If Marc is Suzanne's father, does it follow that Suzanne is Marc's child? An experimental philosophy study in reproductive ethics

Kristien Hens ,[1] Emma Moormann,[1] Anna Smajdor ,[2] Daniela Cutas[3]

► Additional supplemental material is published online only. To view, please visit the journal online (https://doi.org/10.1136/jme-2023-109808).

[1]Department of Philosophy, University of Antwerp, Antwerpen, Belgium
[2]IFIKK, University of Oslo, Oslo, Norway
[3]Clinical Sciences, Lund University, Lund, Sweden

Correspondence to
Professor Kristien Hens, Philosophy, University of Antwerp, Antwerpen 2000, Belgium;
kristien.hens@uantwerpen.be

Received 15 December 2023
Accepted 26 July 2024

To cite: Hens K, Moormann E, Smajdor A, *et al*. *J Med Ethics* Epub ahead of print: [please include Day Month Year]. doi:10.1136/jme-2023-109808

ABSTRACT

In this paper, we report the results from an experimental reproductive ethics study exploring questions about reproduction and parenthood. The main finding in our study is that, while we may assume that everyone understands these concepts and their relationship in the same way, this assumption may be unwarranted. For example, we may assume that if 'x is y's father', it follows that 'y is x's child'. However, the participants in our study did not necessarily agree that it does follow. This means, at the very least, that we need to make sure all parties in a debate have the same relationships in mind when talking about reproduction and parenthood. Moreover, it gives us reason to explore more carefully the conditions which support or undermine the connections between these concepts. This cannot come from purely theoretical reasoning, nor from empirical research alone, but from the alliance between the two.

INTRODUCTION

Reproductive ethicists commonly rely on concepts such as 'sibling', 'parent', 'child', 'donor', 'genes' or 'biology'. Such concepts are assumed to be reasonably reliable: in using them, we can be confident that we are talking about the same thing. These apparently stable concepts can then serve as a basis for discussing, for example, the rights and duties of biological versus social parents. Once we commit to one or another interpretation (eg, biological vs social ties as indicators of parenthood), we may take ourselves to be consistent in our use of these concepts and assume that they fall into a specific relation to each other. For example, if Marc is Suzanne parent, then it must also be true that Suzanne is Marc's child. We also tend to assume that we share an idea of what it means for someone to have reproduced. These choices have normative repercussions. If 'having reproduced' and 'being a biological parent' are taken as meaning more or less the same thing, this implies that the duties and rights of reproducers are the same as the duties and rights of biological parents. For example, Velleman has claimed that the people who reproduce genetically are the parents of the children thus created, and that therefore donor conception is unethical because it intentionally alienates children from their parents.[1] Choices such as these have practical, legal and ethical implications for how we think about donor conception.

Reproduction and parenthood

Since the 1970s, with the development of bioethics as a distinct discipline and the advent of in vitro fertilisation (IVF), questions about ethics and reproductive technologies have proliferated. As new biomedical possibilities emerge, terms such as 'mother', 'biological parent' and 'reproduction' have come under scrutiny. Concepts that were previously regarded as biologically given are now increasingly recognised as negotiable, or underdetermined, or partly/wholly socially constructed.

Accordingly, new avenues of research have emerged in the literature. In particular, questions about parenthood and reproduction have become a prominent feature of the discourse. There are a number of philosophical accounts of parenthood.[2 3] Some of these privilege biological connections, while others focus on the intentions of prospective parents; others take the causal processes involved in conception to be a key component of parenthood. Still others may highlight the Lockean approach, whereby parenthood is viewed as a status that one acquires through one's activities—especially caring activities—in relation to a child. On the biological accounts, parenthood may be construed as a fixed genetic relationship, which is necessarily connected with reproduction. A good deal of work has been undertaken in various areas of ethics on these topics, both conceptual and empirical.[4–10] We add to this broader discussion an analysis of a very specific relationship between reproduction and concepts of parenthood. Our work in this paper aims to yield insights into how people construe the relationship between genes, reproduction and fatherhood, by using scenarios where the genetic relationship is slightly altered in each iteration.

Experimental philosophy

It was a common flaw of analytical philosophy of the past to assume that philosophers' intuitions were the same as those of any 'reasonable' person. New approaches to philosophy seek to go beyond these assumptions and intuitions. Cannold has warned of a failure of moral philosophers adequately to understand and respond to lay reasoning in the abortion context.[11] Empirical approaches, such as that espoused by Cannold herself, offer ways of engaging and interacting with the public that aim to reveal new insights into 'philosophical' problems. The use of such methods may help philosophers to avoid becoming, to borrow from Wittgenstein, a wheel that turns by itself.[12]

The approach we adopt in this paper is commonly known as experimental philosophy.[13 14] A typical study in experimental philosophy involves the design of multiple vignettes which present a particular scenario where one variable is altered in each

iteration of the vignette. The vignettes are then presented to a sample of respondents. Using this method, unexpected associations or inconsistencies in people's interpretations of certain concepts may be revealed. In turn, these help philosophers to understand the ways in which people construct concepts and their relationships. XPhi studies have also fruitfully made apparent cross-cultural differences in intuitions.[15] Many XPhi studies have been conducted in epistemology, free will, moral philosophy and aesthetics.[16 17] Recently, several studies in experimental philosophy of medicine and experimental philosophy of bioethics have also been undertaken.[18]

In the context of reproductive ethics, empirical studies such as interviews, focus groups and surveys to investigate people's opinions and experiences have been increasingly common since around 2000.[11] However, the specific methodology of experimental philosophy has not been widely used. There is some overlap between empirical ethics, qualitative research and experimental philosophy.[19] Given that ethicists are already undertaking empirical work, it might be argued that there is no special need for yet another empirical methodology. However, experimental philosophy, in the sense in which we use the term, is a different endeavour from the studies undertaken by empirical ethicists and qualitative researchers.

