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Original Article

How Men and Women Respond to Hypothetical Parental Discovery: The Importance of Genetic Relatedness

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Abstract: Paternal uncertainty has shaped human behavior both in evolutionary and cultural terms. There has been much research investigating parenting as a function of genetic relatedness to the child, with a focus on male behavior, but the nature of these sex differences is hard to evaluate. We devised a hypothetical scenario that was as similar as possible for men and women to test whether, even in such a scenario, sex differences would remain strong. Participants were presented with the discovery that a child that s/he believed to be theirs was not carrying their own genes. Irrespective of sex, participants ($n = 1007$) were more upset when the baby was not genetically related to them than when the child was genetically related but the sex gamete was not from a chosen donor. Women were more upset than men in both scenarios, but were more likely to want to keep the baby. The results are discussed with reference to evolved and rational mechanisms affecting parenting.

Keywords: parental uncertainty, reproductive decisions, investment, emotions, sex differences

Introduction

One important aspect of mammalian sexuality is internal fertilization, which implies maternal certainty and paternal uncertainty. From an evolutionary perspective, this asymmetry may explain many differences between men and women, for instance a difference in sources of jealousy between the sexes (Buss, Larsen, Westen, and Semmelroth, 1992), a tendency for men to try and control women's sexuality in order to prevent cuckoldry, and a greater need by men for reassurances over their paternity (Anderson, 2006).

In this study, we explored sex asymmetries present (or absent) as a response to a hypothetical scenario in which, suddenly, new information about paternal and maternal

relatedness becomes available. If paternity uncertainty has been a prominent force shaping male behavior, we would expect men to react in a more negative way than women when discovering that their child does not carry their own genes. On the other hand, as female reproductive potential is more limited than that of males, women have more to lose when investing in unrelated offspring. Rationally, it may be that women react in a more negative way than men

when finding out that the offspring is not genetically related to them. Before describing the study, we briefly review two literatures: one on sex differences in parenting investment and one on rigid versus flexible responses to parental uncertainty.

Sex differences in parental investment

According to parental investment theory, men and women face different trade-offs between mating and parenting, resulting in a host of putative hard-wired sex differences in psychological mechanisms (Bjorklund and Shackelford, 1999). The basic asymmetry is not specific to humans. Female mammals, in almost all circumstances, invest more in their offspring than males do and can be confident that the offspring shares their genes. As a consequence, males can enhance their reproductive success by pursuing multiple mating opportunities (but see Kokko and Jennions, 2008 for discussion), whereas female fitness can be enhanced by choosing partners with good genes and/or resources. Indeed, one common view is that males are competitive and promiscuous, and females are coy and choosy (Buss, 1994; but see also Brown, Laland, and Mulder, 2009).

There has been great interest in investigating the effects of genetic relatedness on paternal care-giving (e.g., Anderson, Kaplan, Lam, and Lancaster, 1999; Anderson, Kaplan, and Lancaster, 2007), but this literature has largely ignored women. For example, we know that there is a relationship between mating and parenting effort. Men are most likely to invest resources in offspring (whether they are the genetic father or not) if they are in a relationship with the mother. Hence, male parenting might reflect future reproductive opportunities with the mother of that offspring (Anderson, 2000), as well as increase the survival and well-being of purported genetic descendants (Geary, 2000), both of which may have a function in increasing men's fitness (Anderson, 2000). The parental conflict literature has focused on female choice for partners (e.g., Alonzo, 2010) and has not considered women's parental investment as a function of relatedness. Because the reproductive rate of females is much lower than that of males, bringing up unrelated children is more costly to women in terms of decrease in lifetime reproductive success. Women may have evolved mechanisms to increase reproductive success in terms of an increased desire for biological children (Brase and Brase, 2012; Rotkirch, 2007), and this longing seems to translate into a positive experience, especially in women who are in an established relationship (Adair, Brase, Akao, and Jantsch, 2014). Furthermore, some studies in this area have shown that women have a harder time coping with adoption (Goldberg, Kinkler, and Hines, 2011) and rearing step-children (MacDonald and DeMaris, 1996) than men have. Because women's life-time reproductive span is shorter than that of men, one would expect women to experience more negative emotions than men when investing time in genetically unrelated children. Circumventing female choice may have high reproductive costs for women (see Apostolou, 2013, for a discussion of rape), but this has not, to our knowledge, been studied in humans. One of the aims of the present study is to address sex differences in parenting-related emotions and decisions in scenarios where

genetic relatedness with the offspring is manipulated (Buss and Malamuth, 1996). Our study is based on self-reports in response to hypothetical scenarios. This study will need to be complemented in the future by other approaches.

