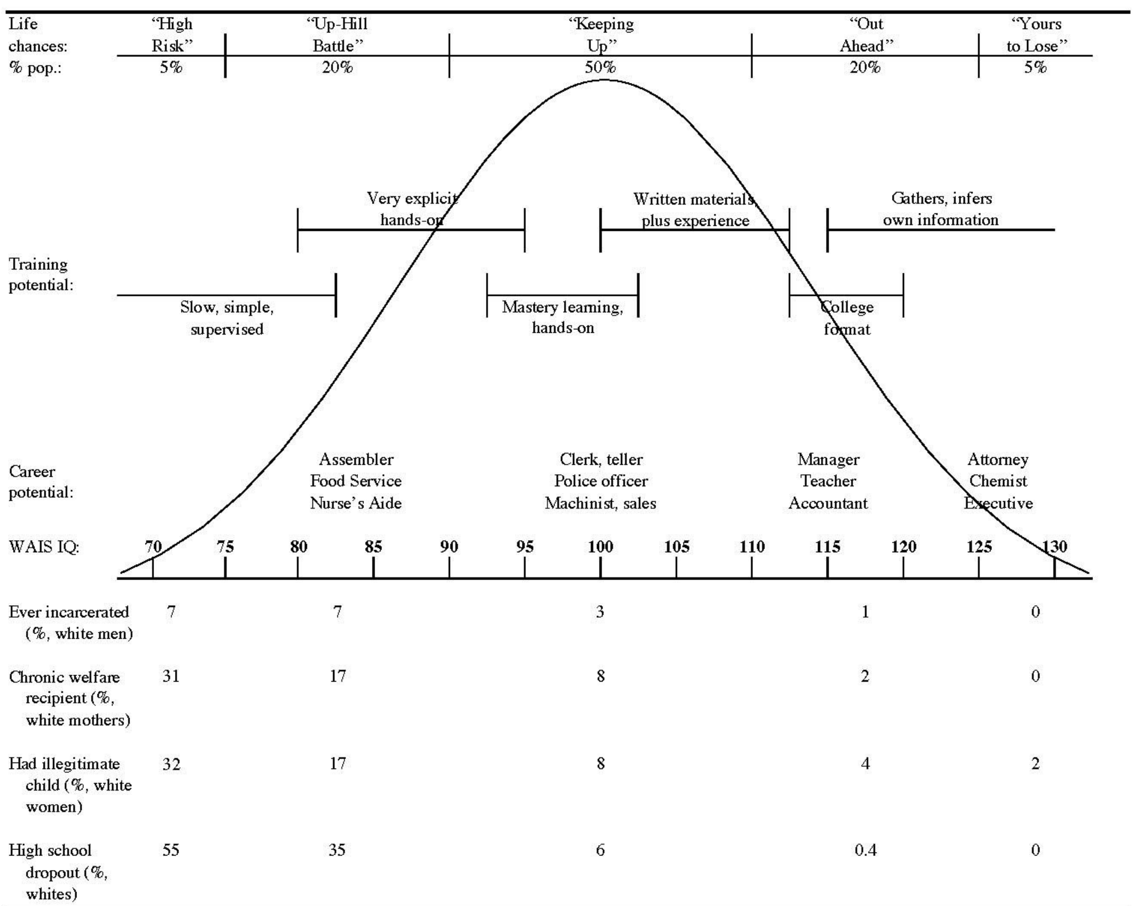
One of the most important of all purpose goods is general intelligence, or *g.* This is a proficiency in learning, reasoning and thinking abstractly. It is the ability to spot problems and to solve them. It is not specific knowledge, but ability to accumulate and apply it.

[1] W. Mischel, Y. Shoda, and P.K. Peake, *The nature of adolescent competencies predicted by preschool delay of gratification*, «Journal of Personality & Social Psychology», 54, 1988, n. 4, pp. 687-696.