Experimental philosophy is in some senses narrower in its scope than other empirical approaches. In most experimental philosophy, especially when vignettes are used, the focus is on the specific concept in question; participants cannot share views, observations or feelings other than those allowed for in the response options. Thus, the overall aim is very different from, for example, that of a qualitative researcher who undertakes semistructured interviews to explore participants' experience of fertility treatment or runs focus groups in order to elicit participants' ethical concerns about a particular phenomenon. Often, the main aim in experimental philosophy is to identify those variables that influence participants' concept of a particular phenomenon. As such, experimental philosophy, especially the flavour that uses vignettes, perhaps has more in common with conceptual engineering than it does with empirical ethics and qualitative research.

Experimental philosophy gives us an additional tool with which to probe the questions we are interested in. Moreover, it can tell us things that do not emerge from other methods of enquiry. For example, the emerging field of *experimental philosophical bioethics* aims to 'make sense of the eliciting factors and underlying cognitive processes that shape people's moral judgments, particularly about real-world matters of bioethical concern[14]'. *Experimental philosophy of medicine* investigates intuitions regarding concepts of disease, health and disability.[18] As with any other empirical methodology, there may be weaknesses in experimental philosophy that can make its findings questionable, or limit its validity in particular cases.[20] We acknowledge these risks and suggest that the vital thing in the context of experimental philosophy is to be concise in pinpointing the concepts to be analysed, to be cautious in interpreting the data and to avoid leaping too quickly from the findings to normative conclusions. Therefore, we deem the method fruitful to analyse concepts in reproductive ethics, which are often fraught with vagueness and uncertainties.

In this experimental reproductive ethics study, we set out to investigate whether our respondents consider reproduction as necessarily entailing parenthood, and whether 'x being y's parent' entails that 'y is x's child'. We also wanted to find out the degree to which genetic contribution is perceived as being necessary or sufficient for reproduction, parenthood and 'being someone's child'. More broadly, we aimed to explore the potential of experimental philosophy as a tool with which to shed light on important issues in reproductive ethics. We wanted to answer the following research question:

Do people's opinions on who has reproduced/is a parent/has a child differ depending on the degree of genetic relatedness between the parties involved?

In the following, we will present the vignettes that we used, our methodology, and discuss our findings.

METHODOLOGY

Design

We designed three vignettes. For each vignette we created three separate sets of questions. Each set consists of four questions, with a 5-point Likert scale answer (from 'completely disagree' to 'completely agree'). We recruited 450 participants using Prolific, an online research platform facilitating the recruitment of participants.[21] We calculated the sample size using the Qualtrics online sample size calculator, with as parameters a confidence level of 95%, 1 000 000 as population size and error margin of 5%. This yielded an ideal sample size of 384 participants. We increased this to 450 participants, so that we could deploy a 9×50 (between subjects) design. This means that each of the nine possible combinations of vignette and question sets were presented to 50 respondents. The only requirement that we used as a pre-screener in Prolific was that participants had English as a mother tongue, and that the sample was gender balanced. We did not collect further demographic information besides age and gender. The participants were distributed among all age ranges, although most responses were within the 25–44 age range. Both the geographical location of the participants and their age may have relevance for the responses. We consider this a pilot study, and we encourage its reproduction in different geographical regions and with younger and older respondents. Figure 1 gives an overview of the flow of the vignettes.

Ethics review was not required for this study. We collected no identifying information and drew up a carefully designed consent process to ensure participants understood the nature of the study and chose to participate freely.

We designed vignettes in which the genetic relatedness between a sperm donor and the social father ('Marc') varied in several ways. The child could be (a) conceived with sperm donated by someone unrelated to Marc, or (b) from sperm donated by Marc's younger brother or (c) from sperm donated by Marc's identical twin brother. We then asked four questions about the degree to which respondents agreed with statements such as 'Marc has reproduced', 'The sperm donor/brother/identical twin has reproduced' and 'The fertility doctor has reproduced'. We also manipulated the type of question: either 'has reproduced' or 'is a parent of' or 'is a child of'. Here is the vignette:

> Maria and Marc are a couple in a long-term relationship. They have always wanted to become parents. However, Marc is infertile. A fertility doctor uses Maria's egg and [sperm from a sperm bank/sperm from Marc's younger brother/sperm from Marc's identical twin brother] to create an embryo. The embryo is transferred to Maria's womb and Maria becomes pregnant. Marc and Maria finally see their dream come true: their baby Suzanne.

Analysis

The data were analysed using SPSS 29. We assumed that the answers on the 5-point Likert scales can be treated as continuous