Although women's fitness can be enhanced by choosing a mate with good genes, there is little research investigating parenting behavior in situations where females conceive offspring with a male they did not choose. Data on children conceived as a result of rape suggest that women may feel alienated from the child, but this could be due to the trauma caused by forced copulation (Ee and Kleber, 2013). Although new reproductive technologies have resulted in an increase of pregnancies with unintended genetic material (Liebler, 2002), there are as of yet no systematic studies looking at emotional differences between the sexes when discovering that the other sex gamete was that of a stranger.

The role of knowledge and rational choice

It seems reasonable that some aspects of human evolution have shaped human behavior and emotional responses. However, evolutionary arguments have also been criticized. In their review on sex differences Wood and Eagly (2002) contrast an essentialist approach, common within evolutionary psychology, and a social constructionist approach, more common within the social sciences. The essentialist stance describes differences between men and women as originating from evolutionary pressures (Caporael, 2001). The social constructivist approach focuses on social pressures, stereotypes, and cultural patterns that cause and reaffirm the roles of each sex. The two are not, however, mutually exclusive.

A fundamental difficulty in making claims about underlying mechanisms is that choices that make sense from an evolutionary perspective may also make sense from a rational standpoint. The feelings that one experiences towards a son who is adopted may depend on a bias towards investing in one's own genes, but it can also depend on a generic self-serving bias that makes everybody more positively inclined towards the self and what is more directly linked with the self, including, for instance, our own name (Nuttin, 1985). In other words, a self-serving bias may increase fitness but multiple self-serving biases may all stem from a generic egocentric predisposition rather than specific evolved mechanisms. Moreover, rational choices are not necessarily conscious (Reder and Schunn, 1996) creating a problem in the interpretation of what people may report.

An interesting example is the response to faces that look like one's own. Both men and women find self-resembling faces attractive, but there is contradictory evidence about how people react to self-resemblance in the faces of infants. In some studies the preference was stronger in men (Platek, Burch, Panyavin, Wasserman, and Gallup, 2002), whereas in others it was absent (DeBruine, 2004) or stronger in females (Bressan, Bertamini, Nalli, and Zanutto, 2008).

The fact that differences between men and women in parenting are widespread does support the hypothesis that they represent essential differences between the sexes. On the other hand, maternal certainty and paternal uncertainty are well known facts that may affect individual behavior and culture because they are important and universal aspects of human life. Evolutionary psychology faces a well-known problem: It is impossible to change the world to test the hypothesis that human behavior would remain constant (at least in the short term) even if conditions were to drastically change. Such impossible manipulation can be tried at least as a thought experiment, or within a science fiction scenario.

Science fiction scenario

In this study, we attempted an “impossible” experiment. To do so, we placed participants in the only place in which unimaginable things can take place: a science fiction narrative (see Appendix 1). Participants read one of the possible hypothetical scenarios in which the baby was not from the chosen egg/sperm donor (Not-other condition) or the baby was genetically not theirs (Not-you condition) and then rated their reactions to the scenarios. The narratives were identical for both sexes, creating symmetry in parental uncertainty. In addition, in our narratives, gestation does not take place in the womb, removing another reproductive difference between men and women.

Let us assume that paternal uncertainty has shaped the male psyche in such a way that men will alter their disposition and their behavior towards a baby on the basis of the likelihood that that baby carries their own genes. This may emerge in various ways, and does not need to be under conscious awareness. Although infanticide is relatively rare, babies are much more likely to be killed by stepfathers than by genetic fathers (Daly and Wilson, 1988). Therefore, it is reasonable to expect that the paternal response to finding out that a baby is not genetically related to them will be much stronger than the response to finding out that a baby is not genetically related to the partner. We can also formulate an alternative hypothesis: Perhaps the importance of knowing that a child carries our own genes will be just as strong for mothers. It is possible that children who share genes with their parents are seen as more valuable, for generic egotistic reasons. Let us call this the egocentric hypothesis. The key test, therefore, will be whether the egocentric effect will be stronger for men than for women. If so, there will be an interaction between type of mistake (self and donor) and sex of the participant (men and women).

