

## Ectogenesis. Beyond Traditional Parenthood, Within the Future Scenarios of Technology

Debora Viviani<sup>a</sup>

### Abstract

Ectogenesis recreates the entire gestation process inside an artificial womb, allowing it to take place outside the body. This technique, in line with other reproductive techniques (Medically Assisted Reproduction and Surrogacy), requires a new interpretation of motherhood and parenthood, even in symbolic terms, but also raises doubts about the boundaries of human physicality.

This article presents an analysis of some data from the research project “Medically assisted reproduction, surrogacy, artificial wombs: new ethical and socio-cultural challenges,” part of the PRIN 2022 project *“Genetic identity and child’s status in the era of medically assisted procreation”*.

Through the analysis of data collected via CAWI administration of 890 questionnaires to men and women over the age of 25, this study aims to understand the social imaginary surrounding reproductive techniques, particularly about the use of ectogenesis.

As highlighted by the results, the analysis focuses on the transformations linked to parenthood, the figures and roles of father and mother, and the body-technique relationship.

Data analysis shows that the traditional resistance that reproductive techniques have always generated seems to have diminished somewhat (Di Nicola et al., 2018). There is undoubtedly still a fear of pregnancy moving into the realm of the artificial, created not to eliminate unforeseen events or health problems, but which raises doubts about the outcome of this process, which could make the birth of a child completely artificial, from conception, with genetic selection, to childbirth.

Keywords: ectogenesis, reproductive techniques, parenthood, social imaginary.

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## 1. Ectogenesis, or artificial womb: between biology and the imaginary

After the contraceptive pill, Medically Assisted Reproduction, first homologous and then heterologous, and surrogacy have made conception possible for those (couples or individuals) who, for whatever reason<sup>1</sup>, are unable to conceive a child naturally, and have allowed greater control over the gestation process.

With the development and spread of these reproductive techniques, the birth of a child is increasingly detached from a completely natural scenario, reshaping the traditional model of parenthood, which ceases to be the only one possible<sup>2</sup>. Even in their symbolic meanings, Motherhood and parenthood are reinterpreted considering new technologies.

Parenting is no longer completely and exclusively linked to biology. Still, in various historical and social contexts, different ways of becoming and being a father and mother have emerged, leading to a clash of paradigms. The traditional image of the mother is now accompanied by figures such as the genetic mother and the surrogate mother, to name a few. Similarly, the conventional figure of the father can be divided into the social father and the genetic father.

This complexity has led to a clash, albeit symbolic, between those who believe it is necessary to remain tied to the traditional model and those who, on the contrary, argue that every new possibility offered by technology is not only helpful but should be supported (Bulletti & Flamigni, 2017).

We are all born from a woman's body; there is no birth without pregnancy and childbirth. Only the female body can procreate, to divide itself while maintaining its uniqueness, and to bring a child into the world that it will care for completely, with a natural inclination toward nurturing (Filippini, 2017; Grilli, 2023; Prasad, 2015).

Starting with the questioning of the instinct to procreate and care for children attributed to mothers (Badinter, 1981; Viviani, 2025), with the introduction of assisted reproduction techniques, the role of women and their bodies appears to be less stable, less defined, and more controversial.

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<sup>1</sup> Infertility, but also, in the case of same-sex couples, limitations related to their sexuality.

<sup>2</sup> In Italy, Law 169/2024 prohibits surrogacy, which is considered a universal crime, punishable even if committed abroad. About Medically Assisted Reproduction, the 18th Activity Report of the Italian National Register of Medically Assisted Procreation, published in 2024, highlights that in Italy, in 2022, 87,192 couples turned to ART, with 109,755 treatment cycles initiated (in 2019, there were 99,062). Of these, 86.2% (94,624) used the couple's gametes and 13.8% (15,131) used donated gametes.

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Over time, thanks in part to reproductive technologies, a rift has emerged in the very concept of motherhood, understood as both a role and a physical condition. Even in interdisciplinary reflections on parenthood, this split has transformed parenthood from a cultural, symbolic, and even legal standpoint (Cordiano, 2023; Clarizia et al., 2024). The biological paradigm is being challenged by scientific advances, which also concern the possible genetic manipulation of individuals, significantly influencing the boundaries of physicality.