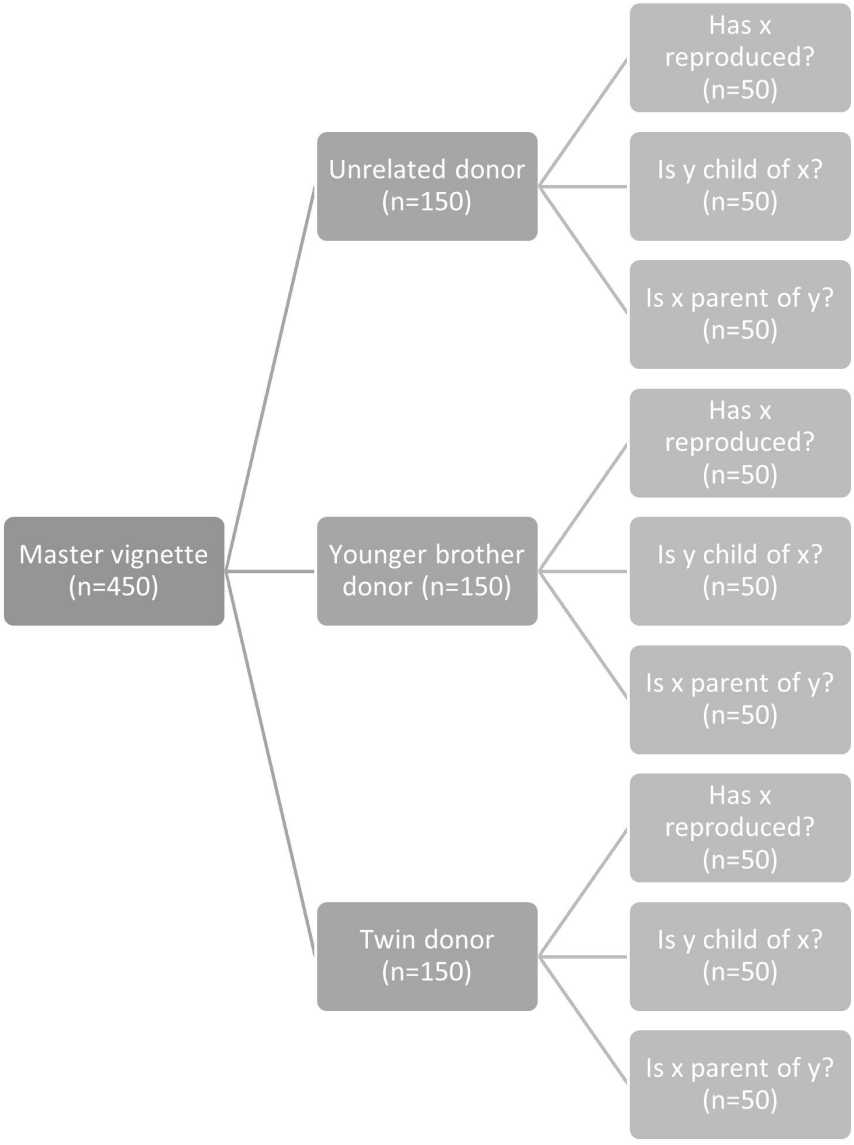

Figure 1 Flow of the vignettes.

variables. First, descriptive statistics (minimum, maximum, means and SD) were done. Next, one-way analysis of variance (ANOVA) tests were used to (1) compare the three groups (unrelated/brother/identical twin) and (2) compare the three formulations (reproduced/parent/child). We performed a Tukey post hoc test. As a multiple testing corrective, the false discovery rate (FDR) method was used on all p values of the ANOVA tests. We found that all initially significant p values survived this FDR correction. Since the Tukey post hoc tests were only used to find those pairs of means significantly different in the case of significant ANOVA results, no multiple testing correction was performed on the Tukey p values. Thus, all p values <0.05 are reported as being significant. Further details can be found in the online supplemental appendix.

RESULTS

We first investigated whether people's opinions on who has reproduced/is a parent/has a child differ depending on the genetic contribution. Two significant differences between the parent and child questions can be observed in the younger brother donor scenario. In this scenario, people seemed more inclined to say that Marc is a parent than that Suzanne is his child ($p<0.001$) (figure 2). Conversely, they were more inclined to say that Suzanne is the donor's child than that the donor is Suzanne's parent ($p<0.001$) (figure 3). Participants were somewhat more likely to agree with the statement 'Marc has reproduced' in cases where an unrelated sperm donor was used than in cases where the sperm of Marc's younger brother or his identical twin brother was used (although this difference was not significant).

We then investigated whether people have different intuitions in judgements about 'is Suzanne X's child', 'is X a parent' and 'has X reproduced', where X is either Marc, Maria, the sperm donor/brother/identical twin or the fertility doctor, depending on whether and how the intended parents and donors are related. Here we found significant differences in answer means for the questions regarding Marc in the child and parent formulations (parent $p=0.013$, $F=4.439$; child $p<0.001$, $F=7.339$) and the donor (parent $p=0.003$, $F=5.958$; child $p=0.001$, $F=14.515$). When we look closer to find out how genetic contribution plays a role here, we find that for the *father,* significant differences can be found between the unrelated donor and twin scenarios