[2] I would like to thank Professor Linda Gottfredson for valuable data and for opening my eyes to the social implications of intelligence. See www.udel.eu/educ/gottfredson for a full archive of her ground breaking work.

General intelligence or *g* varies in a normal distribution naturally within a given defined population. For Western populations, it famously follows a bell curve with a mean of 100 and standard deviation of 15 points.

Intellectual disability for medical, legal and social purposes is arbitrarily defined as an IQ 2 standard deviations below the mean, that is, below 70. However, where one finds oneself on this curve, even within the normal range, as a result of the natural lottery, profoundly affects one's life chances and opportunities, what one can do and who one can be.



For example, the US Department of Education conducts a survey of Estimated Levels of Usual Functioning as a part of its National Adult Literacy Survey (NALS). This involves a nationally representative sample, ages 16-65. There are 5 levels of functioning. The following table illustrates these levels of functioning, together with the fraction of people for whom this is the maximum level of functioning which they can achieve.

The lowest level involves being at levels of functioning like estimating the total of a bank deposit entry or locating the expiration of date on a driving licence. For 22% of Americans, this is the highest level of functioning which they can achieve. Level two tasks involve more information, inference and distracting information. For example, this kind of task would be determing the difference in price between 2 show tickets or locating an intersection on a street map. For 27% of Americans, this is the highest level of functioning and they cannot do more complicated tasks. This is NALS level and correlates with an IQ of about 96[3].

NALS Level	% pop.	**Simulated Everyday Tasks**
5	3	• Use calculator to determine cost of carpet for a room • Use table of information to compare 2 credit cards
4	17	• Use eligibility pamphlet to calculate SSI benefits • Explain difference between 2 types of employee benefits
3	31	• Calculate miles per gallon from mileage record chart • Write brief letter explaining error on credit card bill
2	27	• Determine difference in price between 2 show tickets • Locate intersection on street map
1	22	• Total bank deposit entry • Locate expiration date on driver's license

The US Department of Education has stated that people at levels 1-2 are below literacy level required to enjoy rights and fulfil responsibilities of citizenship.

The US Military has long known that people with intelligence in the low end of the normal range are unfit intellectually for military service. The military administer IQ tests, and since the Second World War, has rejected the bottom 10% (IQ of 80 and below). More recently, the official entry IQ has been raised to 85, eliminating the bottom 15% from jobs in the military. In practice, they reject people with an IQ less than 93, which means that 30% of the population lacks the IQ to qualify for a job in the military[4].

The US Military is not constrained by political correctness or fine sounding ideological redescriptions of reality. One representative from DARPA wrote:

> The world contains approximately 4.2 billion people over the age of twenty. Even a small enhancement of cognitive capacity in these individuals would probably have an impact on the world economy rivaling that of the internet.

[3] Please see http://www.udel.eu/educ/gottfredson/. Accessed 3 July 2009.
[4] Please see http://www.udel.eu/educ/gottfredson/. Accessed 3 July 2009.

Cognitive enhancement is one way of overcoming one of the biological barriers to a good life and a life of opportunity. And it can be cheap. 1 in 3 people in the world don't get enough iodine. This causes mental slowness. Deficiency of iodine in pregnancy results in the loss of 10 to 15 points IQ points in the fetus. Around the world, this results in the more than 1 billion IQ points of mental capital being lost each year. Iodizing salt costs only 2 cents to 3 cents per person per year.

There may be other cheap methods of cognitive enhancement. For example, choline may increase fetal IQ if given in pregnancy. It occurs naturally in eggs.

As drugs are developed to treat memory loss in Alzheimer disease, these drugs are likely to be effective for normal age-related memory loss which occurs after the age of 40. They are also likely to improve memory in normal people.

Already, drugs are being used to improve cognitive performance in the normal range. Modafenil is a new class of drug originally developed for narcolepsy. It is now also prescribed for shift workers. It improves executive function, wakefulness, and working memory. It is now widely used by academics, other professionals and college students in US to enhance cognitive performance. Used daily it would cost about $100-$200 per month. This compares with smoking one pack of cigarettes per day which costs $60 per month.

