Intelligence, Well-Being and Procreative Beneficence

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Intelligence, Well-Being and Procreative Beneficence

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Abstract: If Savulescu's (2001; 2009) controversial principle of Procreative Beneficence (PB) is correct, then an important implication is that couples should employ genetic tests for non-disease traits in selecting which child to bring into existence. Both defenders as well as some critics of this normative entailment of PB have typically accepted the comparatively less controversial claim about non-disease traits: that there *are* non-disease traits such that testing and selecting for them would in fact contribute to bringing about the child who is expected to have the best life. We challenge this less controversial claim, not by arguing deductively for its falsity, but by showing that Savulescu's central argument for this presumably less controversial claim fails. Savulescu offers *intelligence* as the paradigm example of a testable non-disease trait such that testing and selecting for it would increase the likelihood that the child selected would be the one who is expected to have the best life (or at least as good a life as the others). We provide a series of arguments aimed at demonstrating that Savulescu's argument from intelligence fails. If our arguments are successful, the upshot is not that PB is false, but more modestly, that the burden of proof remains squarely with Savulescu.

Key words: procreative beneficence, intelligence, in vitro fertilization, well-being

1. *Introduction*

In a much-discussed paper, Julian Savulescu[1] (2001; 2009) proposes and defends a provocative ethical principle—*procreative beneficence*.

> *Procreative Beneficence* (PB): couples (or single reproducers) should[2] select the child, of the possible children they could have, who is expected to have the best life, or at least as good a life as the others, based on the relevant, available information.

Over the past decade, numerous papers[3] have taken critical issue with PB. One avenue involves challenging the principle by way of rejecting something that Savulescu highlights as an important practical implication of the principle, which is that couples should employ genetic tests for non-disease traits[4] in selecting which child to bring into existence.

Potential challenges on this score can be divided into two camps. Firstly, one might reject Savulescu's normative conclusion about non-disease traits while *granting* the premise that there are non-disease traits such that testing and selecting for them would in fact contribute to bringing about the child who is expected to have the best life (call this the *non-disease-trait* [NDT] premise)[5]. Alternatively, there is scope for a second type of opposition to Savulescu's normative conclusion, which does *not* grant this premise. The strategy we pursue in this paper falls into the second category of criticism. However, in locating our approach, a further distinction is required. It is possible to pursue this second strategy either by arguing (i) that NDT is false; or (ii) that Savelescu's strongest case for defending NDT fails.

We think it would be overly ambitious to argue for (i); perhaps there are some non-disease traits that are both appropriately testable and such that testing and selecting for them would have just the results that Savulescu suggests. At any rate, the current state of genetic research is not developed enough to support any sort of deductive line against NDT.

There is, however, a good case to be made for (ii). Savulescu's defence of NDT is one that appeals, at nearly every crucial juncture, to the trait of *intelligence*[6]. This is because he offers intelligence as the paradigm example of a testable non-disease trait such that testing and selecting for it would increase the likelihood that the child selected would be the one who is expected to have the best life (or at least as good a life as the others[7]).

We think it is no surprise that Savulescu appeals to intelligence as the obvious candidate trait here, given his aim of supporting NDT: after all, intelligence is plausibly connected with various conceptions of human well-being. Moreover, of those genetic traits plausibly connected to well-being, intelligence is (unlike, say, moral conscience[8]) something for which we might plausibly locate a testable genetic basis on which embryo selection would be possible.

Despite its *prima facie* plausibility, we think that Savulescu's paradigm case fails (on several fronts) to support NDT, and our contention that it does will be the focus of

what follows. To the extent that Savulescu's appeal to intelligence fails, the primary case Savulescu *actually offers* for NDT is vitiated. We can appreciate the significance of this observation in the wider context of the debate as follows: without NDT, PB (if true) would fail generate the key mandate Savulescu tells us the principle implies.

2. *The Intelligence Premise*

The specific claim we'll now set out to defend, contra Savulescu, is what we'll call *Intelligence* (INT):

> *Intelligence* (INT): It is not the case that testing and selecting for intelligence would increase the likelihood that the child selected would be the one who is expected[9] to have the best life.

We want to note at the outset that even if it is possible to test and select for intelligence, considerations to do with environment and context[10] bear on the matter whether doing so would contribute to the betterment of the child's life, and we will address some of these issues directly in this section. But first, we want to support INT by raising a more fundamental issue, which concerns the matter of whether intelligence can be defined and selected for in the first place. After raising some of these more fundamental problems, we'll proceed in this section to defend INT by highlighting several considerations that favour an *inverse* correlation between increased testable aspects of intelligence (e.g. analytical abilities, perceptiveness and memory) and overall quality of life. These considerations, we'll show, must be balanced against the considerations Savulescu cites that suggest a positive correlation between testable aspects of intelligence and overall quality of life. We'll argue that, all things considered, the balance between positive and negative contributions of intelligence to quality of life will be about even. That the balance *is* even is a real problem for Savulescu's thought that one should employ genetic tests for intelligence in selecting which child to bring into existence. This is because without being able to fall back on the defence that testing and selecting for intelligence raises the likelihood of the selected child being the one who is expected to have the best life, the third sort of considerations we will present in support of INT become more relevant. This third set of considerations concerns the fact that no matter *which* non-disease traits are selected for, there are a variety of health risks associated with in vitro fertilisation that threaten the likelihood that the selected child

would—out of the possible children one could have—be the one who is expected to have the best life[11]. Additionally, this third set of considerations highlights connections between genetic contributions to intelligence as balanced against the specifically environmental contributions to intelligence that would be associated with IVF.