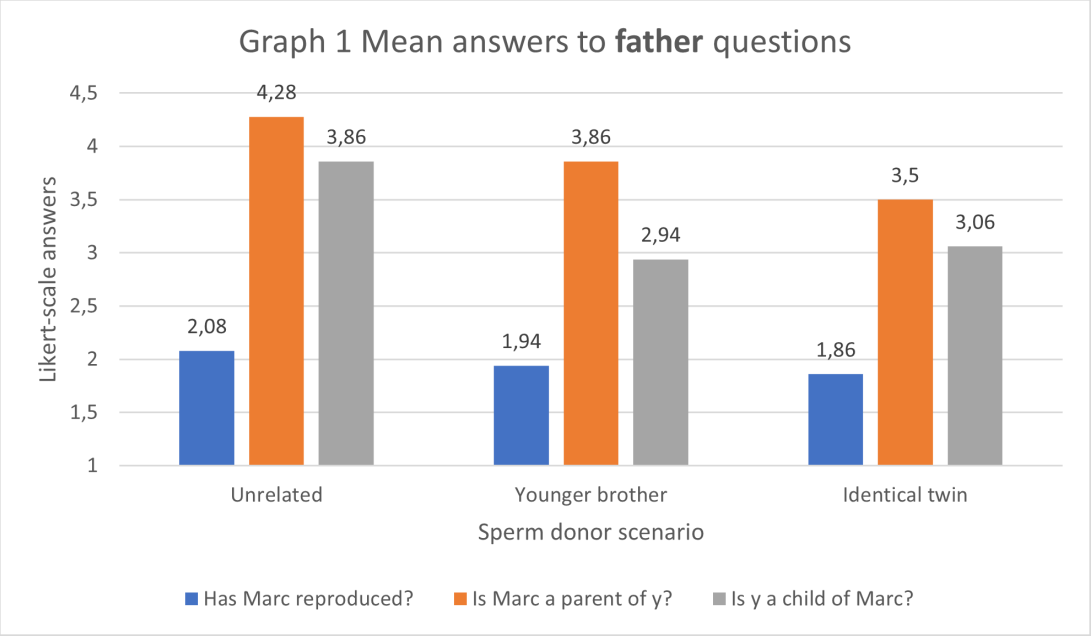

Figure 2 The mean answers to the three formulations of the question about Marc for each genetic contribution scenario. (Answers were given on a 5-point Likert scale, with 1=completely disagree, 3=neither disagree nor agree and 5=completely agree.)

(parent p=0.010, child p=0.007) and between the unrelated donor and younger brother scenarios (child p=0.002) (figure 2). For the *donor*, significant differences can also be found between the unrelated donor and twin scenarios (parent p=0.002, child p<0.001) and between the unrelated donor and younger brother scenarios (parent p=0.082, child p<0.001) (figure 3).

DISCUSSION

Our study yielded some expected and some surprising results. In particular, the 'closeness' of the donor to the social father seemed to have implications for the attribution of parenthood in a way that goes beyond mere genetic contribution. The discrepancy between 'reproduce' and 'is parent' and 'is child' was expected. That there is in some cases a difference between 'is y's parent' and 'is x's child' was not expected. Our respondents were less likely to agree that someone has reproduced than that someone is a parent in the case of donation by a (younger) brother. Surprisingly, they were also less likely to say that Suzanne is Marc's child than that Marc is Suzanne's parent in these cases.

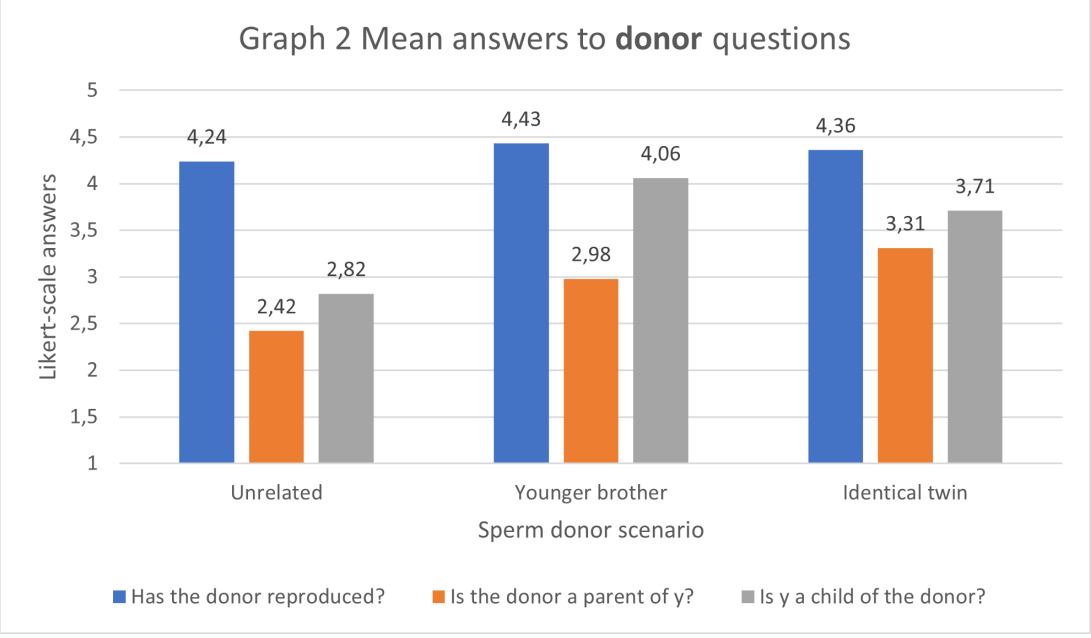

Figure 3 The mean answers to the three formulations of the question about the donor for each genetic contribution scenario. (Answers were given on a 5-point Likert scale, with 1=completely disagree, 3=neither disagree nor agree and 5=completely agree.)

This might suggest a number of things. It is possible that some participants in the survey assumed that an anonymous donor would play no further role in the child's life. Thus, he is merely a genetic contributor. In contrast, respondents may regard a sibling or identical twin of the prospective father as being likely to play a role in the child's upbringing. If the presumption of an ongoing social role affects people's perceptions, this may help to explain why the brother or identical twin are more likely to be seen as a parent than the unrelated donor.

Looked at in this way, the genetic relationship between Marc and the donor may be regarded by our respondents as a proxy indicator of a future relationship between the resulting offspring and the sperm donor. If so, it is not obviously the genes themselves that are the significant feature here. A follow-up study could yield interesting results if it included, for example, a friend of Marc's or an adoptive sibling as a sperm donor. In such a case, one might also assume an ongoing relationship, but one which would lack a close genetic connection between Marc and the sperm donor.