Ectogenesis<sup>3</sup> is undoubtedly an example of how the process of procreation and parenthood has now crossed and blurred the boundaries of physicality.

The term ectogenesis, which in its Greek etymological origin derives from *ecto* (outside) and *genesis* (birth, origin), was coined in 1924 by the English biologist and geneticist John B.S. Haldane, who used the term during a conference to describe technology capable of developing human embryos outside the female body, from fertilization to birth (Atlan, 2006; Balistreri, 2016).

In 1954, US researcher Emanuel M. Greenberg filed a patent application for an “artificial womb,” obtaining the patent in 1955. Greenberg’s design involved maintaining the fetus at body temperature, accessing oxygen and nutrients, and eliminating waste products. The artificial womb designed by Greenberg, therefore, simulated the functions of the maternal womb.

With heterologous Medically Assisted Reproduction and surrogacy, even though the fertilization of the female egg with sperm is prepared in the laboratory, the implantation of the fertilized egg in the female womb remains a necessary condition for the embryo to develop until birth. With ectogenesis, this last necessary and indisputable step ceases to be decisive for birth. An artificial womb allows the entire gestation process to be recreated inside an artificial incubator<sup>4</sup>.

There is no doubt that, while scientific and medical discoveries have complicated the redefinition of the process of procreation and the roles of those involved, the possible introduction of ectogenesis has further social and cultural implications, as it allows for a completely reversed view of human existence (Atlan, 2006; Balistreri, 2016, 2017; Bulletti & Flamigni, 2017).

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<sup>3</sup> The artificial womb is a technique expressly prohibited by Law 40, Article 13, paragraph 3, letter c, because it refers to the manipulation and experimentation on human embryos (Cordiano & Parini, 2024).

<sup>4</sup> Today, it is already possible to gestate outside the mother’s body until the fifth day and from the twenty-fourth week until birth. The complete process of ectogenesis would fill the period between the fifth day and the twenty-fourth week. (Atlan, 2006).

If contraception has enabled the separation of reproduction and sexuality, and if Medically Assisted Reproduction and surrogacy have enabled the separation of reproduction and fertilization from sexuality, then the artificial womb separates pregnancy from sexuality, separating pregnancy and procreation from physicality (Atlan, 2006).

In this scenario, like an artifact, the child born would become a biological artifact.

Ectogenesis would seem to bring gestation closer to the design of artificial humans.

## **2. Research design and methodology used**

Within this complex scenario, the results of part of the research project “Medically assisted procreation, surrogacy, artificial womb: new ethical and socio-cultural challenges” will be presented here. The study is part of the PRIN 2022 project “Genetic identity and child’s status in the era of medically assisted procreation,” which involves three Italian universities: University of Cassino and Lazio Meridionale, University of Napoli Federico II, and University of Verona.

Specifically, the team from the local unit at the University of Verona consisted of me, Giorgia Anna Parini (Principal Investigator – Department of Legal Sciences), Alessandra Cordiano (Department of Legal Sciences), and Alberto Turco (Department of Neuroscience, Biomedicine, and Movement).

The quantitative survey, some of whose data are presented in this article, was carried out in collaboration with Paola Di Nicola (University of Verona). The study involved the administration of 890 questionnaires using CAWI (Computer Assisted Web Interviewing) technology to a sample of subjects (49.7% men and 50.1% women)<sup>5</sup> over the age of 25. The sample is random and non-representative (sampled by geographical area). The questionnaires were administered by Adacta International Consumer & Sensory Science between December 2024 and January 2025.

Without claiming to resolve and answer all the questions raised by Medically Assisted Reproduction, surrogacy, or the possible use of artificial wombs, the study nevertheless attempted to gauge the ideas and opinions that Italians have on these issues.

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<sup>5</sup> 0.2% indicated the alternative “other.” This percentage corresponds to two subjects. Given the low number, this value was included among the missing data.

The survey aimed to identify new cultural perspectives on motherhood, fatherhood, parenthood, and the body that are being produced (concretely and potentially) by reproductive technologies.

For this reason, as in previous studies (Di Nicola et al., 2018), we decided to use social imaginary (Taylor, 2005; Durand, 2022) as an analytical framework for the survey.