It has been estimated that «Ninety percent of the prescriptions are for off-label usage». Sales of this drug have grown exponentially. One version, Provigil (Cephalon), has enjoyed the following success:

2005	*2004*	*2003*	*2002*	*2001*
$500 million	$289 million	$200 million	$150 million	$75 million

If this growth were to continue, the market in 2018 would be $70 billion! In 2007 market for Provigil in US was $1 billion (Provigil in US). Modafenil will go generic in 2012, which will mean it will probably only be worth $7-10 billion in 10 years.

In April, 2008, an online survey of individuals who read the journal *Nature* revealed that roughly **one in five** respondents use prescription drugs to improve their focus, concentration, or memory[5]. A total of 1,400 people from 60 countries responded to the online survey. The subjects were asked specifically about the use of three drugs. Here are the fraction of respondents who had used them:

1. Methylphenidate (Ritalin) 62%
2. Modafinil (Provigil) 44%
3. Beta-blockers 15%

Other drugs were also used:

- Adderall, a drug prescribed for ADHD containing a mixture of amphetamines
- Centrophenoxine
- Piracetam
- Dextroamphetamine Sulfate
- Ginkgo
- Omega-3 fatty acids.

There are a range of other enhancers available even today.

[5] B. Maher, «Poll results: Look who's doping», *Nature*, 452, 2008, pp. 674-675.

Drug	Effect	+	–
Sugar	Stimulates, memory improvement, self-control improvement	Legal, very cheap, safe, well studied	Bad for teeth
Modafinil	Increased alertness, better executive function	Well studied, apparently safe and non-addictive	Risk of overexertion?
Caffeine	Increased alertness	Legal, very cheap, safe, well studied	Quasi-addictive
Nicotine (enhancing cholinergic drugs)	Increased alertness, memory enhancement	Legal	Biased studies? Addictive, smoking unhealthy
Choline	Enhance memory in offspring pregnant rats	Easily accessible, legal, long-term effects	Unknown long-term side effects
Amphetamine	Increased alertness, memory enhancement, reorganisation	Well studied	Not legal, addictive, preservation
Dopaminergic drugs (e.g. Ritalin)	Attention, working memory		Recreational use
Beta blockers	Calming, reduce impact of anxiety in traumatic memory		
Ampakines	Memory enhancement, increased alertness		Experimental, Seizure risk?
CREB-inhibitors	Memory enhancement		Experimental

BIOPSYCHOLOGICAL BARRIERS TO MORAL BEHAVIOUR

Not only does our own biology and psychology limit our cognitive performance, in some cases, with profound consequences even for normal people, but it can also represent a constraint on us acting morally.

Psychopaths

In 1993, two bodies were found on a country road in Ellis County, Texas. One was male, one female. The boy, 14, had been shot, but the 13-year-old girl had been stripped, raped, and dismembered. Her head and hands were missing. They were killed by Jason Massey aged 20.

Massey was nine years old when he killed his first cat. He added dozens more over the years, along with dogs and even six cows. He had a long list of potential victims and his diaries were filled with fantasies of rape, torture, and cannibalism of female victims. He was a loner who believed he served a «master» who gave him knowledge and power. He was obsessed with bringing girls under his control and having their dead bodies in his possession.

We are all familiar with stories about psychopaths. Such people seem to profoundly lack normal human empathy. Often, even their parents realise there is something wrong with them, even from a very young age.

> I have had to work so very hard to distance myself emotionally from my own daughter. I would do anything to make it «right». My husband and I have done everything in our power to help her. We can do no more. I still love her, but I know that she is who she is, and that just about kills me.
>
> I also have a son 18 years of age. He has exhibited problems since childhood. He also has rages, lies. Manipulates. He is now off to a very good college and is extremely bright which actually makes it more lethal. He just hasn't been right since birth. He is no longer living with me and I pray he does well in life. My therapist said I did everything I possibly could for him including therapy since age 3.