The emergence of an asymmetry between the respondents' interpretation of the child/parent relationship may also indicate that people view parenthood as something that has a variety of components. Parent can be a verb as well as a noun. It is not just what one is, but also what one *does*. In contrast, the word 'child' is not a verb, and does not function in the same semantic way as the term 'parent'. To be x's child is thus interpreted in one particular relational sense, which is primarily biological: participants regard the offspring as being the child of the sperm donor, even where they also regard Marc as the father.

However, to be y's parent can be understood in a variety of ways, some of which are static and biologically given, while others are dynamic and active. It may be this that leads to the apparently inconsistent 'x is y's parent, but y is not x's child'. This apparent inconsistency, though, seems not only explainable but perhaps justifiable if one takes a Lockean view of what makes someone a father: 'So little power does the bare act of begetting give a Man over his Issue, if all his Care ends there, and this be all the Title he hath to the Name and Authority of a father.'[22] For Locke, being a father is something that emerges from the activities of caring. By implication, fatherhood is a status that can be gained or lost and is not fixed biologically.

When interpreting the results of this study, it is important to avoid claiming too much. All the versions of our vignettes feature sperm donation, and none features egg donation. Accordingly, our data relate to fatherhood directly, and parenthood only partly. Since these concepts are gendered, we cannot extrapolate from our findings to parenthood in general (even though we acknowledge that the necessary connection between sex and fatherhood is open to question). In terms of reproduction, biology and motherhood, people's intuitions might be very different. In addition, there are several ways in which biological motherhood can be subdivided that would add complexity to vignettes such as ours. This would make for a fruitful avenue for further research.

In summary, possibilities created by reproductive technology challenge norms and understandings of intrafamilial relationships in a variety of ways. Not least, it seems that the existence of a genetic relationship between Marc and the sperm donor makes respondents *less* likely to say that Marc has reproduced. This is surprising, since we might otherwise think that *more* genetic relatedness between the social father and the offspring would make people more likely to think that the social father has a claim to have reproduced. For example, in discussions of mitochondrial transfer, the fact that a mitochondrial donor *only* transmits mitochondria and no or little nuclear DNA has formed the basis for denying the mitochondrial donor the status of a biological parent. One might wonder what the result would have been if we had included a sister as a mitochondrial donor in our vignettes: would that have made participants less likely to say that Maria has reproduced? This remains to be seen in further studies.

X Kristien Hens @kristienhens and Anna Smajdor @acsmajdor

Contributors KH, AS and DC initiated the study and designed the vignettes. KH collected the data. EM did the statistical analysis. All authors (KH, EM, AS, DC) contributed substantially to the content, approved the final submission, and take responsibility for the content.

Funding This study was funded by Marcus och Amalia Wallenbergs Minnesfond (MAW2020.0074).

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

ORCID iDs
Kristien Hens http://orcid.org/0000-0003-1062-7918
Anna Smajdor http://orcid.org/0000-0002-9752-6302

REFERENCES

1 Velleman JD. Family History. *Phil Pap* 2005;34:357–78.
2 Cutas D, Smajdor A, *et al*. Duped fathers', 'cuckoo children', and the problem of basing fatherhood on biology: a philosophical analysis. In: Beier K, Brügge C, Thorn P, eds. *Assistierte Reproduktion mit Hilfe Dritter: Medizin - Ethik - Psychologie - Recht*. Berlin, Heidelberg: Springer, 2020: 171–82.
3 Austin MW. *Conceptions of Parenthood: Ethics and the Family*. London: Routledge, 2016.
4 Ives J, Draper H. Appropriate methodologies for empirical bioethics: it's all relative. *Bioethics* 2009;23:249–58.
5 Ives J. Theorising the 'deliberative father': compromise, progress and striving to do fatherhood well. *Fam Relatsh Soc* 2015;4:281–94.
6 Ives J. Framing fatherhood: the ethics and philosophy of researching fatherhoods. In: Gatrell C, Dermott E, eds. *Fathers, Families and Relationships: Researching Everyday Lives*. Bristol University Press, 2018: 11–30. Available: https://doi.org/10.46692/9781447331483.002
7 De Proost M, Coene G, Nekkebroeck J, *et al*. 'At least I have done something': A qualitative study of women's social egg freezing experiences. *Clin Ethics* 2022;17:425–31.
8 Pérez-Hernández Y, De Proost M. Egg freezing, genetic relatedness, and motherhood: A binational empirical bioethical investigation of women's views. *Bioethics* 2024;38:592–9.
9 Archard DW, Benatar D. *Procreation and Parenthood: The Ethics of Bearing and Rearing Children*. Oxford: Oxford university press, 2010.
10 Kostenzer J, de Bont A, van Exel J. Women's viewpoints on egg freezing in Austria: an online Q-methodology study. *BMC Med Ethics* 2021;22:4.
11 Cannold L. Women, Ectogenesis and Ethical Theory. *J Applied Philosophy* 1995;12:55–64.
12 Wittgenstein L, Anscombe GEM, Hacker PMS, *et al*. *Philosophische Untersuchungen: = Philosophical Investigations. Rev. 4. ed*. Chichester, West Sussex, U.K Malden, MA: Wiley-Blackwell, 2010.