All things considered, we will show that there is good reason to think that it is *not* the case that testing and selecting for intelligence would increase the likelihood that the child selected would—out of the possible children one could have—be the one who is expected to have the best life. Having already outlined the upshot of this result for Savulescu's argument, we'll now focus exclusively on INT.

2.1 *Intelligence and quality of life: What is intelligence, and what contributes to it?*

As noted above, we submit that the connection between intelligence and quality of life is not as straightforward as is often assumed, partly because of definitional hurdles. Many who hold that intelligence is positively correlated with quality of life do so on the basis of a varied range of assumptions about what intelligence involves. For one thing, some (e.g. Gardner (1983; 1985; 1993) suppose that there are *intelligences* rather than one form of intelligence[12]. Even if there were a consensus here—and one is hardly in sight[13]—there are considerable problems, as Newson and Williamson (1999)[14] admit, associated with the prospect of *measuring* intelligence (however conceived)[15]; accordingly, evaluating the prospects of measurement is best accomplished against a definitionally thin background account of the nature of intelligence.

For their purposes, Newson and Williamson accept the following minimal description of intelligence from Gottfredson (1997): '[intelligence] is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience...[16].' Such an account of intelligence is intuitively plausible (as a thin descriptive account goes), and is also one on which it seems sensible to suppose that there will be multiple genes capable of contributing to the various abilities of which intelligence is comprised (and so multiple relevant genes that must be located and tested for). Although we have some reservations, we will not be challenging Savulescu's contention that some such genetic bases for intelligence will include dispositions to have good memory and good concentration (among other things).

Now, if we construe intelligence broadly in this way, *a la* Gottfredson, what can we fairly say is known about the genetics of intelligence? Savulescu (2001: 413; 421, fn. 9) suggests that research here is 'rapidly progressing', citing here Newson (2000), though Newson and Williamson explicitly say that the potential for the development of predictive genetic tests for intelligence is 'overstated.' One field of research that has led some to view the genetics of intelligence as 'rapidly progressing' is molecular genetic studies, which have sought to locate and characterise specific genes that play a biological role in intelligence[17]. This approach has yielded some success—for example, Chorney (1998)[18] has discovered a gene sequence that contributes around 2% (i.e. approximately four IQ points) to the total variation of intelligence [19]. Even with promising leads towards identifying and understanding at least *some* of the genes that correspond with intelligence, the issue of how much of a contribution these genes make to intelligence remains extremely controversial.

It's important to consider just why claims about the genetic contribution to intelligence are so controversial; while the thought that intelligence is hereditary was first introduced by Galton (1869), there are good reasons why the dominant contemporary view is considerably more cautious. Presently, it is generally supposed that social and economic environmental factors also have a role to play in determining a given individual's intelligence. As Plomin (1997)[20] has argued, *genes alone do not pre-determine intelligence* but rather roughly indicate how likely a person is to be of a particular intelligence level. Accordingly, a new question becomes salient: on average, what *proportion* of contribution do genetics and environment respectively make to a person's intelligence?

It has not been ruled out that the specifically genetic contribution may be no more significant to intelligence than are these aforementioned non-genetic factors. For example, behaviour genetic studies by Chipeur et al (199)[21] suggest that around 50% of intelligence differences (between people in a particular population) are due to genetic difference, though in any one individual the extent to which genes contribute to intelligence might be more or less than 50%. Crucially, the quantitative studies that yield this result use psychometric tests, and these have been subject to considerable criticism[22].

Given these cautions, even if we nonetheless assume that we can locate the genes that can *directly* influence (to some degree) how intelligent a future person will be, it is at best naïve to suppose we thereby have the ability to 'test for intelligence'. Consider, after all (as Newson and Williamson observe) that compared to IQ tests, genetic tests would likely be

less efficient at predicting intelligence; environmental *and* genetic factors are evident in IQ tests, while genetic tests will provide information about only the latter of these factors.

Plomin (1997: 100) claims that the significant environmental impact combines with the large amount of genes involved in intelligence to make it the case that any one gene relevant to intelligence will only contribute to overall intelligence in a minor way. Accordingly, Reiss (2000) speculates that we might plausibly bring about more intelligent people by focusing research on developing more effective methods of education and child rearing. Even if there are benefits to be gained from encouraging a more intelligent population, then, it is not obviously the case that genetic projects focused on intelligence would be powerfully instrumental in bringing this about.

The relevance that the above has for our central contention is *practical*: our view that testing and selecting for intelligence does not obviously increase the likelihood of selecting the child who is expected to have the best life is supported by the fact that it may not even be plausible to suppose that we *can* effectively test and select for *intelligence*. That being said, let's put aside the above concerns and assume for now that we *can* effectively test and select for intelligence using the fruits of genetic research. Would this really lead to selecting the child (of the possible children that one could have) that would have the best expected life?