The research was conceived to design and understand the social imaginary that takes shape with the development of these procreation techniques and that shapes the actions of the subjects involved in the study. As a composition of knowledge, ideologies, and common wisdom, the social imaginary allows individuals to make choices guided by this knowledge and these values (Taylor, 2005). This is not abstract logic but the consequence of real and concrete facts that take shape from experience and tradition (Durand, 2022).

Through the social imaginary, whose composition changes over time due to the knowledge conveyed by sources of information, the subject can make choices. These choices draw on the world of values, experience, and knowledge that shape the imaginary and inform practices (Taylor, 2005; Durand, 2022).

By studying social imaginary, it is possible to understand how the individuals involved position themselves on the thematic issues that arise and what practices need to be implemented.

The innovations emerging from all these techniques concern the relationships formed based on genetic descent, on a personal level, and on a legal level, involving the body and the choices related to it in the stages of procreation, gestation, and birth. This last aspect brings up ideas like control, freedom of choice, and the contrast between natural and artificial, with the possible unpredictability of the first and the concept of perfection in the second.

Part of the questionnaire focused on these aspects, starting with reflections on the artificial womb.

In particular, one question asked respondents to express their degree of agreement or disagreement with certain statements regarding the introduction and use of artificial wombs. The question was designed to investigate the respondents' position on certain statements that outlined possible future scenarios and were built around important issues.

1. Parenthood. The artificial womb undermines the archetype of parenting. The figure of the woman/mother, as Mother Goddess, and the father's role, as creator and protector of the family, are changing. The mother may be someone who does not give birth or conceive a child, while the father may be someone who donates his sperm but does not raise the child (Di Nicola, 2021). While these transformations had already been brought about by Medically Assisted Reproduction and surrogacy, the artificial womb eliminates the body-pregnancy link. In

this case, the social imaginary associated with conception, gestation, and birth is changing and enriched with new narratives. The traditional images of mother and father, of family, are being overcome, as families can now be created without the involvement of the physicality of a man and a woman throughout the entire process from conception to birth. The lack of connection with the parents' bodies, primarily with the mother's body, can mean that this delicate moment of gestation can be controlled. At the same time, if the psycho-affective dimension of the fetus is also constructed during gestation through the mother-child bond, the lack of this bond could have effects in this sense.

2. The intervention of technology. Undoubtedly, the issue of risks to the fetus has been raised in the past about early in vitro fertilization techniques, and the same could happen with the use of artificial wombs. However, the results obtained in the former case over time give hope that any problems that may arise with artificial wombs can be overcome. Furthermore, the use of the artificial womb would make it easier to make genetic corrections and modifications to the fetus that is not in the mother's womb, also making pregnancy safer from the point of view of the mother's health. There is no doubt that when it comes to the artificial womb, the undisputed protagonist is technology, its power to recreate the period of gestation and, consequently, the different position assumed by the woman's body, which is no longer central to the growth of the fetus. The critical protective function assigned to the female womb about the fetus, which symbolizes the protection recognized to women in their role as mothers in the growth of their children, disappears. Not only that. Entrusting gestation to technology allows for continuous monitoring of the gestation process, anticipating and therefore avoiding the onset of possible genetic diseases, controlling every slightest change in the gestation process, and thus eliminating the appearance of any problems. This contributes to increasing the importance of doctors (and medicine) in procreation and childbirth, to the point that we can talk about "medicine of desire" (Filippini, 2017): a "medicine of desire" that, in addition to fulfilling the dream of having a child and providing greater control, in terms of health, over the entire process leading up to birth, can also bring economic benefits, with the emergence of a veritable industry of fertilization and, at this point, of birth.

The data analysis discussed here will follow the items included in the questionnaire, seeking to identify the social imaginary that emerges from the responses of the research participants about these topics.

### 3. Data analysis

As mentioned above, one question in the questionnaire sought to investigate how respondents view the transformations that ectogenesis could bring about in terms of family context, the use of technology in pregnancy for prevention and control purposes, the emotional bond between mother and child, and possible future scenarios that the use of this technology could bring about in terms of costs and power. To do this, 13 items were introduced, each of which respondents had to rate their agreement or disagreement on a scale of 1 to 10.