13 "Moral theorizing and intuition pumps; or, should we worry about people" by James McBain. Available: https://digitalcommons.pittstate.edu/phil_faculty/37/ [Accessed 15 Dec 2023].
14 Earp BD, Lewis J, Dranseika V, *et al*. Experimental philosophical bioethics and normative inference. *Theor Med Bioeth* 2021;42:91–111.
15 Machery E, Stich S, Rose D, *et al*. Gettier Across Cultures1. *Noûs* 2017;51:645–64.
16 Cova F, Garcia A, Liao S. Experimental Philosophy of Aesthetics. *Philos Compass* 2015;10:927–39.
17 Alexander J. *Experimental Philosophy: An Introduction*. Polity, 2012.
18 De Block A, Hens K. A plea for an experimental philosophy of medicine. *Theor Med Bioeth* 2021;42:81–9.
19 Hens K, De Black A, eds. *Advances in Experimental Philosophy of Medicine*. London: Bloomsbury Academic, 2023.
20 Smajdor A. Why bother the public? A critique of Leslie Cannold's empirical research on ectogenesis. *Theor Med Bioeth* 2021;42:155–68.
21 Palan S, Schitter C. Prolific.ac—A subject pool for online experiments. *J Behav Exp Finance* 2018;17:22–7.
22 Locke J. *The Second Treatise on Civil Government*. New York: Prometheus, 1986.

Appendix: test results (ANOVA + Tukey)

Tests performed in SPSS in December 2023

ANOVA 1

Formulation_cat			Sum of Squares	df	Mean Square	F	**Sig.**
Reproduce	Mary	Between Groups	,734	2	,367	1,341	**,265**
		Within Groups	39,698	145	,274		
		Total	40,432	147			
	Marc	Between Groups	1,247	2	,623	,524	**,593**
		Within Groups	172,510	145	1,190		
		Total	173,757	147			
	Donor	Between Groups	,844	2	,422	,799	**,452**
		Within Groups	76,581	145	,528		
		Total	77,426	147			
	Doctor	Between Groups	3,979	2	1,990	1,296	**,277**
		Within Groups	222,582	145	1,535		
		Total	226,561	147			
Parent	Mary	Between Groups	,032	2	,016	,064	**,938**
		Within Groups	35,779	145	,247		

		Total	35,811	147			
	Marc	Between Groups	14,947	2	7,474	4,439	**,013**
		Within Groups	244,100	145	1,683		
		Total	259,047	147			
	Donor	Between Groups	20,007	2	10,004	5,958	**,003**
		Within Groups	243,473	145	1,679		
		Total	263,480	147			
	Doctor	Between Groups	,194	2	,097	,691	**,503**
		Within Groups	20,367	145	,140		
		Total	20,561	147			
Child	Mary	Between Groups	,338	2	,169	1,055	**,351**
		Within Groups	23,873	149	,160		
		Total	24,211	151			
	Marc	Between Groups	25,580	2	12,790	7,339	**<,001**
		Within Groups	259,683	149	1,743		
		Total	285,263	151			
	Donor	Between Groups	41,075	2	20,537	14,515	**<,001**
		Within Groups	210,820	149	1,415		
		Total	251,895	151			

	Doctor	Between Groups	,482	2	,241	,986	**,375**
		Within Groups	36,406	149	,244		
		Total	36,888	151			

Multiple Comparisons 1

Tukey HSD

Formulation_Cat	Dependent Var.	(I) Genetic_cat	(J) Genetic_cat	Mean Difference (I-J)	Std. Error	**Sig.**	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Reproduce	Mary	Unrelated	Brother	-,14286	,10571	**,369**	-,3932	,1075
			Twin	,01265	,10518	**,992**	-,2364	,2617
		Brother	Unrelated	,14286	,10571	**,369**	-,1075	,3932
			Twin	,15551	,10518	**,304**	-,0936	,4046
		Twin	Unrelated	-,01265	,10518	**,992**	-,2617	,2364
			Brother	-,15551	,10518	**,304**	-,4046	,0936
	Marc	Unrelated	Brother	,14286	,22036	**,794**	-,3790	,6647
			Twin	,22163	,21926	**,571**	-,2976	,7408
		Brother	Unrelated	-,14286	,22036	**,794**	-,6647	,3790
			Twin	,07878	,21926	**,931**	-,4404	,5980
		Twin	Unrelated	-,22163	,21926	**,571**	-,7408	,2976
			Brother	-,07878	,21926	**,931**	-,5980	,4404
	Donor	Unrelated	Brother	-,18367	,14682	**,425**	-,5314	,1640
			Twin	-,11510	,14609	**,711**	-,4610	,2308
		Brother	Unrelated	,18367	,14682	**,425**	-,1640	,5314

			Twin	,06857	,14609	**,886**	-,2774	,4145
		Twin	Unrelated	,11510	,14609	**,711**	-,2308	,4610
			Brother	-,06857	,14609	**,886**	-,4145	,2774
	Doctor	Unrelated	Brother	-,04082	,25031	**,985**	-,6336	,5519
			Twin	,32449	,24905	**,396**	-,2653	,9143
		Brother	Unrelated	,04082	,25031	**,985**	-,5519	,6336
			Twin	,36531	,24905	**,310**	-,2245	,9551
		Twin	Unrelated	-,32449	,24905	**,396**	-,9143	,2653
			Brother	-,36531	,24905	**,310**	-,9551	,2245
Parent	Mary	Unrelated	Brother	,02000	,09935	**,978**	-,2153	,2553
			Twin	-,01583	,10038	**,986**	-,2535	,2219
		Brother	Unrelated	-,02000	,09935	**,978**	-,2553	,2153
			Twin	-,03583	,10038	**,932**	-,2735	,2019
		Twin	Unrelated	,01583	,10038	**,986**	-,2219	,2535
			Brother	,03583	,10038	**,932**	-,2019	,2735
	Marc	Unrelated	Brother	,42000	,25950	**,241**	-,1945	1,0345
			Twin	,78000*	,26218	**,010**	,1591	1,4009
		Brother	Unrelated	-,42000	,25950	**,241**	-1,0345	,1945
			Twin	,36000	,26218	**,358**	-,2609	,9809
		Twin	Unrelated	-,78000*	,26218	**,010**	-1,4009	-,1591
			Brother	-,36000	,26218	**,358**	-,9809	,2609
	Donor	Unrelated	Brother	-,56000	,25916	**,082**	-1,1737	,0537
			Twin	-,89250*	,26185	**,002**	-1,5126	-,2724
		Brother	Unrelated	,56000	,25916	**,082**	-,0537	1,1737
			Twin	-,33250	,26185	**,415**	-,9526	,2876
		Twin	Unrelated	,89250*	,26185	**,002**	,2724	1,5126