Do more intelligent people have better lives?

We turn now to the considerations that Savulescu supplies for thinking that there is a positive correlation between intelligence and overall quality of life. He pursues two argumentative strategies here. Firstly, he argues that intelligence is a component of the *general purpose means* that are useful to any plan of life, and as such, provides individuals the freedom to form and act on their own conception of the good life[23]. Secondly, Savulescu advances a presumptive case for thinking that intelligence would promote well-being on *any* of several plausible accounts of well-being, including (i) the hedonistic account (on which what matters is the pleasure quality of our experiences), (ii) the desire-fulfilment view (on which what matters is the degree to which our desires are satisfied), and (iii) objective list theories (according to which there are certain activities that are good for people, such as worthwhile achievements, dignity, bearing children, knowing a lot about the world, developing talents, and so on)[24].

With a view to assessing the cogency of his argument, we should note that if his second strategy fails, this significantly undercuts the plausibility of the first. Accordingly, our focus will be on the second strategy.

Hedonism and Intelligence

Savulescu submits that intelligence will promote well-being on a hedonistic account because the capacity to imagine alternative pleasures and remember the salient features of past experiences can facilitate the choosing of future pleasurable choices. This seems right. However, intelligence can also promote a *lack* of pleasure, and we will consider this point at a level of abstraction that corresponds with Savulescu's own arguments that intelligence *promotes* well-being. Consider (in comparison with Savulescu's suggestions) that being intelligent can easily lead to feelings of restlessness and to trouble experiencing long-term happiness—recall Hemingway's oft-quoted observation (1995) [25] that 'happiness in intelligent people is the rarest thing I know.' Similarly, as Schopenhauer[26] sees it, 'the person in whom genius is to be found suffers most of all.' Arguably, (for example), Nietzsche, Plath, Wittgenstein and Cantor (among many others) suffered significantly as a result of their high intelligence. They are not exceptions. Further, reflect on the number of highly intelligent people who have problems relaxing or 'turning off' their tendencies to examine and analyse information (ad nauseum).

These tendencies can all cause significant *displeasure* in addition to a mere *lack* of pleasure[27]. Even more, studies published by Martin Voracek (2004, 2005, 2006, 2009[28]) at the University of Vienna offer empirical evidence supporting (though at present inconclusively[29]) a positive correlation between intelligence and suicide.

While intelligence does promote pleasure in some ways, it also promotes a lack of pleasure in other ways; accordingly, on a hedonistic account of well-being, intelligence cannot be fairly said (without considerable further argument) to promote well-being *all things considered*—instead, it appears after more judicious consideration, to roughly break even[30].

Desire-fulfilment and intelligence

Savulescu claims that intelligence promotes well-being on a desire-fulfilment account because 'intelligence is important to choosing means which will best satisfy one's ends.'

Again, it seems like this is right. Likewise, it is clear that intelligence can *thwart* one's ends in some important cases. The sorts of cases mentioned in the discussion of the hedonistic account apply here *mutatis mutandis*. For example, for one who seeks the attainment of peace (broadly defined), intelligence can, for reasons previously suggested, stand as a frequent and potentially insurmountable barrier. Similar considerations apply vis-à-vis the end of happy friendships or relationships[31]. Intelligent people might find others predictable and uninteresting, while struggling to find suitably engaging romantic partners. In addition, intelligence is often resented (especially in childhood), and others' feelings of inferiority can lead to social exclusion.

Objective-list theory and intelligence

Finally, Savulescu maintains that intelligence will promote well-being on an objective list account because 'intelligence would be important to gaining knowledge of the world, and developing rich social relations' (both of which are relatively uncontentious objective aims). However, note that these are but *two* of the ends Savulescu mentions when defining the idea of an objective list account. For example, he also mentions an ability to appreciate beauty, and this ability can easily be undermined by intelligence; the intelligence in virtue of which one can 'see how things work' can prevent one from finding the kind of beauty in wonder as would someone less intelligent[32]. In addition, if intelligence *were* to afford a heightened ability to appreciate beauty, would it not also afford a heightened ability to detect and comprehend just as much (or more) suffering? At the very least, it seems as though intelligence as a means to appreciating beauty breaks even in terms of effectiveness.

In addition to the ideas advanced in the discussion of the desire-fulfilment account, there are further reasons to think that intelligence stands to hinder as much as foster rich social interactions. For example, a highly intelligent individual might be so consumed by intellectual pursuits that little energy or thought is directed toward colleagues, partners or family members. Alternatively, you might only *appear* to have rich social relations—people may deeply enjoy your company and conversational skills, but you in turn might find these conversation partners to be so transparent (and their ability to understand your own more complex psychology so contrastingly poor) that the social relations are not experienced as rich by *you*.

Memory

By now it should be clear that the idea that intelligence just obviously promotes well-being is not nearly as plausible as it first appears. Savulescu primarily discusses intelligence broadly construed, but he briefly considers one candidate component of testable intelligence—memory. He defines memory in a highly contentious (and in the context, self-serving) manner, as the ability to 'remember important things when you want to' (p. 420). However, having a good memory also involves remembering things when one would rather not, and at times being 'haunted' by these memories. Savulescu is right that selecting for genes that contribute to the memory component of intelligence may help you to avoid having a child who forgets to take a compass on a dangerous bush walk (as his example claims).