The items were. With the artificial womb:

1. Women would finally be freed from the biblical curse: You will give birth in pain.
2. Women could freely decide to have a child, even if they do not want to become pregnant or do not want to remain pregnant.
3. Men could freely decide when to have a child, regardless of age, marital status, employment status, or sexual orientation.
4. Pregnancy would be monitored more accurately and precisely to protect the fetus.
5. The psycho-social-emotional and relational development of the fetus would not be affected.
6. The choice of gametes to be used could be very accurate and precise regarding gender and physical, behavioral, and health characteristics.
7. The children would be the result of design: one could effectively speak of “test-tube babies”.
8. There is a high probability that the “chosen” children will have very similar physical and behavioural characteristics. There is a substantial risk that a class of superior, “elected” children will emerge.
9. The question arises as to “who controls” this technology.
10. The more sophisticated and expensive the technologies are, the greater the likelihood that the controllers will be multinational companies working for profit.
11. The more sophisticated and expensive the technologies are, the higher the chances that only the wealthy will have access to them.
12. At present, and perhaps even in the coming years, we will still not know what these children will be like.
13. The artificial womb is an ethical choice because it allows us to intervene in the genetic code and correct any abnormalities.

Before proceeding with a detailed analysis of the data collected for these items, it is interesting to note that the correlation between them, although moderate, with Pearson values within the range 0.3-0.7 (Ratner, 2009), divides

the items into two parts. The first part includes six items, while the second contains 7 to 13.

Although within the Pearson index values, which, as mentioned above, indicate a moderate correlation (Ratner, 2009), the highest values are recorded between item 2 “*Women could freely decide to have a child, even if they do not want to become pregnant or do not want to remain pregnant*” and item 3 “*Men could freely decide when to have a child, regardless of age, marital status, employment status, or sexual orientation*” (0.602) and between item 10 “*The more sophisticated and expensive the technologies are, the greater the likelihood that the controllers will be multinational companies working for profit*” and item 11 “*The more sophisticated and expensive the technologies are, the higher the chances that only the wealthy will have access to them*” (0.673). The latter is correlated with item 9 (0.593) “*The question arises as to ‘who controls’ this technology*” which in turn is correlated (0.549) with item 12 “*At present, and perhaps even in the coming years, we will still not know what these children will be like*”.

As highlighted above, Pearson’s index analysis reveals two correlation clusters. The first cluster includes the first six items, while the second cluster includes the remaining items. It should be noted that the only cross-correlation is item 4, “*Pregnancy would be monitored more accurately and precisely to protect the fetus*” which correlates (0.583) with item 13, “*The artificial womb is an ethical choice because it allows us to intervene in the genetic code and correct any abnormalities*”.

Let us proceed with a detailed analysis of the items in this question.

### **3.1. Parenthood: conceiving a child**

Traditionally, a child is born through childbirth by a woman, after a period of gestation following conception in union with a male body, according to the biological timing of the female body. Since the artificial womb allows gestation outside the mother’s body, the presence of a father, a mother, and their bodies is called into question. While ectogenesis gives men and women greater freedom in choosing to become parents, as they are no longer bound by their physicality, it can also remove the ‘test’ aspect of childbirth, through which women measured their own worth, their ability to endure pain, and face fear. A test that healed the original sin attributed to Eve in the Bible.

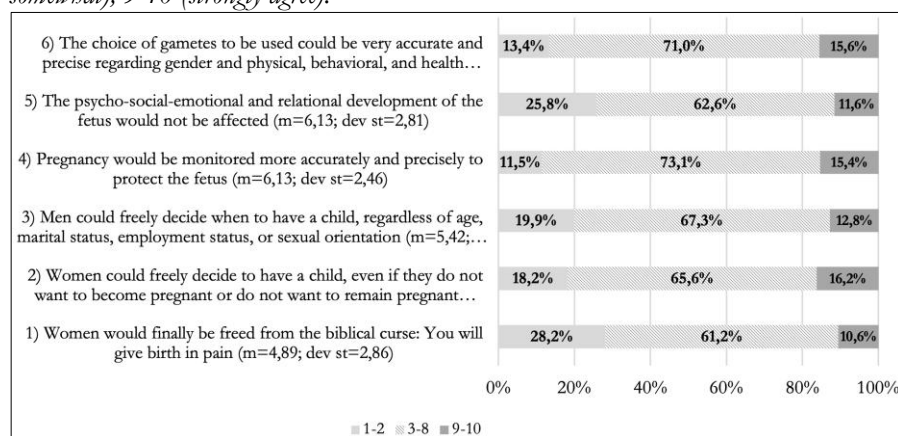
At the same time, ectogenesis offers the possibility of intervening in the choice of gametes to guarantee a specific type of “result,” both in terms of the child’s health (eliminating genetic problems) and in terms of its behavioral and physical characteristics, with continuous monitoring of the growth and development of the fetus.