			Brother	,33250	,26185	**,415**	-,2876	,9526
	Doctor	Unrelated	Brother	,06000	,07496	**,703**	-,1175	,2375
			Twin	-,02667	,07573	**,934**	-,2060	,1527
		Brother	Unrelated	-,06000	,07496	**,703**	-,2375	,1175
			Twin	-,08667	,07573	**,488**	-,2660	,0927
		Twin	Unrelated	,02667	,07573	**,934**	-,1527	,2060
			Brother	,08667	,07573	**,488**	-,0927	,2660
Child	Mary	Unrelated	Brother	-,05686	,07966	**,756**	-,2455	,1317
			Twin	,05882	,07927	**,739**	-,1288	,2465
		Brother	Unrelated	,05686	,07966	**,756**	-,1317	,2455
			Twin	,11569	,07966	**,317**	-,0729	,3043
		Twin	Unrelated	-,05882	,07927	**,739**	-,2465	,1288
			Brother	-,11569	,07966	**,317**	-,3043	,0729
	Marc	Unrelated	Brother	,92275*	,26274	**,002**	,3008	1,5447
			Twin	,80392*	,26143	**,007**	,1850	1,4228
		Brother	Unrelated	-,92275*	,26274	**,002**	-1,5447	-,3008
			Twin	-,11882	,26274	**,893**	-,7408	,5032
		Twin	Unrelated	-,80392*	,26143	**,007**	-1,4228	-,1850
			Brother	,11882	,26274	**,893**	-,5032	,7408
	Donor	Unrelated	Brother	-1,23647*	,23673	**<,001**	-1,7969	-,6760
			Twin	-,88235*	,23556	**<,001**	-1,4400	-,3247
		Brother	Unrelated	1,23647*	,23673	**<,001**	,6760	1,7969
			Twin	,35412	,23673	**,296**	-,2063	,9145
		Twin	Unrelated	,88235*	,23556	**<,001**	,3247	1,4400
			Brother	-,35412	,23673	**,296**	-,9145	,2063
	Doctor	Unrelated	Brother	-,06196	,09838	**,804**	-,2949	,1709

			Twin	-,13725	,09789	**,342**	-,3690	,0945
		Brother	Unrelated	,06196	,09838	**,804**	-,1709	,2949
			Twin	-,07529	,09838	**,725**	-,3082	,1576
		Twin	Unrelated	,13725	,09789	**,342**	-,0945	,3690
			Brother	,07529	,09838	**,725**	-,1576	,3082

ANOVA 2

Genetic_cat			Sum of Squares	df	Mean Square	F	**Sig.**
Unrelated	Mary	Between Groups	1,760	2	,880	3,873	**,023**
		Within Groups	33,413	147	,227		
		Total	35,173	149			
	Marc	Between Groups	134,747	2	67,374	47,663	**<,001**
		Within Groups	207,793	147	1,414		
		Total	342,540	149			
	Donor	Between Groups	90,820	2	45,410	34,649	**<,001**
		Within Groups	192,653	147	1,311		
		Total	283,473	149			
	Doctor	Between Groups	40,380	2	20,190	36,613	**<,001**
		Within Groups	81,060	147	,551		
		Total	121,440	149			
Brother	Mary	Between Groups	,399	2	,200	,881	**,416**
		Within Groups	33,051	146	,226		
		Total	33,450	148			
	Marc	Between Groups	91,377	2	45,689	29,301	**<,001**

		Within Groups	227,656	146	1,559		
		Total	319,034	148			
	Donor	Between Groups	56,307	2	28,154	27,811	**<,001**
		Within Groups	147,800	146	1,012		
		Total	204,107	148			
	Doctor	Between Groups	43,297	2	21,649	31,002	**<,001**
		Within Groups	101,951	146	,698		
		Total	145,248	148			
Twin	Mary	Between Groups	1,892	2	,946	4,200	**,017**
		Within Groups	32,887	146	,225		
		Total	34,779	148			
	Marc	Between Groups	71,116	2	35,558	21,555	**<,001**
		Within Groups	240,844	146	1,650		
		Total	311,960	148			
	Donor	Between Groups	27,539	2	13,769	10,557	**<,001**
		Within Groups	190,421	146	1,304		
		Total	217,960	148			
	Doctor	Between Groups	16,301	2	8,151	12,352	**<,001**
		Within Groups	96,343	146	,660		
		Total	112,644	148			