In summary, we investigated sex-differences in two hypothetical situations relating to parenting: a situation where a child is not genetically related to the parent, and a situation where a child is genetically related to the parent, but conceived with a person who the individual did not choose. We expected that due to higher constraints in female reproductive potential, and perhaps due to social pressures, women would have stronger negative emotions than men in both situations. It is also possible that men are more affected by the situation where the child carries the genes of the partner, but not theirs, because of the similarity between this situation and that of cuckoldry. We also included relationship status, as being in a stable relationship is a strong predictor of the intention to have biological children (Schoen, Astone, Kim, Nathanson, and Fields, 1999) and, at least in men, predicts the investment in related and non-related offspring (Anderson, 2000).

Materials and Methods

Participants

In total, 1,186 participants filled in an on-line survey on “Fertility, conception, and sexuality,” advertised on an on-line participation website. To make the sample more uniform, we decided to exclude individuals who were non-heterosexual, did not report their sex, or were under the age of 18. We were left with a sample of 1,007 volunteers (343 men, 664 women; Mean age = 27.00, $SD = 9.88$, 18–72 years, 439 single, 566 in a relationship, 2 not reported; 525 British, 482 Other). The study was approved by the Ethics Committee of the University of Liverpool. No payment or credit system was used to attract participants.

Procedure

After reading an information page and giving consent, participants were directed to a page with a set of demographic questions (sex, age, sexual orientation, relationship status). Following this, participants read a hypothetical science fiction vignette on a situation where babies were created in a baby-lab (http://www.liv.ac.uk/vp/sf_intro.html). Based on random assignment participants were either in a condition where, due to a mistake, (i) the baby was not genetically related to the participant ($n = 505$), or (ii) genetically related, but the sex gamete of the other parent was not one chosen by the participant ($n = 408$).

After reading the story, participants were asked to rate (i) How upsetting they would find the situation (1 = Not at all upsetting, 10 = Extremely upsetting), (ii) How much an effect this would have on their relationship with the child (1 = No effect, 10 = A great effect), (iii) How likely would they be to keep the baby (1 = Very unlikely, 10 = Very likely), and (iv) How angry they would be to the lab for the mistake (1 = Not angry, 10 = Very angry).

Data analysis

To investigate the interactions between sex, relationship status, and experimental condition on the reactions to the vignettes, we conducted a multivariate analysis of variance, controlling for age and the number of existing children. This was followed by univariate ANOVA's to investigate the interactions further. We also conducted *t*-tests in order to reveal any significant main effects and simple main effects between the independent variables.