Figure 1 shows the percentages relating to the degree of disagreement and agreement expressed by the study participants, referring to the first six items.



To analyze the data, the 1-10 scale was divided into three levels: values 1-2 (*strongly disagree*), values 3-8 (*somewhat disagree to agree somewhat*), and values 9-10 (*strongly agree*). This way, we sought to identify polarized, dichotomous positions, eliminating those who fell into intermediate positions<sup>6</sup>.

Figure 1. On a scale of 1 to 10 (1 = *strongly disagree* and 10 = *strongly agree*), how much do you agree with the following statements? With the artificial womb: (for the analysis, the values are grouped into three levels: 1-2 (*strongly disagree*), 3-8 (*somewhat disagree to agree somewhat*); 9-10 (*strongly agree*)).



The average values (m) and standard deviation (sd) for each item are indicated in parentheses.

In general, the items that show the highest degree of disagreement expressed by respondents are item 1, “*Women would finally be freed from the biblical curse: You will give birth in pain,*” and item 5, “*The psycho-social-emotional and relational development of the fetus would not be affected*”. Specifically, in the first case, 28.2% assigned minimum values (1-2), and in the second case, 25.8% did so.

For the same items, at the opposite end of the spectrum (values 9-10 – total agreement), we find 10.6% and 11.6%.

About item 1, it is mainly women ( $p < 0.05$ ) who disagree with this statement. In fact, 32.7% of women (23.8% of men) indicate values between 1 and 2 (*strongly disagree*), and 43.7% of women indicate values between 1 and 4 (*strongly disagree or disagree*).

<sup>6</sup> If relevant for the analysis, the values will also be divided into 1-4 (*strongly disagree or disagree*), 5-6 (*agree*), and 7-10 (*strongly agree or agree*). In this case, polarised positions do not emerge, but rather levels of disagreement or agreement on a larger scale.

The relationship between this item and age<sup>7</sup> ( $p < 0.01$ ) and the presence or absence of children in the family ( $p < 0.05$ ) is also significant.

As age increases, so does the degree of disagreement with this statement (values 1-2): 17.6% (31-40 years old), 32.5% (41-50 years old), 27.6% (51-60 years old), and 34.5% (over 61 years old). Among younger people, there are similar percentages between those who disagree (values 1-2) (14.9%) and those who totally agree (values 9-10) (17%).

Regarding whether or not they have experienced parenthood, 31.3% of those with children disagree with this statement (values 1-2). Among those who do not have children, 23.1% chose these values.

The two extreme positions have similar percentages about the statement “*Women could freely decide to have a child, even if they do not want to become pregnant*” (item 2), the two extreme positions have similar percentages. 18.2% indicate values 1-2, 16.2% indicate values 9-10. However, if we consider the less extreme division of values (1-4, 5-6, 7-10), we see that 42.1% agree strongly or totally (values 7-10). This means there is consensus on this statement, but it is not polarized on the highest values.

This item shows a particular significance with the age variable ( $p < 0.001$ ). The percentages of those strongly disagree with this item are higher among older people. Values of 1-2 (strongly disagree) are assigned by 22.4% of subjects aged 41-50, 17.3% of those aged 51-60, and 24.8% of those aged 61 or older. Younger people, on the other hand, take a more decisive stance and express complete agreement with this statement. Values of 9-10 are given by 23.4% of those aged 25-30 (4.3% provide values of 1-2) and 16.9% of those aged 31-40 (8.1% give values of 1-2).

The relationship with this item is also significant for the variable marital status ( $p < 0.001$ ) and parenting experience ( $p < 0.01$ ). Married individuals (19.4%), separated individuals (16%), and divorced individuals (36%) disagree (values 1-2) with the idea that artificial wombs would give women more freedom in choosing to conceive a child. On the other hand, 15.3% of single people fully agree with this statement (values 9-10). As for the presence of children in the family, those with children do not agree with this statement (21.2%, values 1-2), while those who do not fully agree (15.3%, values 9-10).