On the other hand, that child may grow up to be haunted by perfect recollections of something awful that they witness, and the more vivid the recollection, the more acute the suffering. Indeed, de Quervain et al. (2012)[33] have discovered that a genetic factor for good memory leads to an increased risk of developing psychological trauma. This study tested over a thousand healthy volunteers and found that those carrying a variant of the *PRKCA* gene had more brain activity in areas related to memory and exhibited an above average ability to remember learned information. Also investigated were the effects of the *PRKCA* variant gene on 350 survivors of the genocide in Rwanda. Those with the gene variant had more painful and psychologically troubling memories of the events that occurred during the genocide and were twice as likely to be sufferers of post-traumatic stress disorder. In sum,, it is not obvious that a good memory leads to more well-being than lack thereof.

To recap, then, we have highlighted some substantial considerations that support a negative correlation between intelligence and well-being. We submit that balancing these considerations against the positive contributions of intelligence to quality of life show that intelligence is roughly as likely to increase well-being as it is to *decrease* well-being (on all of the plausible accounts of well-being that Savulescu mentions). This discredits the supposition that testing and selecting for intelligence would increase the likelihood that the child selected would be the one who would be expected to have the best life, as it does not appear that that intelligence is *reliably conducive* to bringing about the best life[34]. In short, it does not seem obvious that we should 'expect' possessing a trait that breaks even in terms

of effectiveness as a means to well-being (on multiple plausible proposals) to be one that will improve a child's likelihood of being the one that would have the best life.

We can turn now to a different group of considerations that add additional weight to our claim that it is not the case that testing and selecting for intelligence would increase the likelihood that the child selected would be one that would be expected to have the best life.

In vitro fertilization and quality of life

Thus far, we have focused on issues that are intimately connected with intelligence. However, a second set of problems stands to discredit the claim that testing and selecting for intelligence will increase the likelihood that the child selected would be one that would be expected to have the best life. These considerations focus not on intelligence itself but on the practical risks of the scenario that Savulescu describes, i.e. one in which people who would not have otherwise required in vitro fertilisation to conceive nonetheless employ the process in order to select the 'best' child[35]. Our concern in this section is that IVF—which is required for selecting for *any* non-disease trait—threatens the likelihood that the child one tests and selects for intelligence would (out of the possible children one could have) be the one expected to have the best life. This constitutes further support for our central claim, INT. Our first set of considerations to this end concerns risks of ectopic pregnancy, and the second set of considerations concerns birth defects[36].

IVF and Ectopic pregnancy

In an ectopic pregnancy, the fertilised egg develops outside the uterus (typically in one of the fallopian tubes). Almost all such pregnancies are unsustainable. In North America, ectopic pregnancy occurs at a rate of around 19.7 cases per thousand[37], i.e. 1.97%, and the Ectopic Pregnancy Foundation lists those undergoing IVF as being in one of the 'at risk' categories. Some studies suggest that approximately 2-5% of IVF pregnancies are ectopic[38], but even if the percentage is more like 1-3% (as the British Fertility Society estimates), this is almost twice the normal rate. If undergoing IVF comes with an increased risk of ectopic pregnancy, then--since using genetic tests for embryo selection requires IVF--genetic testing makes the chosen embryo *less likely to survive* until birth than is the possible embryo that results from natural conception. It's being less likely that there will be a child

born in Savulescu's suggested scenario provides further reason to suppose that testing and selecting for intelligence does not clearly increase the likelihood of selecting a child that (of the possible children one could select) will turn out to have the best life. That we have already highlighted considerations that show that intelligence is about equally likely to promote well-being as it is to promote the *inverse* of well-being vitiates a potential reply from Savulescu. Specifically, it serves to undermine the claim that an increased risk of ectopic pregnancy is less significant (vis-à-vis the aim of selecting the child expected to have the best life) than is the alleged increase in overall well-being that results from selecting for intelligence.

IVF and birth defects

In addition to studies suggesting an IVF-conceived baby is less likely to be born than is a naturally conceived baby, it may be the case that children produced by IVF are more likely to have severe health problems. These risks must be weighed against the alleged benefits to a child's well-being brought by intelligence.

It is currently contentious whether IVF is correlated with an increased risk of serious birth defects, but there are some persuasive reports available. For example, Reefhuis et al (2009)[39] observe that a 2008 analysis of data produced by the National Birth Defects Study in the United States found that infants conceived through IVF more commonly suffered from some particular birth defects. These included cleft lip (sometimes accompanied by cleft palate), septal heart defects (abnormalities in the wall of tissue between the two sides of the heart), oesophageal atresia (a segmented and closed off point of the oesophagus), and anorectal atresia (a malformed rectum). As Reefhuis et al note, the mechanism of causality is unclear, but the correlation between IVF and higher instances of these diseases is certainly present. There is also an established link between IVF and Beckwith-Widermann Syndrome (BWS), a condition that involves an over-sized tongue, post-natal overgrowth, abdominal wall defects and an increased risk of kidney tumours. A 2004 study[40] concluded that the risk of BWS in the sampled IVF population was 'nine times greater than in the general population.' Further, Newby (2003)[41] discusses a 2002 study showing that birth records of children produced by IVF indicated that they were twice as likely to have birth defects (when compared to 'normal' births). These defects included Down syndrome (and other chromosomal abnormalities), heart defects, spina bifida (in

