# MEDICAL STUDY

## ASPIRING PARENTS, GENOTYPES AND PHENOTYPES: THE UNEXAMINED MYTH OF THE PERFECT BABY[1]

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ABSTRACT

**Summary**

Although many have argued that assisted reproductive technologies ("ARTs") attract those with a desire to genetically engineer their offspring, this claim has yet to be verified. To address this question, we surveyed three groups: the general public, people enrolling in an in vitro fertilization ("IVF") program, and pregnant couples. We asked subjects which traits they would select

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in their children if it were possible to use a magic wand to do so and to value genetic relatedness. In our sample, the potential parents who were using ARTs were less likely to express a desire to select traits in their offspring than were the general public, and just as likely as the pregnant couples. Those using ARTs, however, placed greater importance on having genetically related children than the others. Thus, the widely held view that reproductive technology is utilized by those most likely to favor genetic engineering is falsified by our findings.

**Key Words**

Assisted Reproductive Technology, Genetic Engineering, Enhancement, Cosmetic Procedures, In Vitro Fertilization, Gamete Donation (egg & sperm), Infertility, Autonomy, Pregnancy, Obstetrics, Bioethics, Psychology of patient decision making.

Since the birth of Louise Brown, technology has progressed rapidly in the areas of human reproduction and infertility medicine.[2] After the birth of a cloned mammal in 1997,[3] most governments[4] and clinical associations[5] renewed efforts to regulate and study the ethical limits of specific forms of assisted reproduction or of the practices of assisted reproductive technology ("ART") in general. In making recommendations, some of which resulted in new law or policy,[6] these groups were able to rely on a number of studies that examined how assisted reproductive technology affects those who participate.[7] However, one and perhaps the most important question about the effects of ARTs has remained a matter of mere conjecture in the service of political argumentation for or against specific ARTs: Do those who utilize

[2] *See generally* Glenn McGee, *Introduction* to THE HUMAN CLONING DEBATE 1–15 (Glenn McGee ed., 1998) (detailing advancements in reproductive technology ranging from cloning to in vitro fertilization).

[3] *See* I. Wilmut et al., *Viable Offspring Derived from Fetal and Adult Mammalian Cells*, 385 NATURE 810, 810–13 (1997) (explaining the process employed in cloning lambs and the effect that technology had on reproductive research).

[4] *See 19 Nations Agree to Ban Cloning of Humans*, WASH. POST, Jan. 13, 1998, at A11.

[5] *See* AMERICAN SOCIETY FOR REPRODUCTIVE MEDICINE, ETHICAL CONSIDERATIONS OF ASSISTED REPRODUCTIVE TECHNOLOGIES: ASRM ETHICS COMMITTEE REPORTS AND STATEMENTS, *at* http://www.asrm.org/Media/Ethics/ethicsmain.html (2003).

[6] *See* CLONING HUMAN BEINGS: REPORT AND RECOMMENDATIONS OF THE NATIONAL BIOETHICS ADVISORY COMMISSION i-v, *at* http://www.bioethics.gov/reports/past_commissions/nbac_cloning.pdf (1997) (urging scientists to use caution when approaching the subject of human cloning, indicating certain possible harms that might occur to cloned children).

[7] *See* Sheryl Gay Stolberg, *House Backs Ban on Cloning for Any Objective*, N.Y. TIMES, Aug. 1, 2001, at A1.

ARTs differ from others in their attitudes about altering the characteristics of their future children? Do those who utilize ARTs demonstrate a preference, held consciously or otherwise, for phenotype or genotype when making the decisions required of those who use ART to create a baby?