Even for the statement “*Men could freely decide when to have a child, regardless of age, marital status, employment status, or sexual orientation*” (item 3), there are no significant differences between those who indicate complete disagreement and those who indicate complete agreement. 19.9% assign values 1-2, while 12.8% assign values 9-10.

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<sup>7</sup> For the data analysis, the following age groups were established: 25-30 years, 31-40 years, 41-50 years, 51-60 years, and 61 years and older.

About the age of respondents ( $p < 0.01$ ), 21.5% of those aged 41-50, 17.7% of those aged 51-60, and 28.6% of those aged 61 or older expressed total disagreement (values 1-2). The youngest respondents are mainly in the opposite position. Values 9-10 were indicated by 12.8% of 25-30 year olds and 14.2% of 31-40 year olds.

In relation to marital status and parenting experience ( $p < 0.05$ ), those who totally disagree (values 1-2) are married people (21.7%), divorced people (28%), widowed people (40%), and those who have children (23.2%). Respectively, 11.6% of married people, 14% of divorced people, 13.3% of widowed people, and 12.9% of those with children are in the opposite position of total agreement.

The data shown in Figure 1 highlight that even for item 4, "*Pregnancy would be monitored more accurately and precisely to protect the fetus*" there are no particular percentage differences between the two extreme positions of agreement. 11.5% indicate minimum values (1-2) and 15.4% indicate maximum values (9-10). Notably, 10% assign a value of 10 to this item, and the mode corresponds to 7. Considering agreement intervals 1-4, 5-6, and 7-10, about half of the respondents (47.9%) agree strongly or totally with this statement (values 7-10). This indicates a general agreement that does not emerge with an extreme position.

This item has a significant correlation with the age of respondents ( $p < 0.05$ ), their marital status ( $p < 0.05$ ), and whether or not they have children ( $p < 0.05$ ). 10.6% of those aged 25-30, 11.5% aged 31-40, and 19.1% aged 41-50 agree strongly or completely with this statement (values 9-10)<sup>8</sup>. The same idea is shared by 13.2% of single people, 15.4% of married people, and 13.2% of those without children (13.2%).

If we analyze item 5, "*The psycho-social-emotional and relational development of the fetus would not be affected*" a significant correlation emerges with respect to gender and age ( $0.01 < p < 0.001$ ).

Specifically, 20.8% of men and 30.8% of women disagree with this statement (values 1-2). Conversely, 12.4% of men and 10.5% of women express no concern about the psycho-social-emotional and relational development of the fetus and indicate maximum agreement (9-10).

About age, younger people (25-30 years old) are in complete agreement (9-10) (17% compared to 10.6% who disagree). Conversely, as age increases, the ratings are reversed: 31-40 years old (19.6% ratings of 1-2, 8.8% ratings of 9-10), 41-50 years old (27.2% values 1-2, 17.1% values 9-10), 51-60 years old (28.8% values 1-2, 7.4% values 9-10) and 61 years old and over (28.6% values 1-2, 10.7% values 9-10).

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<sup>8</sup> They score minimum values (1-2): 6.4%, 6.1%, and 11.8% respectively.