According to major textbook of psychiatry, *DSM-III-R* (pp. 343-344):

> Antisocial Personality Disorder is five times more common among first-degree biological relatives of males with the disorder than among the general population**.** The risk to first-degree biologic relatives of females with the disorder is nearly ten times that of the general population … Adoption studies show that both genetic and environmental factors contribute to the risk of this group of disorders, because parents with Antisocial Personality Disorder increase the risk of Antisocial Personality Disorder … in both their adopted and biologic children.

There are good reasons to believe that antisocial personality disorder and psychopathic behaviour have significant biological and even genetic causes.

People with an antisocial personality have a limited range of human emotions and, in particular, lack empathy for the suffering of others. Empathy may be provided by some remarkable neurons located in the inferior frontal cortex and the anterior part of the inferior parietal lobule of the brain. These nerve cells are active when specific actions, such as picking an object of food and eating. are performed, but what makes them remarkable is that they also fire when another animal, the experimenter or even a robot perform the same action. A mirror neuron fires as though the observer were itself performing the action. Evidence is mounting that the region of the brain known as the insula, provides the substrate for our understanding of the emotions of others.

Activity of insula neurone underpins the emotion of disgust. The mirror system for hand actions and the mirror system for emotions are more active in people who are empathic as judged by questionnaires. Similarly in children, the degree of activity of mirror neurons induced by observations and imitation of facial expression correlated with empathic concern and interpersonal competence. Children with the autism spectrum disorders who are socially isolated and have difficulty demonstrating warmth and interpersonal connectivity also have disturbed activation of the mirror neurones. There are good reasons to believe that autism spectrum disorders have a strong genetic causation. So at least in these groups, not only is there an emerging biological pathway being identified but the ultimate cause of such behaviour may be strongly genetically influenced.

The mirror neurons are thus important candidates to represent what philosophers call the «Theory of Mind», or the ability to infer other people's mental states, thoughts and feelings.

The upshot of this is that our own biology and psychology may represent barriers to us empathising with other people, and to understanding their own mental states.

Even our conceptions of fairness may be, in part, determined by our own individual biopsychological natures. Here is one reason to believe this. In the Ultimatum Game, there are two players, a proposer and a responder. The proposer divides a reward. For example the proposer can divide ten rewards between two pots in different ways, e.g., five and five, or eight and two. The proposer can choose one of two trays, each with two pots with a different distribution of rewards. The responder then accepts his share or can reject the offer altogether, in which case each of them gets nothing.

When this experiment is done with chimps, responders generally accepted 2/8 distributions without any sign of dissatisfaction even when there was an equal distribution of five raisins in each pot on the alternative tray. In contrast, under similar conditions adult human responders as a rule respond by rejecting the offer, thereby forgoing a smaller reward in order to punish the proposers for their blatant unfairness.

However, humans differ in terms of how much unfairness they will tolerate in the Ultimatum Game. Some will accept a 4/6 distribution; others only 5/5. What is remarkable is not that humans differ from each other, but that when human identical twins play the proposer and responder roles of the ultimatum game, there is a striking correlation between the average division with respect to both what they propose and what they are ready to accept as responders. There is no such correlation in the case of fraternal twins. Since identical twins share the same genes (and these twins have been separated at birth), this strongly suggests that the human sense of fairness has some genetic basis. In humans, the rejection of unfair offers is more than 40% genetically determined, with a very modest role for environmental influences.

One of the greatest constraints on freedom is imprisonment. Yet the risk of imprisonment is much higher in those with lower intelligence and poor self-control. Indeed, there may be states of human biology that directly relate to criminal behaviour.