The argument has been made that ARTs, taken collectively, represent the dawn of a new eugenics movement.[8] Preimplantation diagnosis, sex selection and gamete donation have each been characterized as morally ambiguous, unethical or even "evil."[9] However appealing these arguments may be to those who, for a variety of reasons, find ART objectionable, such claims have never been grounded in data. For example, while it is argued both by some feminists and fundamentalists that sex selection through ART represents "the ultimate sexism," such a claim is simply false and not reflected by evidence that those who use ART sex selection have gendered notions of ideal offspring.[10] Without data about what couples who use ARTs want from children, or how their desires differ from those who do not use ART or do not have children, the commonly articulated supposition that ART is dangerous, irrevocably linked to a desire by parents to genetically engineer in new and special ways, is in the most meaningful sense groundless. Consequently, it is critical to conduct empirical research to assess the attitudes of those using ARTs.

We conducted this study to identify the ways, if any, in which those seeking ARTs differ from other parents-to-be or members of society in their desire to prevent disease or enhance traits in their future offspring. Do those using these technologies care more than others about their offspring having specific or enhanced traits, or is their concern only about a genetic link to their child? In order to answer this question, we compared the attitudes of those using in vitro fertilization to members of the general public and to those who

[8] *See* David S. King, *Preimplantation Genetic Diagnosis and the 'New' Eugenics*, 25 J. MED. ETHICS 176–82 (1999); Michael D. Lemonick, *Designer Babies*, TIME, Jan. 11, 1999, at 61–64; Gail Vines, *Test Tube Pioneer Fears Rise of Eugenics*, NEW SCIENTIST, Oct. 9, 1986, at 17; Agneta Sutton, *The New Genetics: Facts, Fictions and Fears*, LINACRE Q., Aug. 1, 1995, at 76–87; Ruth Hubbard, *"Fetal Rights" and the New Eugenics*, SCI. FOR THE PEOPLE, Mar./Apr., 1984, at 7–9, 27–29.

[9] *See* John A. Robertson, *Ethical and Legal Issues in Preimplantation Genetic Screening*, 57 FERTILITY & STERILITY 1, 1–11 (1992); Dorothy C. Wertz & John C. Fletcher, *Fatal Knowledge?: Prenatal Diagnosis and Sex Selection*, HASTINGS CENTER REP., May/June 1989; E. Weil et al., *Psychological Aspects in Anonymous and Non-Anonymous Oocyte Donation*, 9 HUM. REPROD. 1344, 1344–47 (1994).

[10] Abby Lippman, *Prenatal Genetic Testing and Screening: Constructing Needs and Reinforcing Inequities*, 17 AM. J.L. & MED. 15, 41 (1991).

became pregnant without the use of IVF.

## MATERIALS AND METHODS

### Subjects

This study involved a questionnaire administered to three groups: members of the general public (prospective jurors in Philadelphia, "prospective jurors"), couples enrolling in an IVF program ("IVF couples"), and couples who became pregnant without the use of IVF ("pregnant couples").

Prospective jurors were surveyed in the Philadelphia County Courthouse in Philadelphia. In that county, prospective jurors are selected from voter-registration and drivers' license records. We recruited prospective jurors to participate in the study by announcing that those who completed the questionnaire would receive a candy bar. We recruited consecutive IVF couples at the time of their enrollment in the IVF program at Pennsylvania Reproductive Associates, at that time part of the University of Pennsylvania Health System. Couples who were entering the program filled out, on enrollment, a comprehensive set of forms, of which our questionnaire was one, in the waiting area of the clinic. Completion of this paperwork was a prerequisite of enrollment in the program. Pregnant couples were recruited to participate by filling out the questionnaire at the beginning of evening parent education classes at the Hospital of the University of Pennsylvania. For IVF and pregnant couples, where both husband and wife completed the questionnaire, subjects were asked by attendants in the waiting area to fill out their questionnaire independent of their spouse.

### Survey instrument

The instrument was developed through the distribution of a variety of possible questions followed by interviews with clinicians at the World IVF Congress in Philadelphia, and a subsequently created pilot instrument was tested on prospective jurors as well as on the first fifteen IVF couples that were eligible for the study. The fifteen couples, as pilot subjects, were asked to make comments on the questionnaire regarding any comprehension and clarity

problems they encountered while filling out the questionnaire. After final revision, the questionnaire was administered to the study participants, with data from the first fifteen couples excluded from collection.