which the spinal canal and backbone do not close before birth), gastrointestinal abnormalities, club feet, and musculoskeletal problems. The children in this study were also more likely to be born early or at a low birth weight, as well as to suffer from cerebral palsy, which impacts brain and nervous system functions (including seeing, hearing and cognitive ability). More recently, Kelley-Quonn et al. (2012) have presented findings[42] supporting the claim that 'IVF independently contributes a significant risk of congenital malformation in addition to known maternal factors.' All of the aforementioned health problems are highly likely to reduce overall quality of life, and in some cases may also substantially shorten life.

Although the Kelley-Quonn et al. study represents an important step in researching the link between the process of IVF and birth defects, in light of the currently limited evidence of a connection we do not wish to make the unqualified claim that the above problems are caused by IVF[43]. Our overall argument does not require that claim--rather, we submit that since experts do not fully understanding this apparently increased risk of birth defects, the burden of proof that IVF is *not* responsible for the defects lies with proponents of Savulescu's view. This is because if it *is* the case that the process of IVF itself increases the risk of birth defects, this is one thing that counts against Savulescu's claim that testing and selecting for intelligence would increase the likelihood that the child selected would be the one who is expected to have the best life.

If it is correct that IVF comes with an increased risk of ectopic pregnancy (which translates to a lower likelihood of being born) and/or an increased risk of certain substantial congenital abnormalities (which in some cases means a shortened life and in all cases means a reduced quality of life in an important sense), this further supports our central claim, INT[44]. Once again, testing and selecting for intelligence does not seem to be reliably conducive to bringing about child who has the best life.

The interplay between in vitro fertilization, environment and intelligence

In this final section, we will explore how testing and selecting for intelligence will often lead to circumstances in which the genetic contribution tested and selected for will (at best) break even with negative environmental factors associated with IVF that reduce the likelihood of high intelligence.

According to Melo-Martin (2004), 'the average cost of an IVF cycle ranges from $10,000 to $43,000, excluding the costs of previous treatments and the post-natal expenses', and many undergo multiple cycles in attempting to become pregnant[45]. The likelihood of IVF resulting in a live birth is commonly thought to be highly influenced by maternal age, and so the process will be most successful when the woman is at at the peak of her fertility (in the early to mid-twenties). That the optimal maternal age for IVF ends before a woman is in her late twenties combines with the expense of IVF cycles to make it the case that pushing all reproducers to select for intelligence means pushing them to attempt get pregnant at a younger age than they may otherwise have chosen[46]. With this in mind, recall that the general consensus is that genetics are not the only factor influencing intelligence—environment also plays a role, and many factors in this environment matter, including the quality of schooling, home environment, rearing style and parental maturity.

People generally have more resources to offer children later in life, and their completed educations and established careers usually leave them with more flexibility, allowing them to spend more time teaching and engaging with their children. For example, in a study conducted on 113 mothers aged between 35 and 56 (Gregory 2007), many testified to having emotional resources for parenthood that they were certain they lacked earlier in their lives[47]. One contributing factor was that most of these women had stable jobs and had achieved much of what they wanted in their lives and workplaces, giving them an increased ability to focus on raising children. We also think it plausible that younger mothers will less often be financially secure, and this lack of financial security will in turn mean that (for example) they will be unable to afford as high quality education for children as they would have later in life. This is especially likely to be the case after paying the steep price for at least one cycle of IVF. We submit that this suggests that young parents will, all things considered, be less likely to provide an environment that fosters intellectual development, both in the home and in education. So, even without the health considerations mentioned in §3.2, any benefit of selecting for genes involved in intelligence (which, again, we think is in balance with the costs of being intelligent) gets offset by the likelihood of negative environmental contributions of raising a child when you are younger, less mature, more selfish, less experienced, and most likely less financially secure.

3. *Concluding Remarks*

We have explored a cluster of issues here, but it is worth reiterating what we have *not* attempted to do. We have not (as many other critics of procreative beneficence have) attempted to directly *refute* PB, but nor have we tried to indirectly challenge PB by arguing against the normative claim Savulescu takes PB to entail: the normative claim that couples *should* employ genetic tests for non-disease traits in selecting which child to bring into existence.

Our critical interest has been, rather, a premise (granted by both Savulescu and most critics), which we call NDT. Specifically, this is the premise that there are non-disease traits such that testing and selecting for them would in fact contribute to bringing about the child who is expected to have the best life. If this premise is false, then it's false that couples should employ genetic tests for non-disease traits in selecting which child to bring into existence. We haven't attempted to argue deductively for the falsity of the NDT. Instead, we hope to have cast doubt on it (and by extension PB) by examining the paradigm example that Savulescu uses to support NDT—intelligence. We have argued that under closer scrutiny, appealing to intelligence does not succeed in supporting Savulescu's claim about testing and selecting for non-disease traits. That the argument from intelligence fails to support NDT does *not*, we contend, imply that NDT is false. More modestly, it shows that Savulescu has not done enough to argue for it.