Multiple Comparisons 2

Tukey HSD

Genetic_cat	Dependent Variable	(I) Formulation_cat	(J) Formulation_cat	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Unrelated	Mary	Reproduce	Parent	-,24735*	,09584	**,029**	-,4743	-,0204
			Child	-,21048	,09537	**,073**	-,4363	,0153
		Parent	Reproduce	,24735*	,09584	**,029**	,0204	,4743
			Child	,03686	,09488	**,920**	-,1878	,2615
		Child	Reproduce	,21048	,09537	**,073**	-,0153	,4363
			Parent	-,03686	,09488	**,920**	-,2615	,1878
	Marc	Reproduce	Parent	-2,19837*	,23900	**<,001**	-2,7642	-1,6325
			Child	-1,78111*	,23783	**<,001**	-2,3442	-1,2180
		Parent	Reproduce	2,19837*	,23900	**<,001**	1,6325	2,7642
			Child	,41725	,23662	**,186**	-,1430	,9775
		Child	Reproduce	1,78111*	,23783	**<,001**	1,2180	2,3442
			Parent	-,41725	,23662	**,186**	-,9775	,1430
	Donor	Reproduce	Parent	1,82490*	,23012	**<,001**	1,2800	2,3698
			Child	1,42137*	,22901	**<,001**	,8792	1,9636
		Parent	Reproduce	-1,82490*	,23012	**<,001**	-2,3698	-1,2800
			Child	-,40353	,22783	**,183**	-,9430	,1359
		Child	Reproduce	-1,42137*	,22901	**<,001**	-1,9636	-,8792
			Parent	,40353	,22783	**,183**	-,1359	,9430
	Doctor	Reproduce	Parent	1,08449*	,14927	**<,001**	,7311	1,4379
			Child	1,12645*	,14855	**<,001**	,7747	1,4782
		Parent	Reproduce	-1,08449*	,14927	**<,001**	-1,4379	-,7311
			Child	,04196	,14779	**,957**	-,3080	,3919
		Child	Reproduce	-1,12645*	,14855	**<,001**	-1,4782	-,7747
			Parent	-,04196	,14779	**,957**	-,3919	,3080

Brother	Mary	Reproduce	Parent	-,08449	,09564	**,652**	-,3110	,1420
			Child	-,12449	,09564	**,397**	-,3510	,1020
		Parent	Reproduce	,08449	,09564	**,652**	-,1420	,3110
			Child	-,04000	,09516	**,907**	-,2653	,1853
		Child	Reproduce	,12449	,09564	**,397**	-,1020	,3510
			Parent	,04000	,09516	**,907**	-,1853	,2653
	Marc	Reproduce	Parent	-1,92122*	,25101	**<,001**	-2,5156	-1,3269
			Child	-1,00122*	,25101	**<,001**	-1,5956	-,4069
		Parent	Reproduce	1,92122*	,25101	**<,001**	1,3269	2,5156
			Child	,92000*	,24974	**<,001**	,3286	1,5114
		Child	Reproduce	1,00122*	,25101	**<,001**	,4069	1,5956
			Parent	-,92000*	,24974	**<,001**	-1,5114	-,3286
	Donor	Reproduce	Parent	1,44857*	,20225	**<,001**	,9697	1,9275
			Child	,36857	,20225	**,166**	-,1103	,8475
		Parent	Reproduce	-1,44857*	,20225	**<,001**	-1,9275	-,9697
			Child	-1,08000*	,20123	**<,001**	-1,5565	-,6035
		Child	Reproduce	-,36857	,20225	**,166**	-,8475	,1103
			Parent	1,08000*	,20123	**<,001**	,6035	1,5565
	Doctor	Reproduce	Parent	1,18531*	,16798	**<,001**	,7876	1,5831
			Child	1,10531*	,16798	**<,001**	,7076	1,5031
		Parent	Reproduce	-1,18531*	,16798	**<,001**	-1,5831	-,7876
			Child	-,08000	,16713	**,881**	-,4757	,3157
		Child	Reproduce	-1,10531*	,16798	**<,001**	-1,5031	-,7076
			Parent	,08000	,16713	**,881**	-,3157	,4757
Twin	Mary	Reproduce	Parent	-,27583*	,09590	**,013**	-,5029	-,0487
			Child	-,16431	,09445	**,194**	-,3880	,0593

		Parent	Reproduce	,27583*	,09590	**,013**	,0487	,5029
			Child	,11152	,09544	**,474**	-,1145	,3375
		Child	Reproduce	,16431	,09445	**,194**	-,0593	,3880
			Parent	-,11152	,09544	**,474**	-,3375	,1145
	Marc	Reproduce	Parent	-1,64000*	,25954	**<,001**	-2,2545	-1,0255
			Child	-1,19882*	,25561	**<,001**	-1,8041	-,5936
		Parent	Reproduce	1,64000*	,25954	**<,001**	1,0255	2,2545
			Child	,44118	,25829	**,206**	-,1704	1,0528
		Child	Reproduce	1,19882*	,25561	**<,001**	,5936	1,8041
			Parent	-,44118	,25829	**,206**	-1,0528	,1704
	Donor	Reproduce	Parent	1,04750*	,23077	**<,001**	,5011	1,5939
			Child	,65412*	,22729	**,013**	,1159	1,1923
		Parent	Reproduce	-1,04750*	,23077	**<,001**	-1,5939	-,5011
			Child	-,39338	,22966	**,204**	-,9372	,1504
		Child	Reproduce	-,65412*	,22729	**,013**	-1,1923	-,1159
			Parent	,39338	,22966	**,204**	-,1504	,9372
	Doctor	Reproduce	Parent	,73333*	,16415	**<,001**	,3446	1,1220
			Child	,66471*	,16167	**<,001**	,2819	1,0475
		Parent	Reproduce	-,73333*	,16415	**<,001**	-1,1220	-,3446
			Child	-,06863	,16336	**,907**	-,4554	,3182
		Child	Reproduce	-,66471*	,16167	**<,001**	-1,0475	-,2819
			Parent	,06863	,16336	**,907**	-,3182	,4554