The questionnaire asked subjects to: "Imagine that you have a magic wand and can control what your future child will be like. We want to know how you would use your magic wand to choose traits in your child." Subjects were asked to state how likely they would be to choose or improve the following fourteen traits: not be susceptible to breast cancer, have a certain hair color, be very creative, have a good memory, have a good sense of humor, have key social skills, be skilled at activities (e.g. sports, music, art), be attractive, not be very short or very tall, not be homosexual, have a certain eye color, not be very heavy, increased IQ, and have normal hearing (see Appendix).

The fourteen traits were chosen after a pilot study of prospective jurors showed these fourteen traits to be those with the most variation in respondents' likelihood of choosing or improving the traits. Subjects were also asked how important it would be to them for their child to have their genes and their partner's genes (see Appendix). The responses to these two genes questions were averaged to create the "genes" variable. Subjects were then asked if they were pregnant, if they were presently attempting to reproduce, and which, if any, ARTs they were using to do so.

**Statistical analysis**

Data were cleaned by checking that the entered values for each variable were within the appropriate range.

A principle component factor analysis with VARIMAX rotation was used to divide the fourteen traits into factors. The number of factors considered was taken as those with egen values greater than 1.0. Item loadings with absolute values greater than .5 were used to describe the factors.

ANOVAs were used to test whether the IVF couples were more or less likely to choose or improve traits in their children, and if they placed greater importance on their child having their genes compared to prospective jurors or pregnant couples. ANOVAs were used to determine if any group differences in attitudes about traits and genes were due to group differences in demographics.

## RESULTS

A total of 329 people completed the survey: 132 prospective jurors, 101 people (fifty couples and one individual) enrolling in an IVF program, and ninety-six members of pregnant couples (pregnant without the use of IVF). Eight subjects in the IVF couples group were excluded from the analyses: two were not using IVF (they were only using artificial insemination) and six did not complete the majority of the survey. Two subjects in the pregnant couples group were excluded: one was using IVF, and one did not fill out the majority of the survey. The remaining respondents' demographic characteristics are shown in Table 1.

Mean responses to the likelihood of choosing or improving all fourteen traits across all three groups are shown in Table 2. On average, health traits were most likely to be chosen or improved and appearance traits were least likely. The other traits, relating to personality and abilities, fell in between the health and appearance traits in reported likelihood of being chosen or improved.

The three factors resulting from the factor analysis, which captured 70.3% of the rotated variance, are identified in Table 2. With the exception of the homosexuality trait, the traits loaded into factors according to the likelihood with which subjects (all three groups combined) would choose or improve them in their children. The traits loaded into Factor 1 were the most likely to be chosen or improved, the traits loaded into Factor 2 (with the exception of homosexuality) were in the middle, and the traits loaded into Factor 3 were the least likely to be chosen or improved. We will therefore refer to the three factors as "important traits," "moderately important traits," and "unimportant traits."

Are specific traits and a genetic link to children more or less important to IVF couples compared to the general public (prospective jurors) or to those who became pregnant without the use of IVF? The mean group responses and overall group differences in each factor of traits and the genes variable are shown in Table 3. Moderately important traits were significantly less likely to be chosen or improved by IVF couples than prospective jurors ($p=.001$) and just as likely by pregnant couples ($p=.37$). There were no group differences in the likelihood of choosing or improving important and unimportant traits ($p>.147$ for both comparisons). A group comparison of the average responses to all

fourteen traits showed that overall, the traits were significantly more likely be chosen or improved by IVF couples than by prospective jurors (p=.005) and just as likely by pregnant couples (p=.52).

A genetic link to future children was very important to most respondents (mean response of 3.8, where 4 is very important), but significantly more important to IVF couples than to pregnant couples (p=.009) and to prospective jurors (p=.004). Therefore, these results show that IVF couples care less than others about their children having specific traits, but care more than others about their children having a genetic link to them.