Results

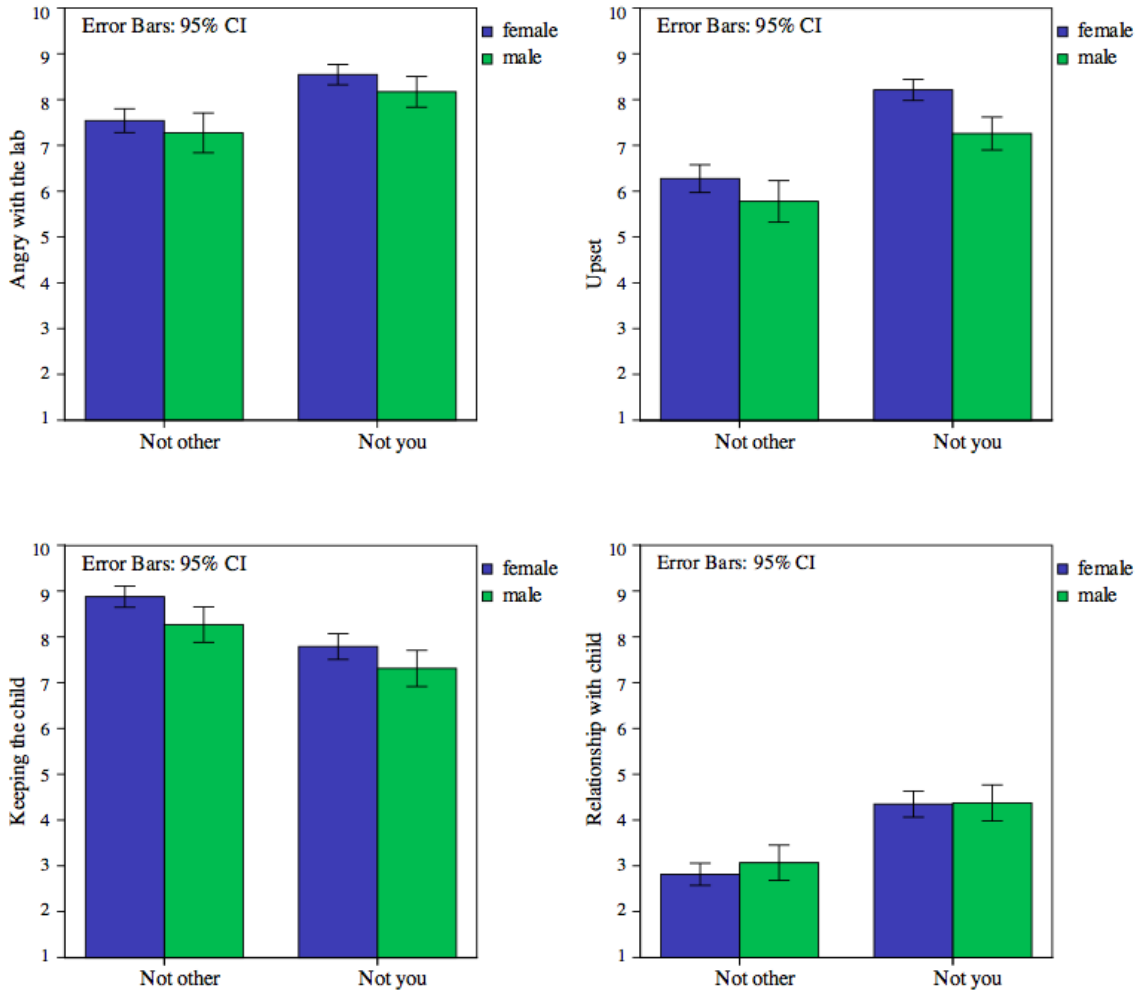
In Table 1 and Figure 1, we report the descriptive statistics for each experimental condition, broken down by sex and relationship status.

Table 1. Mean rating in the different conditions on the four questions for men and women (separated for single and partnered respondents)

| | Mean (<i>SD</i>) | | | |
|-------------------------|--------------------|-------------|-------------|-------------|
| | Men | | Women | |
| | Single | Partnered | Single | Partnered |
| <i>Not You</i> | | | | |
| Upset | 7.53 (2.36) | 7.00 (2.64) | 8.05(2.08) | 8.34 (2.19) |
| Anger at lab | 7.93 (2.48) | 8.45 (2.16) | 8.27 (2.19) | 8.76 (1.96) |
| Relationship with child | 4.34 (2.84) | 4.41 (2.70) | 3.96 (2.56) | 4.60 (2.72) |
| Keep the child | 7.93 (2.48) | 7.75 (2.66) | 8.16 (2.40) | 7.62 (2.74) |
| <i>Not Other</i> | | | | |
| Upset | 6.03 (2.80) | 5.59 (2.96) | 6.18 (3.00) | 6.38 (2.66) |
| Anger at lab | 7.23 (2.78) | 7.31 (2.76) | 7.29 (2.49) | 7.51 (2.34) |
| Relationship with child | 3.18 (2.45) | 2.98 (2.46) | 3.22 (2.63) | 2.52 (1.84) |
| Keep the child | 7.73 (2.66) | 8.77 (2.19) | 8.43 (2.44) | 9.21 (1.81) |

Note: Higher values indicate higher reported levels of upset and anger, a greater effect on the relationship, and a greater willingness to keep the baby.

Figure 1. Reactions and emotions relating to discovering the child is not genetically related to the chosen donor (Not other), or not related to the self (Not you)



Note: Error bars are 95% confidence interval for the mean

To investigate interactions between condition, sex, and relationship status, we conducted a 2 x 2 x 2 Multivariate Analysis of Variance, controlling for age and number of children. The covariates had no significant relationship with the dependent variables (p s > .05) and will not be reported here. The between-participants IV's were sex (male, female), condition (not your genes, not chosen gametes), and relationship status (single, in a relationship). The dependent variables were ratings for (i) how upsetting they would find the situation, (ii) effect on their relationship with the child, (iii) likelihood of keeping the baby, and (iv) anger evoked by the mistake. Table 2 shows the multivariate statistical values for the analyses.