Caspi and colleagues[6] investigated the relationship between the presence of a change in the gene encoding for monoamine oxidase A (MAOA), a neurotransmitter metabolising enzyme, and the tendency towards antisocial behaviour in a large cohort of New Zealand males. They found that men who had been mistreated as children *and* were positive for the polymorphism conferring low levels of MAOA were significantly more likely to exhibit antisocial behaviour than those who had been mistreated but lacked the change. Both groups were more likely to exhibit antisocial behaviour than those who were not mistreated. This suggests a possible interaction between mistreatment and MAOA deficiency in causing antisocial behaviour. It also raises the possibility that pharmacological manipulation of MAOA may influence the development of such behaviour.

The neurotransmitter serotonin has been linked to less aggressive behaviour. There is an inverse relationship between indices of serotenergic function and impulsive aggressive behaviour. For example, depleting serotonin leads to more aggressive behav-

[6] A. Caspi, J. McClay, T.E. Moffitt, J.S. Mill, J. Martin, I. Craig, A. Taylor, R. Poulton, «Role of genotype in the cycle of violence in maltreated children», *Science*, 297, 2002, pp. 851-854.

iour. And drugs such as Selective Serotonin Reuptake Inhibitors like Prozac increase co-operation and reduce aggression.

Oxytocin, a hormone released by the hypothalamus, has been shown to influence ability to infer another's mental state. It increases willingness to trust, but this does not extend to all risk taking, only social risks. For example, it prevents decrease of trust after betrayal and even after several betrayals. It also reduces fear of social betrayal.

How much we trust others and are willing to co-operate, especially in large groups, varies across individuals. This variation has a biological basis capable of being altered by biological interventions for example, by the administration of oxytocin and drugs like Prozac.

Biopsychological Barriers to Rational Decision-Making

Since Kahneman and Tversky first began to describe the psychological biases and heuristics which constrain human rationality, an increasing number of psychological barriers to fully rational decision-making, even means-end rationality, have been identified. But increasingly we are coming to understand how states of our own biology can frustrate rational choice.

In recent work from Cambridge, Coates and colleagues described how testosterone and cortisol levels (naturally occurring hormones) could lead to irrational decision-making which could in turn contribute to financial crisis[7]. This is not to say that hormonal fluctuations have caused recent financial crises; but they may well have contributed.

Coates and colleagues found that City traders who have high morning testosterone levels make more than average profits for the rest of that day. These researchers hypothesized that this may be because testosterone has been found to increase confidence and appetite for risk – qualities that would augment the performance of any trader who had a positive expected return. However, previous studies have shown that administered testosterone can lead to irrational decision-making. Thus, if testosterone continued to rise or became chronically elevated, it could begin to have the opposite effect on a trader's profitability by increasing risk-taking to unprofitable levels. They argued that this is because testosterone has also been found to lead to impulsivity and sensation seeking, to harmful risk taking, and in extreme cases (such as among users of anabolic steroids) to euphoria and mania.

Testosterone may therefore underlie a secondary consequence of the «winner effect» in which a previous win in the markets leads to increased, and eventually irrational, risk taking in the next round of trading.

Professor Joe Herbert, from the Cambridge Centre for Brain Repair, said:

> Market traders, like some other occupations (such as air traffic controllers), work under extreme pressure and the consequences of the rapid decisions they have to make can have profound consequences for them, and for the market as a whole. Our work sug-

[7] J.M. Coates and J. Herbert, *Endogenous steroids and financial risk taking on a London trading floor*, PNAS, 105, 2008, pp. 6167-6172.

gests that these decisions may be biased by emotional and hormonal factors that have not so far been considered in any detail.

Any theory of financial decision-making in the highly demanding environment of market trading now needs to take these hormonal changes into account. Inappropriate risk-taking may be disastrous. Hormones may also be important for determining how well an individual trader performs in the highly stressful and competitive world of the market. We are now exploring this in much more detail.

FREE TO LOVE?