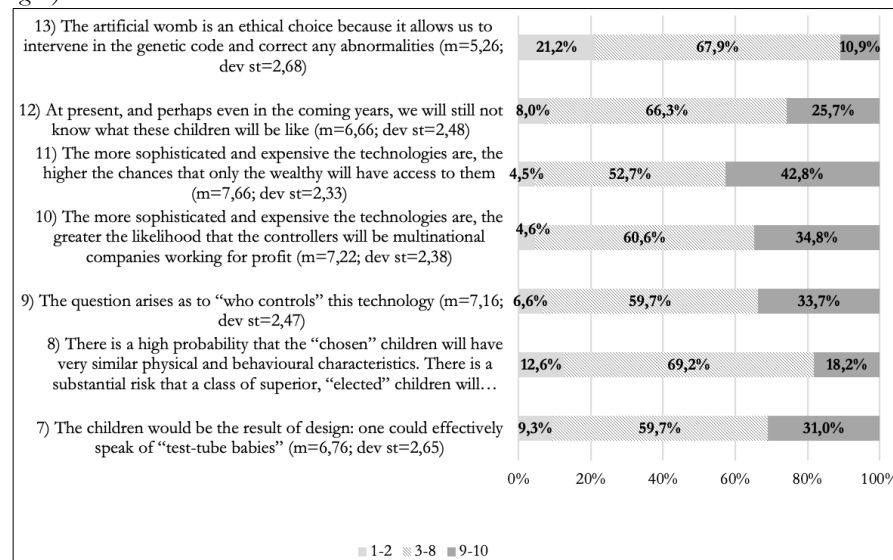
Finally, “*The choice of gametes to be used could be very accurate and precise regarding gender and physical, behavioral, and health characteristics*” (item 6) shows similar percentages in the two extreme positions. 13.4% disagree with this statement, while 15.6% agree.

### 3.2. The intervention of technology: who controls whom?

The other seven items in this question, rated from 1 to 10 (1 = strongly disagree and 10 = strongly agree), ask respondents how much they agree with the following statements. “*With the artificial womb*” is aimed at respondents in an attempt to understand their position about the mechanism of control, selection, and intervention of technology in the gestation of a child.

Figure 2 shows the response percentages indicating the degree of disagreement/agreement.

Figure 2. On a scale of 1 to 10 (1 = strongly disagree and 10 = strongly agree), how much do you agree with the following statements? *With the artificial womb*: (for the analysis, the values are grouped into three levels: 1-2 (strongly disagree), 3-8 (somewhat disagree to agree somewhat); 9-10 (strongly agree)).



The average values (m) and standard deviation (sd) for each item are indicated in parentheses.

Item 7, “*The children would be the result of design: one could effectively speak of ‘test-tube babies’*” has the highest average value (m=6.76). The sample, therefore, falls

around the value 7 on the scale. The analysis of the percentages also confirms this: 31% agree (values 9-10) with this statement. Of these, 21.1% indicate a value of 10, also the mode value. More than half of the respondents (56.6%) agree strongly or fully with this statement (values 7-10).

In this case, there is a significant correlation between the variables gender and whether or not respondents have children ( $p < 0.05$ ).

29.4% of men (6.8% indicate minimum values of 1-2) and 32.5% of women (11.9% indicate minimum values of 1-2) indicate values of 9-10. About whether or not there are children in the family, 33.3% of those with children fully agree with this statement (10.3% disagree).

The hypothesis that the artificial womb could contribute to creating children with similar characteristics (item 8) is fully embraced by 18.2% of the subjects involved in the study. 12.6% assign minimum values (1-2) to this statement. This is confirmed by analyzing responses for the agreement range 7-10. In this case, we find 43.8% of the subjects involved in the study.

21.2% of subjects with children ( $p < 0.01$ ) strongly agree with this statement<sup>9</sup> (12.8% show minimal agreement).

As can be seen in Figure 2, for all subsequent items, study participants express complete agreement, except for items 12 and 13<sup>10</sup>.

The item that received the highest level of agreement was “*The more sophisticated and expensive the technologies are, the higher the chances that only the wealthy will have access to them*” (item 11). In fact, 42.8% gave values between 9 and 10. This is followed by item 10, “*The more sophisticated and expensive the technologies are, the greater the likelihood that the controllers will be multinational companies working for profit*,” and item 9, “*The question arises as to ‘who controls’ this technology*”. The maximum values of 9 and 10 are indicated by 34.8% and 33.7%, respectively.

These three items have the highest average values, respectively  $m=7.66$  (item 11),  $m=7.22$  (item 10), and  $m=7.16$  (item 9).

As highlighted, knowing who will control this technology is essential for respondents because it can represent a problem (item 9). In fact, 24.7% assign the maximum value of 10. In this case, there is a significant relationship with age ( $p < 0.05$ ). In particular, the degree of agreement increases in parallel with the age of the respondents. 21.3% of respondents aged 25-30, 25.7% aged 31-

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<sup>9</sup> This is the case for 13.2% of those without children.

<sup>10</sup> With a significant percentage difference compared to those who strongly disagree (values 1-2).