We found a significant interaction between the experimental condition and relationship status, sex and relationship status, and significant main effects on condition, sex, and relationship status (see Table 2). In order to investigate the multivariate ANOVA further, we conducted univariate and pairwise tests for each dependent variable separately. For clarity, we only report the significant interactions here, but an interested reader can contact the authors for full results. Significant interactions were found between condition

and relationship status for (i) perceived relationship with the child, $F(1, 1000) = 4.92, p < .03, \eta_p^2 = .01$, and (ii) subsequent decision to keep the baby, $F(1, 1000) = 4.79, p < .03, \eta_p^2 = .01$. Individuals who were currently partnered in the “not chosen gametes” condition thought their relationship with the child would be less affected ($M = 2.66, SD = 2.05$) compared to individuals who were currently single ($M = 3.21, SD = 2.56$), $t(485) = 2.61, p < .01$.

Table 2. Statistics for the multivariate ANOVA

| Multivariate ANOVA | <i>F</i> | <i>p</i> | η^2_{partial} |
|--------------------------------|----------|----------|---------------------------|
| Condition | 30.36 | .001** | .11 |
| Sex | 7.83 | .001** | .03 |
| Relationship | 5.85 | .001** | .02 |
| Condition x Sex | 0.66 | .621 | .003 |
| Condition x Relationship | 2.91 | .02* | .01 |
| Sex x Relationship | 3.77 | .005* | .02 |
| Condition x Sex x Relationship | 0.93 | .445 | .004 |

Note: * $p < .01$, ** $p < .001$

Similarly, participants in the “not chosen gametes” condition were more likely to want to keep the child if they were in a relationship ($M = 9.08, SD = 1.94$) rather than if they were single ($M = 8.19, SD = 2.54$), $t(485) = -4.39, p < .01$. Individuals who were partnered in the “not your genes” condition were angrier at the lab for the mistake if they were in a relationship ($M = 8.66, SD = 2.02$) than if they were single ($M = 8.11, SD = 2.02$), $t(520) = -2.87, p < .01$.

Furthermore, we found a significant interaction between participant sex and relationship status on how individuals would feel towards the baby, $F(1, 1000) = 5.16, p < .02, \eta_p^2 = .01$, in the main model. Significant interactions were found for (i) how upset they would feel, $F(1, 1000) = 4.08, p < .05, \eta_p^2 = .004$, and (ii) subsequent decision to keep the baby, $F(1, 1000) = 7.36, p < .01, \eta_p^2 = .01$. Irrespective of the experimental condition, single ($M = 6.88, SD = 2.27$) rather than partnered men ($M = 6.23, SD = 2.88$) reported being more upset, $t(326) = 2.12, p < .04$. Single men also reported a reduced likelihood of keeping the child ($M = 7.28, SD = 2.76$) in comparison to partnered men ($M = 8.64, SD = 2.43$), $t(326) = -3.67, p < .001$.

Finally, in order to clarify the effect of the experimental condition on the participant’s reactions, we conducted independent *t*-tests where the condition was the independent variable. Participants were less likely to keep the baby ($t[1005] = -6.71, p < .001$, Cohen’s $d = 0.40$), and felt more upset ($t[1009] = 10.79, p < .001, d = 0.67$), angry ($t[1009] = 6.45, p < .001, d = 0.40$), and thought that their relationship with the child would be affected ($t[1009] = 9.35, p < .001, d = 0.59$) in the condition where they discovered that the child is not genetically related to them compared to the condition where the other sex gamete was not the chosen one (see Table 1 and Figure 1). Lastly, we analyzed the differences between men and women in their reactions, and found that although women felt more upset ($t[1005] = 3.62, p < .001, d = 0.28$) than men, they were more likely to want to keep the baby ($t[1005] = 3.36, p < .001, d = 0.22$; see Table 1 and Figure 2).