Were the group differences in moderately important traits, average of all traits and genes due to demographic differences between the groups? In bivariate analyses, the likelihood of choosing or improving moderately important traits was not related to income or gender, but was positively associated with education (F=9.1, p=.003), age (F=11.6, p=.001), and being non-Caucasian (F=7.8, p=.005). In a multivariate analysis that adjusted for age, education and race when assessing group differences in moderately important traits, the overall group difference diminished (F=2.5, p=.085), and age (F=9.8, p=.002) and education (F=6.4, p=.012) remained significantly associated with likelihood of choosing or improving moderately important traits.

The likelihood of choosing or improving all traits (average responses to all fourteen traits) also increased with education (F=11.9, p=.001), age (F=10.8, p=.001) and being non-Caucasian (F=7.2, p=.008). When we adjusted for these demographics, the overall group difference (F=1.8, p=.165) and the race difference became nonsignificant (F=.77, p=.380).

The genetic link (genes variable) was more important to higher income participants (F=4.1, p=.045), but no other demographic characteristic was significantly related to this variable. The overall group difference in genes remained significant (F=4.9, p=.008) and the income association did not (F=.612, p=.435) once income was factored into the model.

## DISCUSSION

Before discussing these results further, it is necessary to acknowledge the limitations of this study. First, the samples we obtained are not necessarily representative of all IVF couples, pregnant couples not using IVF, or the general population. In

addition, we did not collect data on the percentage of those who turned in the specific questionnaire enclosed in the enrollment packets of the IVF program. Thus, it is not possible to determine from our method how many couples who entered the waiting room of the IVF clinic elected to leave the waiting room without completing the paperwork, so it is impossible to adduce a response rate inclusive of such couples. However, according to the relevant clinic staff, very few (<10%) of couples who began paperwork in the clinic left without completing it in a typical day.[11] In addition, all couples who completed the waiting room paperwork, to the best of our knowledge, responded to the survey, according to the same clinic staff, although from our method it is impossible to verify this, though we spoke with those who collected the data at all three sites, and all recollect response rates in line with the rate at which material is turned in prior to enrollment in the programs, i.e., of approximately 90-95% and certainly well above 50%. Nevertheless, extrapolation about the ART population necessitates the caveat that limits on our data collection are not insignificant, even if no particular bias is suggested by those limits. Further, reproduction was an immediate issue for pregnant couples and couples attempting to become pregnant, which was not necessarily the case for the prospective jurors. A personal emphasis on childbearing may partially explain the different attitudes seen in the different groups. This can either be interpreted as a limit or strength of the present study, and certainly calls for further study.

Within these limits, we conclude that, contrary to the published arguments of the present authors in our earlier work, and in direct opposition to the majority of the philosophical and political argumentation on the matter, IVF couples we studied cared less than or only as much as others about their children having specific or enhanced traits. Desires to genetically engineer one's children were no stronger among our IVF couples than the rest of our study population. Specifically, it is further concluded that the view that ART enlists (in disproportionate or even significant numbers) those whose aim is "a perfect baby"[12] is not supported by our research, again contrary to prior arguments of author McGee.

However, and perhaps more interesting from a scientific point of

[11] Telephone conversation between Glenn McGee and Andrea Braverman, psychologist and collaborator most immediately responsible for collection of materials from IVF couples and person seeing couples immediately upon enrollment in the IVF program (1998).

[12] *See* GLENN MCGEE, THE PERFECT BABY: PARENTHOOD IN THE NEW WORLD OF CLONING AND GENETICS 115–39 (2d ed. 2000).

view given the arguments of those for and against the use of ART as an aid to the neuro or physiologic betterment of the human species, the IVF couples we studied were significantly more likely than other couples or individuals to care about making children who have a genetic link to the couple. The evidence for a preference among IVF parents for a genotypic link was manifest both in terms of the specific desires of IVF parents as well as in their general attitudes, whereas, by contrast, the differences among studied groups in terms of each group's likelihood to choose or improve individual traits were reduced to a statistically insignificant level when adjusting for age, education and race. Group differences in the importance of a genetic link remained after adjusting for demographics: those who became pregnant without IVF and jurors expressed no such strong interest.