There are a number of biopsychological constraints on our capacity to love which are a product of our evolution[8]. Love for humans, as other animals, pass through three stages:

1. **Lust** promotes mating with any appropriate partner
2. **Attraction** makes us choose and prefer a particular partner
3. **Attachment** allows pairs to cooperate and stay together until their parental duties have been completed.

Each of these states has a different basis in brain activity associated with activation of different neurotransmitters and hormones. Neuroimaging of studies of romantic love have shown activations in regions linked to the oxytocin and vasopressin systems, activation in reward systems, and systematic deactivation in regions linked to negative affect, social judgement and assessment of other people's emotions and intentions.

For various reasons, including evolutionary considerations, each of these states may pass or disappear. And this is amenable to biological manipulation. Consider the example of attachment, which is involved in pair bonding. Failure of pair bonding is a part of the explanation of increasing and high divorce rates, which are approaching 50% of marriages.

Much work in social neuroscience studying pair bonding has gone into examining the mating habits of monogamous prairie voles (*Microtus ochrogaster*) and closely related but polygamous meadow voles (*M. montanus*). The vole pair bonding systems are based on the neurohormones oxytocin and vasopressin. These also modulate other social interactions such as infant-parent attachment and social recognition and trust. The receptors for these hormones are distributed differently in monogamous and polygamous voles.

The sexual behaviour of these voles can be altered. Infusion of oxytocin into the brains of female prairie voles and vasopressin in male prairie voles facilitated pair-bonding even in the absence of mating (while the non-monogamous meadow voles were unaffected). Researchers used gene therapy to introduce a gene from the monogamous male prairie vole into the brain of the closely related but polygamous meadow vole. Genetically modified meadow voles became monogamous, behaving like prairie voles. This gene, which controls a part of the brain's reward centre, is known as the vasopressin receptor gene.

[8] J. Savulescu and A. Sandberg, «The Neuroenhancement of Love and Marriage: The Chemicals Between Us», *Neuroethics*, 1, 2008, pp. 31-44.

A recent study[9] identified a similar gene in humans: the Vasopressin Receptor 1a (AVPRIA) gene. This has previously been associated with autism, age at first sexual intercourse, altruism, and creative dance performance. This study assessed relationships on a Pair Bonding Scale (PBS) and found pair bonding was significantly lower for men carrying allele (gene variant) 334 than for those who were not. The effect was dose dependent – pair bonding was even lower for carriers of 2 x 334 alleles.

Carriers of the 334 variant more often reported marital crisis including the threat of divorce in the last year. 15% of men with no 334 allele reported such a crisis, compared to 34% of men with 2 copies. The frequency of nonmarried men was higher among 2 x allele 334 carriers (32%) than men with no 334 allele (17%) even though all cohabiting individuals in the trial had been in relationship for at least 5 years and the majority of all couples were biological parents to adolescent child.

Women also expressed more dissatisfaction with partners who carried the 334 allele; women married to men with 1 or 2 x 334 allele reported lower affection expression, dyadic consensus and dyadic cohesion.

The 334 variant is associated with increased activation of amygdale, which is a brain region known to be of importance for pair bonding.

These findings suggest that people may vary in their capacity to sustain a long term loving relationship. This capacity is amenable to alteration.

RADICAL POSSIBILITIES

Drugs like Modafenil and Ritalin scratch at the surface of enhancing human capacities and increasing human freedom by removing biological and psychological limitations on human freedom to act and be. But more radical modifications are possible in principle. Scientists have created a range of radically enhanced non-human animals. The most striking example is Supermouse, created by scientists at Case Western Reserve University in Cleveland, Ohio. Supermouse is a genetically engineered mouse which runs for up to six hours at a speed of 20 metres per minute before needing a rest. This results from changes to the metabolism of glucose. The genetic change means the glucose metabolising gene – PEPCK-C – is overexpressed in the skeletal muscle, which avoids the muscle-cramping effects of build-up of lactic acid which is normally experienced during prolonged exercise. The researchers will use the new mouse to study the effects of diet and exercise on longevity and cancer risk and potentially to better understand the genetic basis of inherited conditions which lead to muscle wasting in humans.