Independently of the connection our argument has for the debate about procreative beneficence, we hoped to also reveal that some natural assumptions about the connection between intelligence, its testability, and its relationship to well-being are in some instances false and in others too hasty. We suspect that some of the practical setbacks that plague attempts to quantify, measuring, and selecting (via IVF) for intelligence will also apply, *mutatis mutandis*, to other traits that a defender of NDT might claim are plausibly connected with human well-being. However, an argument on this score is a topic for another occasion[48].

NOTES

[1] Julian Savulescu. 'Procreative Beneficence: Why We Should Select the Best Children', *Bioethics*, 15 (2001): 413-426.

[2] Regarding his use of 'should', Savulescu says, 'I will understand morality to require us to do what we have most reason to do.' (p. 415)

[3] See here Michael Parker, 'The Best Possible Child', *Journal of Medical Ethics*, 3 (2007): 279-283; Inmaculada de Melo-Martin, 'On Our Obligation to Select the Best Children: A Reply to

Savulescu', *Bioethics*, 18, 1 (2004): 72-83 and Robert Sparrow, 'Procreative Beneficence, Obligation and Eugenics', *Genomics, Society and Policy*, 3, 3 (2007): 43-59.

[4] Examples of authors who reject the claim that we should employ genetic tests for non-disease traits include Parker (2007) and De Melo-Martin (2004). We thank a referee for pointing out that more general arguments could be marshaled in support of viewing non-disease trait selection as problematic. *Cf.* Kean Birch 'Beneficence, determinism and justice: An engagement with the argument for the genetic selection of intelligence', *Bioethics* 2005 19(1): 12-28 and also Kean Birch 'Neoliberalising bioethics: Bias, enhancement and economistic ethics', *Genomics, Society and Policy* 2008 4(2): 1-10. We add, for clarification, that in referring to non-disease trait selection, we are not implying that such selection is feasible or morally permissible, in any form. For the present purposes, we remain agnostic and use the language only to engage with Savulescu on his own terms.

[5] Arguments from social inequality fall within this category. Also, as a referee (as well as Robert Sparrow) point out, there is scope to argue in a similar fashion that, even if NDT were true, arguments from eugenics stand to threaten Savulescu's normative conclusion. It is our view that Sparrow has defended the eugenics line well enough, and we will not attempt to recite or improve on his arguments here; our critical focus lies elsewhere.

[6] For example, he states (p. 414) that intelligence is one of the non-disease traits for which he believes we are morally obligated to test, and intelligence is the only non-disease trait that he systematically attempts to show promotes well-being on any plausible account (p. 421). We also thank a referee for pointing out that, as an academic, Savulescu might be more inclined than non-academics to associate intelligence (as opposed to, for instance, emotional empathy) as a hallmark of the good life. To Savulescu's credit, part of his emphasis on intelligence is based on his supposition that it is a feature of the good life that could be tested and selected for. Though, as we argue, even this latter claim turns out to be problematic.

[7] Hereafter, for the sake of conciseness we will simply say 'the child who is expected to have the best life.'

[8] Savulescu has, in recent work with Ingmar Persson, suggested that *moral* enhancement, if possible, would be morally mandatory. Although there is presently some evidence suggestive of a biological basis of moral behaviour, Savulescu and Persson concede such evidence is both controversial and not well-established. See, for example, Persson and Julian Savulescu, 'The Perils of Cognitive Enhancement and the Urgent Imperative to Enhance the Moral Character of Humanity', *Journal of Applied Philosophy* 25, 3 (2008), 162-177; Julian Savulescu, *Unfit for the Future: The Need for Moral Enhancement* (Oxford: Oxford University Press, 2012). Thanks to an anonymous referee for drawing attention to this point.

[9] It is important to note that (both here and elsewhere) we are following Savulescu in using 'expected to have the best life' in a sense not suggestive of mere 'purely subjective' expectation. Rather, we are concerned with whether intelligence is reliably conducive to bringing about the best life.

[10] *Cf.* Kean Birch, 'Beneficence, determinism and justice: An engagement with the argument for the genetic selection of intelligence', *Bioethics*, 19, 1 (2005): 12-28.

[11] We assume throughout that natural conception can plausibly be construed as 'selecting' a possible child out of the possible children one could have, in so far as it counts as selecting a naturally conceived child over an embryo created by way of IVF. Note also that our second sorts of considerations are only meant to count against testing and selecting for specific non-disease treats when the relevant reproducer(s) are ones who could reproduce *without* IVF. These particular considerations are not meant to apply to situations in which, for example, one half of a couple has fertility problems (or where there is a single reproducer, a same-sex couple, or someone acting as a surrogate mother for someone else's child).

[12] See, for example, Howard Gardner, *The Theory of Multiple Intelligence* (New York: Basic Books, 1985).

[13] See Robert J. Sternberg, 'Death, Taxes and Bad Intelligence Tests', *Intelligence* 15, 3 (1991): 257-270. See also Michael W. Eysenck, 'Intelligence' in Michael W. Eysenck (ed.) (Cambridge, Massachusetts: Blackwell Publishers, 1994): 192-93.

[14] Ainsley Newson and Robert Williamson, 'Should We Undertake Genetic Research on Intelligence?' Bioethics, 13 (1999): 327-42.