Discussion

Participants felt more negative when the baby was not carrying their own genes, highlighting the importance of genetic relatedness on parenting emotions irrespective of the sex of the individual. Women felt angrier than men, but were more likely to keep the baby. Stronger negative reactions could be a reflection of the higher lifetime reproductive cost incurred by women who (i) have had their mate choice options removed by conceiving with a potentially low-quality male, or (ii) invest expensive reproductive time in bringing up genetically unrelated children. This finding is consistent with the “baby-fever” research suggesting that women have a stronger and fundamental drive to have children that are their genetic progeny (Brase and Brase, 2012; Rotkirch, 2007). However, despite stronger negative emotions, women were more likely than men to keep the baby in both conditions. According to work by Sarah Hrdy and colleagues (Hrdy, 1999, 2009), cooperative breeding and allomothering played a key role in human evolution (Burkart, Hrdy, and Van Schaik, 2009), and could provide a plausible explanation for the higher likelihood of keeping the baby despite stronger negative emotions. Experimental evidence suggests that women have evolved greater sensitivity to infants, possibly as a proximate mechanism for maintaining allomothering behavior (Cárdenas, Harris, and Becker, 2013). The higher likelihood of women in our study keeping a child could be based on the same mechanisms. Future work should investigate the nature of sex differences between behavior (i.e., keeping the child) and emotions and feelings towards the child and the situation. Women may have evolved a higher sensitivity to signals of need, resulting in care-giving behavior, but may still experience frustration because of the high fitness costs.

Relationship status of the participants played a role in the decision to keep the genetically unrelated child. Participants who were currently in a relationship were more likely to keep a genetically unrelated baby than single participants were and thought that their relationship with the child would be less affected. It is possible that partnered individuals are more ready to make positive decisions about parenting, even when they are considering a child without the input of the current partner. Current relationship status has been identified as an important variable in mating-related decisions (Burriss, Marcinkowska, and Lyons, 2013; Little, Jones, Penton-Voak, Burt, and Perrett, 2002). Especially in men, relationship affects the investment in current offspring irrespective of genetic relatedness, which could be a tool for securing future offspring with the partner (Anderson, 2000), as well as increase the survival and well-being of the supposed genetic offspring (Geary, 2000). It is possible that being in a relationship changes the attitudes that people have about children, and makes them more positive about the idea of being a parent.

We come now to the discussion of what was not confirmed by the data. In the introduction we have discussed some reasons why men may be more sensitive to discovering that the genes were not theirs. It is possible that men have evolved a host of anatomical, physiological, and psychological anti-cuckoldry mechanisms, as paternity uncertainty has been a recurrent problem during evolutionary history (Goetz and Shackelford, 2009). If these psychological mechanisms did exist, men would be expected to have a much stronger negative attitude towards discovering that a child that they are caring for is not carrying their own genes. On this basis, we predicted an interaction between condition and sex, which was not present. One possibility is that the vignettes lack ecological validity and do not reflect how people would react in real life. Another

possibility is that we succeeded in making the hypothetical situation symmetrical and that male and female behavior was symmetrical as a consequence, as predicted by theories that stress the rationality of human reproductive choices.

In conclusion, we provided evidence for sex differences in the responses to hypothetical scenarios that were similar for both sexes. We found that women reported more negative emotions but also a higher likelihood of keeping the baby, demonstrating a possible conflict between parenting emotions and actual behaviors. Parenting decisions are likely to be based on a host of rational and instinctive mechanisms (Chasiotis, Hofer, and Campos, 2006), and future research should concentrate on detangling the role of conscious and unconscious decision making in parental investment.

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Appendix 1. Science fiction narrative

It is the year 2100 and a terrible environmental disaster has affected the whole planet. A biological difference between men and women allowed only females/males to survive the great tragedy. As a consequence humanity has lost the possibility for natural reproduction. However, technology has allowed wo/men to continue reproducing using a technique where babies are created and grown in laboratories. In this situation you are given the opportunity to select a sperm/egg from a sperm/egg-bank created before the disaster. There is a large catalogue of sperm/egg donors from which you can select the characteristics that you desire in a child. The gestation takes place in a laboratory pod.

Consider yourself as a wo/man living in the year 2100. You are a young adult with a successful career and have decided that you are ready to bring up a child.

You select your sperm/egg donor, go through the novel process and are eventually given your child from the Baby Laboratory. On the same day you are contacted by the Laboratory who explains to you that there has been a problem in which some samples were mixed up.

Not-other condition

They regretfully inform you that your baby does not carry the genes of the donor that you chose. You do not know which sperm/egg donor was used or what characteristics your child will have.

Not-you condition

They regretfully inform you that your baby does not carry your own genes. You are not the genetic mother/father.