Supermouse is more active: it has 7 times more cage activity than normal mice. It has greater endurance – it ran 6 km on a treadmill (compared with the normal mouse who could only manage 0.2 km). It has improved metabolism – it ate 60% more but had half the body weight and only 10% of the body fat of a normal mouse. It had an extended lifespan: «survived longer and looked healthier». It had extended youthfulness: mice of 30 months were still twice as fast as 6 month old normal mice and repro-

[9] H. Walum, L. Westberg et al, *Genetic Variations in the Vasopressin Receptor 1a Gene (AVPR1A) Associates with Pair-Bonding Behavior in Humans*, PNAS, 105, 2008, pp. 14153-14156.

ductively active at 21 months (and up to 30 months), which is equivalent to being reproductively active as a woman at the age of 80. Supermouse was healthier, having lower cholesterol levels.

Humans have the same gene as supermouse. We could create superhumans today with the same abilities as supermouse. Scientists have recently created a fluorescent human embryo by successfully transferring a gene from a jellyfish into a human embryo. This proves in principle what was long been known in non-human animals. Transferring genes from one species to another can be safe and effective, as can genetic engineering.

Other examples of genetically enhanced animals include:

- **The Doogie Mouse***:* Better memory through overexpression of the receptor subunit NR2B.
- **Methuselah Mice**: By reducing growth hormone levels long-lived dwarf mice can be produced. The current record holder survived 4 years 11 months and 3 weeks, while normal mice have a two year lifespan.
- **Regenerating MRL Mice**: These mice regenerate holes punched in their ears as well as some injuries to heart muscle (accidental breeding rather than genetic engineering).
- **Schwarzenegger Mice and Belgian Blue Cows**: Increased muscle mass through myostatin knockout. Occurs naturally in cows and humans.
- **Hard Working Monkeys**: Monkeys tend to slack off until they get close to a reward they have to work for. If injected with a DNA construct that blocks the D2 receptor they work at an even rate.
- **Anticancer Mice**: Immune systems that kill cancer cells efficiently and can even help other mice through blood transfusions.
- **Antiobesity Mice**: Protected from obesity and diabetes by their lack of the enzyme DGAT1. Their fat tissue can even reduce obesity and glucose buildup in other mice if transplanted.
- **Marathon Mice**: Overexpress PPARδ in their muscles – turn into slow twitch fibres that work well for long-distance running. More endurance and increased resistance to obesity.

At present, scientists are trying to unravel the genetic contribution to human physical and mental ability, performance and behaviour in the field of behavioural genetics. For example, scientists are trying to elucidate the contribution of differences in genetics to aggression and criminal behaviour, alcoholism and addiction, anxiety, personality disorders, psychiatric diseases, homosexuality, maternal behaviour, memory and intelligence, personality traits such neuroticism and novelty seeking, and sprint/endurance performance in sport. This knowledge may allow prediction of behaviour and ability, as well as opening the door to biological interventions to improve performance. But, as animal research has shown, it is clearly possible in principle to radically improve performance.

Our biological and psychological nature as individuals represents a barrier to our own well-being, to moral behaviour and to love. This nature constrains our freedom. Should we enhance our biological and psychological nature? Or are only social remedies permissible?

WHY WE SHOULD LIBERATE OURSELVES FROM OUR BIOPSYCHOLOGICAL LIMITATIONS

I have given three arguments in favour of enhancement[10].The first argument is that it is wrong to fail to enhance. Consider an analogy. Imagine a couple have a child with some valuable talent or property, e.g. self-control or empathy. I will use the example of IQ as it is easy to quantify. Let's assume the child has an IQ of 130, meaning the child can have any job or profession she chooses. But the child has a rare metabolic variant. If Vitamin K is not regularly administered, the child's IQ will drop to 90. This is still «normal» but severally constrains the range of jobs and opportunities the child could pursue, and increases the risk of accidents and misfortune, as well as lowering the capacity to attract more highly paid jobs. The child would also be unlikely to get a job in the military!