How might we explain the attitudes of IVF couples revealed in this study? What aspect of their experience leads them to favor a genetic link more than others, but care less than others about enhancing their child? One possibility is that the types of people who enroll in IVF programs are uninterested in having a child with certain traits; they just want a child who is biologically related to them.[13] Such "types of people" were identified, for example, most prominently by Ferdinand Tönnies, particularly in his nineteenth century book, *Community and Society*.[14]

Alternatively, the preferences of those using IVF found in this study may be influenced by the experience of being infertile and the process of enrolling in an ART program. It is also possible that the stress of being infertile and having difficulties in conceiving their own child may lead couples not to care about having the perfect baby, and to instead simply want their own baby. Couples could come to understand the notion of "one's own" baby as being limited by the genetic link through their experience of ART. The former explanation is supported by the finding that the group differences in likelihood of choosing or improving traits were reduced when adjusting for demographics. It may be the characteristics of those who choose to enroll in an IVF program, such as being wealthier, Caucasian, and more highly educated (Table 1), not the experience of being infertile or the use of IVF *per se*, that affects these preferences. Causation cannot be established by our data, but it is

[13] *See* Glenn McGee & Daniel B. McGee, *Nuclear Meltdown: Ethics of the Need to Transfer Genes*, 17 POL. & THE LIFE SCI. 26, 26–29 (1998).

[14] *See generally* FERDINAND TÖNNIES, COMMUNITY & SOCIETY (GEMEINSCHAFT UND GESELLSCHAFT) (Charles P. Loomis ed. & trans., Mich. State U. Press 1957) (1887).

certainly clear that there is a correlation. Future research on more representative populations is warranted to explore these issues in more detail.

Despite the limitations on our data, it is the first direct evidence that ARTs do not demonstrably attract those seeking to utilize it as a tool for genetic engineering, nor does ART always appeal to those with unusual clinical or personal agendas for the children they seek to conceive. This flies in the face of a long chain of claims made over more than thirty years by those who had not examined the attitudes of aspiring parents concerning phenotype and genotype, and to some extent a long history of claims concerning the attitudes parents might have given theory of sociobiology. Those people utilizing IVF in our study actually cared less about whether their future children would have specific traits than did any other members of the study population. Based on decades of speculation with no foundation in empirical analysis, the concern that we will soon be facing a new eugenics movement utilizing ARTs may turn out to be exaggerated. Only through further examination of how the attitudes of those seeking to use ART can differ, with regard to both phenotypic and genotypic traits, from the rest of the population can physicians, scientists, and their institutions, as well as governmental institutions, make responsible policy or suggest productive educational programs for participants in the ARTs of today and tomorrow.

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**Competing Interests Statement**

The authors declare that they have no competing or conflicting financial interests.

TABLE 1. DEMOGRAPHIC CHARACTERISTICS OF THE SURVEY RESPONDENTS

| | **Prospective Jurors** | **IVF Enrollees** | **Pregnant w/o use of IVF** |
|---|---|---|---|
| **CHARACTERISTIC** | (N=132) | (N=101) | (N=96) |
| Age mean (SD) | 42 (13) | 36 (6) | 32 (6) |
| Male sex (%) | 35 | 51 | 45 |
| Race (%) | | | |
| White | 55 | 90 | 78 |
| Black | 42 | 6 | 10 |
| Other | 3 | 4 | 12 |
| Education (%) | | | |
| High school or less | 44 | 23 | 10 |
| Beyond high school | 56 | 77 | 90 |
| Income (%) | | | |
| <$40K | 45 | 5 | 17 |
| $40-$80K | 29 | 32 | 30 |
| $80-$100K | 16 | 28 | 21 |
| $100-$140K | 8 | 10 | 27 |
| >$140K | 2 | 26 | 6 |