[15] For work demonstrating the controversy concerning defining, measuring and quantifying intelligence, see John Maddox, 'Genetics and Hereditable IQ', *Nature*, 309, 5969 (1984): 579; Stephen Jay Gould, *The Mismeasure of Man* (New York: Norton, 1996). For discussion of the fact that history provides us with evidence of continual prejudice against women, blacks, and the working class when measuring intelligence, see Michael J. Reiss, 'The Ethics of Genetic Research on Intelligence', *Bioethics*, 14, 1 (2000): 1-15.

[16] They note that this means intelligent behaviour will vary according to the environment and will change throughout a life. This will become more relevant as we progress.

[17] See for example R. Plomin et al. DNA Markers Associated with High Versus Low IQ: The IQ Quantitative Trait Loci (QTL) Project. *Behav Genet* 1994; 24: 107-118.

[18] M. J. Chorney et al. A Quantitative Trait Locus Associated With Cognitive Ability in Children. *Psychological Science* 1998; 9: 107-118.

[19] Molecular genetic studies tend to focus specifically on genes that might play a role in *high* intelligence, and this is confusing when we note that there is cause to suppose that low intelligence is actually more strongly connected to genetic inheritance (e.g. J. Michael Bailey and William Revelle, 'Increased Heritability For Lower IQ Levels?', *Behavior Genetics*, 21 (1991): 397-404). However, Newson and Williamson claim that the focus on high intelligence can be defended on the grounds that there is more scope for interference by negative environmental factors when low rather than high intelligence is the subject of investigative research.

[20] Robert Plomin, 'Identifying Genes for Cognitive Abilities and Disabilities' in Robert J. Sternberg and Elena Grigorenko (eds.) *Intelligence, Heredity and Environment* (Cambridge: Cambridge University Press, 1997), pp. 89-104.

[21] Heather M. Chipeur, et al., 'LISREL Modelling: Genetic and Environmental Influences on IQ Revisited', *Intelligence*, 14 (1990): 11-29.

[22] See Robert C. Bailey, 'Hereditarian Scientific Fallacies', *Genetica*, 99 (1997): 125-33. In addition, as Newson and Williamson point out, the application of behaviour genetics research outside the population on which the research is conducted is imprecise, given that the application of group measurements to individuals are insensitive to the possibility that a gene that influences the range of intelligence in the group may have no significance for a given individual in that group.

[23] This is supported by Allen Buchanan et al., *From Chance to Choice* (Cambridge: Cambridge University Press, 2000).

[24] For a defence of the desire-fulfilment account, see H. Sidgwick *The Methods of Ethics*. London: Macmillan & Co. Ltd, 1981. For classical defences of hedonism, see J. Bentham. 1879. *An Introduction to the Principles of Morals and Legislation*. Oxford: Clarendon Press and Mill. 1957. *Utilitarianism*. Indianapolis: Bobbs-Merrill. For a defence of the objective list theory, see Hurka. 1993. *Perfectionism*. Oxford: Clarendon Press.

[25] Ernest Hemmingway, *The Garden of Eden* (New York: Simon and Schuster, 1995), p. 86.

[26] Arthur Schopenhauer, *The World as Will and Representation* (New York: Dover, 1969/1818).

[27] Consider, for example, when the aforementioned tendencies might play a role in driving loved ones away).

[28] Michal Voracek, 'National Intelligence and Suicide Rate: an Ecological Study of 85 Countries', *Personality and Individual Differences,* 37, 3, (2004): 543–53; Michal Voracek, 'National Intelligence, Suicide Rate in the Elderly, and Threshold Intelligence for Suicidality: An Ecological Study of 48 Eurasian Countries', *Journal of Biosocial Science* 37, 6 (2005): 721–40; Michal Voracek, 'Smart and Suicidal? The Social Ecology of Intelligence and Suicide in Austria', *Death Studies* 30, 5

(2006): 471–85; Michal Voracek, 'National Intelligence, Suicide Rate, and Subjective Well-Being', *Perceptual and Motor Skills*, 109, 3 (2009): 718–20.

[29] Some challenge Voracek's studies as inconclusive due to the significance of other potential contributors to suicide (e.g. Michael Minkov, 'Predictors of National Suicide Rates: A Reply to Voracek (2004, 2006, 2009)', *Psychological Reports*, 106 (2010): 718-20).

[30] Thanks to an anonymous referee for pointing out that we have not in any conclusive way *established* that the pleasure and displeasure resulting from intelligence in fact break even. More modestly, our aim was to challenge Savulescu's presumption that intelligence would obviously connect with the good life (on a hedonistic conception of the good life).

[31] Many intelligent people can also easily see when other people's beliefs are poorly supported or hypocritical, and this degree of perceptiveness can thwart the end of enjoyment in interpersonal relationships.

[32] Consider here William Blake, *Songs of Innocence and of Experience* (London: Arcturus Publishing, 2009).

[33] Dominique de Quervain et al., 'PKCα is genetically linked to memory capacity in healthy subjects and to risk for posttraumatic stress disorder in genocide survivors', *Proceedings of the National Academy of Sciences of the United States of America*, published online on 14 May, 2012.