It would be wrong to fail to administer absent some good reason. The couple might have a good reason for not giving the drug, e.g. it is dangerous in some way, expensive, difficult to obtain or painful to administer. But absent some strong good countervailing reason, it would be wrong to fail to give the vitamin.

Now imagine another couple who have a child with an IQ of 90. That child faces the constraints and obstacles I have just mentioned. His life is constrained by that IQ. Now imagine a simple vitamin would increase the IQ to 130. We have exactly the same reasons to provide the vitamin as in the analogy: the opportunities and freedom that the higher IQ affords. It would be equally wrong to fail to give this life-enhancing intervention.

This is an imaginary example. There are no such metabolic disorders (though PKU is close) and simple vitamin treatments. But we may soon identify pharmacological and perhaps more fundamental biological interventions which may be like these imaginary vitamins. If so, the same moral imperatives will operate to employ them. There is a moral obligation to remove the biological and psychological constraints on human freedom.

The second argument which I gave was that we already accept a wide range of environmental interventions, like improved education and diet. We inculcate values, train and educate children to be well behaved, co-operative and intelligent. These interventions do not act mysteriously – they change biology. When we form a memory or learn a new skill, like playing piano or skiing, we change our brains. Why then should we reject interventions which directly change or enhance brain activity, or facilitate learning? The outcomes are the same. Education raises IQ. Why not then accept drugs or other interventions that, if safe, also raise IQ?

The last argument I gave in favour of removing biopsychological obstacles to our well-being (and other valuable ends) was that we already accept the value which drives this imperative when we treat or prevent disease. Health and disease are not intrinsic goods or bads – they are not bad in themselves. A symptomless disease is irrelevant. And people trade health for things they value when they engage in risky activities, like professional sports, dangerous sex or overwork. Health is an instrumental good. What

[10] J. Savulescu, «Genetic Interventions and the Ethics of Enhancement of Human Beings», in B. Steinbock (ed.), *The Oxford Handbook of Bioethics*, Oxford University Press, Oxford 2006, pp. 516-535.

matters intrinsically is well-being. But if our well-being is what is intrinsically valuable to each of us, insofar as there are biopsychological obstacles to that well-being, then we have good reason to remove those obstacles.

So, we have good moral reasons to remove biopsychological constraints on our freedom when those constraints compromise our well-being, or some other valuable end, like morality, or preventing harm to others.

CONCLUSION

There are four ways to increase human freedom. Alter:

1. Natural environment
2. Social environment
3. Psychology
4. Biology.

We should consider *all* options and make an active choice which reason supports. We should not privilege biological or psychological interventions over social change. But should consider them as all candidates for improvement.

Human liberation is the concept that our biology and psychology present impediments to:

- Wellbeing
- Social justice
- Economic productivity
- Morality
- Human relationships
- Existence of humanity.

We will soon understand these impediments better and may be able to liberate ourselves from the constraints our biology and evolutionary origins impose on us.

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J. Savulescu, «Genetic Interventions and the Ethics of Enhancement of Human Beings», in B. Steinbock (ed.), *The Oxford Handbook of Bioethics*, Oxford University Press, Oxford 2006, pp. 516-535

J. Savulescu, «Genetic Enhancement», in H. Kuhse and P. Singer (eds), *A Companion to Bioethics*, second edition, Blackwell Publishing, Oxford, forthcoming

J. Savulescu and G. Kahane, «The Moral Obligation to Create Children with the Best Chance of the Best Life», *Bioethics*, 23, 2009, pp. 274-290

J. Savulescu, «Procreative Beneficence: Why We Should Select the Best Children», *Bioethics*, 15, 2001, pp. 413-426