*Numbers may not add up to 100% due to rounding

TABLE 2. FACTORS AND IMPORTANCE OF OFFSPRING CHARACTERISTICS TO ALL SUBJECTS

| Trait | Mean response* (SD) | Factor |
|---|---|---|
| Cancer | 4.68 (.7) | Important traits |
| Hearing | 4.18 (1.1) | Important traits |
| IQ | 3.98 (1.2) | Moderately important traits |
| Memory | 3.83 (1.3) | Moderately important traits |
| Social skills | 3.75 (1.3) | Moderately important traits |
| Not heavy | 3.61 (1.3) | Moderately important traits |
| Creative | 3.56 (1.3) | Moderately important traits |
| Sense of humor | 3.36 (1.4) | Moderately important traits |
| Skills at activities | 3.34 (1.4) | Moderately important traits |
| Homosexual | 3.17 (1.6) | Unimportant traits |
| Attractive | 3.01 (1.4) | Moderately important traits |
| Height | 2.72 (1.4) | Unimportant traits |
| Eye color | 1.77 (1.1) | Unimportant traits |
| Hair color | 1.77 (1.1) | Unimportant traits |

*1=not at all likely to want to choose/improve, 5=extremely likely

TABLE 3. IMPORTANCE OF OFFSPRING CHARACTERISTICS

| | **Prospective Jurors (J)** | **IVF Enrollees (I)** | **Pregnant w/o use of IVF (P)** | **Overall group difference?** * |
|---|---|---|---|---|
| Important traits | 4.5 | 4.4 | 4.5 | p=.610 |
| Moderately important traits | 3.8 | 3.3 | 3.5 | p=.001[a] |
| Unimportant traits | 2.5 | 2.3 | 2.3 | p=.147 |
| Average | 3.5 | 3.2 | 3.3 | p=.006[b] |
| Genes[t] | 3.7 | 4.1 | 3.6 | p=.002[c] |

response scale: 1=not at all likely to choose/improve traits, 5=extremely likely
t response scale: 1=not at all important, 5=extremely important
*by ANOVA comparing all 3 groups
a I<J (p=.001) and I=P (p=.367) by Tukey test
b I<J (p=.005) by Tukey test
c I>P (p=.009) and I>J (p=.004) by Tukey test

## APPENDIX

1. If you could make sure your future child will not be susceptible to breast cancer, how likely would you be to do so?
2. If you could choose your future child's hair color, how likely would you be to do so?
3. If you could make sure your future child will be very creative, how likely would you be to do so?
4. If you could make sure your future child will have a good memory, how likely would you be to do so?
5. If you could improve your future child's sense of humor, how likely would you be to do so?
6. If you could make sure your future child will have key social skills, how likely would you be to do so?
7. If you could choose how skilled your future child is at certain activities (e.g. sports, music, IVF), how likely would you be to make sure they have the capacity to do those activities?
8. If you could make sure your future child will be attractive, how likely would you be to do so?
9. If you could choose to prevent your future child from being very short or very tall, how likely would you be to do so?
10. If you could make sure your future child will not be homosexual, how likely would you be to do so?
11. If you could choose your future child's eye color, how likely would you be to do so?
12. If you could prevent your future child from being very heavy, how likely would you be to do so?
13. If you could increase your future child's IQ, how likely would you be to make sure that they are not well below average?
14. If you could make sure your future child will have normal hearing, how likely would you be to do so?
15. How important is it to you for your child to have your genes?
16. How important is it to you for your child to have your partner's genes?
17. Are you or your partner pregnant?
18. Are you presently attempting to adopt a child?
19. Are you presently attempting to reproduce?

20. If you are attempting to reproduce, which, if any, of the following assisted reproductive technologies are you presently using in your attempt to reproduce?
(a) donor sperm (b) gestational carrier (c) donor egg
(d) Intrauterine insemination (e) gestational carrier with donor egg (f) In Vitro fertilization (IVF)/Gamete Intrafallopian Transfer (GIFT)