[34] To be clear, we are not suggesting that intelligence reliably brings about a *lack* of a better life--a claim on which we remain agnostic. Our having highlighted several inverse correlations between intelligence and quality of life was intended rather to cast doubt on Savulescu's contention that the correlation is clearly positive.

[35] We do not mean to imply a commitment to the claim that a child exists at the point of IVF (or thereafter, until birth). When we use language that discusses 'selecting children', we do so merely in order to be consistent with Savulescu's original statement of his position. Thanks to a referee for noting that this may be controversial (in a strict sense) if left unqualified.

[36] In discussing some of the risks associated with using IVF to implement Savulescu's scheme, we are focusing specifically on the risks that concern the future of the implanted embryo. This is not meant to imply that we think these risks constitute the most significant reasons to reject Savulescu's proposed use of IVF--as a reviewer has pointed out, (i) requiring everyone to undergo IVF would constitute a huge waste of money, and (ii) women would bear the brunt of Savulescu's scheme (both physically and psychologically). For a clear presentation of some of the most significant ways in which Savulescu fails to appropriately consider this second concern in particular, see Melo-Martin (2004). Here, we focus on the increased risks of ectopic pregnancy and birth defects solely because the purpose of our paper is to argue against a very specific element of Savulescu's argument, i.e. his claim that testing and selecting for intelligence increases the likelihood of selecting an embryo that will turn out to have the best life.

[37] Josie L. Tenore, 'Ectopic Pregnancy', *American Family Physician*, 61, 4 (2000): 1080-88.

[38] See, for example, Samuel F. Marcus and Peter R. Brinsden, 'Analysis of the Incidence and Risk Factors Associated With Ectopic Pregnancy Following In-Vitro Fertilization and Embryo Transfer', *Human Reproduction*, 10 (1995): 199–203.

[39] Jennita Reefhuis et al., 'Assisted Reproductive technology and major structural birth defects in the United States', *Human Reproduction*, 24, 2 (2009): 360-6.

[40] Jane Halliday et al., 'Beckwith-Wiedemann Syndrome and IVF: A Case-Control Study', *The American Journal of Human Genetics* 75, 3 (2004): 526-8.

[41] Jonica Newby, 'Catalyst: IVF Defects', *Australian Broadcasting Corporation* (2003). Available at: http://www.abc.net.au/catalyst/stories/s904186.htm [accessed 5 May 2012].

[42] See Lorraine Kelley-Quonn et al., 'Congenital Malformations Associated With Assisted Reproductive Technology: A California Statewide Analysis', presented on 20th October at the American Academy of Pediatrics National Conference and Exhibition in New Orleans (abstract available online at https://aap.confex.com/aap/2012/webprogrampress/Paper17831.html [accessed 11th Noveber 2012]). Their study used the California Linked Birth Cohort Dataset from 2006-2007 to

identify children born from IVF and to create control groups of naturally conceived children. We assume that the known maternal risk factors they discuss include (for example) age and certain antecedent fertility problems.

[43] For example, as a referee helpfully observed, there remains uncertainty about whether the problem lies with the donors or with IVF itself. Some donor risk factors could be unknown Kelley-Quonn et al., and they do not considered the role that male donors may play.

[44] There may be additional reasons that IVF has a lower live birth rate than does natural conception. However, there are problems sourcing relevant statistics because (i) it is difficult to measure the live birth rate in the general population because of cases in which a woman may be unaware of a fertilised egg that fails to result in a live birth, and (ii) the numbers available about the live birth rate for those undergoing IVF will not exactly mirror the success rates that would be part of a Savulescu-style scenario in which people who did not *require* IVF to conceive would nonetheless undergo the process. The numbers that would best represent the success of IVF in such as a scenario would be the percentages of different age groups of women with no antecedent fertility problems who use ideally healthy sperm in an IVF cycle and succeed in having a live birth. However, if the live birth rate after IVF really is significantly lower than is the live birth rate resulting from natural conception, this is another sense in which testing and selecting for intelligence does not make it more likely that the selected child will (of the possible children) be the one expected to have the best life.

[45] See Jeffrey R. Botkin, 'Ethical Issues and Practical Problems in Preimplantation Genetic Diagnosis', *Journal of Law, Medicine and Ethics*, 26 (1998): 17-28. Even if that cost is declining, it will still be substantial.

[46] For example, 2003 figures from the Office of National Statistics in United Kingdom show the number of women who are having pregnancies later in life to be on the rise (with the number of women having children in their thirties and forties increasing sharply over the preceding two decades). In North America, The National Center for Health Statistics shows that between the years of 1980 and 2004 (i) the amount of women having children at age thirty has doubled, (ii) the amount of women having children at age thirty five has tripled, and (iii) the amount of women having children at age forty and over has nearly quadrupled. Further, the Centers for Disease Control report that the birth rate for women 45 and over more than doubled during the twelve years between 1990 and 2002.

[47] It is also plausible that older couples or single reproducers make more extensive preparations and put more thought into whether they truly want children, while a lot of younger people may in part be caving to social and familial expectations that are voiced once a committed relationship is part of their lives.

[48] The authors owe a special thanks to Jeremy Watkins, with whom correspondence on this topic has been particularly instructive.