40, 32.9% aged 41-50, 32.1% aged 50-60, and 45.1% aged 61 and over express complete agreement<sup>11</sup>.

The statement “*The more sophisticated and expensive the technologies are, the greater the likelihood that the controllers will be multinational companies working for profit*” (item 10) is also correlated with the age of the study participants ( $p < 0.01$ ).

As the age of the subjects increases, there is a greater divide between the two extreme positions of agreement (minimum agreement – values 1 and 2, maximum agreement – values 9-10). In fact, the percentages present in the maximum values 9-10 are distributed as follows: 27.7% (25-30 years old, 2.1% indicate values 1-2), 24.3% (31-40 years old, 4.1% indicate 1-2), 35.4% (41-50 years old, 4.5% values 1-2), 33.3% (51-60 years old, 5.8% values 1-2) and 45.1% (61 years old and over, 4.4% values 1-2).

Item 11, “*The more sophisticated and expensive the technologies are, the higher the chances that only the wealthy will have access to them*” is significantly correlated with gender ( $p < 0.05$ ), age ( $p < 0.01$ ), and whether or not respondents have children ( $p < 0.05$ ). In the first case, women agree more than men, even totally (9-10). In fact, about half of women (47.5%) assign maximum values (among men, 38.2% do so<sup>12</sup>).

As in the previous item, the percentage of respondents who agree with this statement increases with age. On the other hand, the rate of respondents who disagree entirely decreases. The data are distributed as follows in the highest values (9-10): 31.9% of those aged 25-30, 31.1% of those aged 31-40, 43.1% of those aged 41-50, 42.8% of those aged 51-60, and 53.4% of those aged 61 and over. Among those with children, 44.2% agree (9-10) with this statement, while 56.9% of those without children take an intermediate position of agreement (values 3-8).

The uncertainty regarding the potential consequences for children born through ectogenesis is an essential issue for more than half of the sample. The statement (item 12) “*At present, and perhaps even in the coming years, we will still not know what these children will be like*” is fully agreed with by 25.7% of respondents, while 8% disagree with this statement (assigning values 1-2).

This item shows a significant correlation with the age of participants ( $p < 0.01$ ) and with the presence of children in the family ( $p < 0.05$ ).

Subjects over 40 are uncertain about the future consequences of ectogenesis. In fact, within the 41-50, 51-60, and 61+ age categories, there is a

<sup>11</sup> Respectively, the opposite position (minimum agreement values, 1-2) is held by 14.9% (25-30 years old), 4.7% (31-40 years old), 7.7% (41-50 years old), 6.2% (51-60 years old) and 5.3% (61 years and over).

<sup>12</sup> Men are mainly in the middle range (3-8). In this case, we find 56.8% of men and 48.4% of women.

significant percentage difference between those who disagree with this item and assign values of 1-2, and those who, on the contrary, fully agree (values 9-10). Respectively, they are:

- 41-50 years old: 11.4% (1-2) and 26.4% (9-10);
- 51-60 years: 7.8% (1-2) and 25.1% (9-10);
- 61 years and over: 5.8% (1-2) and 34% (9-10)<sup>13</sup>.

Those with children in particular agree with this statement. 28.1% indicate agreement values of 9-10.<sup>14</sup>

The data relating to item 13, “*The artificial womb is an ethical choice because it allows us to intervene in the genetic code and correct any abnormalities*” show that the sample does not agree with this statement. 21.2% indicate values 1-2. On the opposite side (values 9-10), we find 10.9%.

The low level of agreement with this statement is confirmed by analyzing the average value (5.26), the weakest among all the items in the question, and the mode value, which is 1. This same value is also obtained from the analysis of item 1, relating to the pain of childbirth, and item 5, on the psycho-social-emotional and relational development of the fetus.

#### 4. Discussion of data

It is essential to make a few observations about the analysis presented here.

First, the subjects involved generally have a relatively straightforward social imaginary of using the artificial womb. The data show a fairly straightforward opinion, especially when the research participants are asked to express their agreement or disagreement with using ectogenesis, specifically with the technique. In fact, the items referring to the use of the technology show more precise and more defined opinions than the first items, which refer to the possible transformations related to the figure of women, men, and children.

Respondents express considerable concern about the use of technology in the gestation process, particularly regarding the power that such technology can wield in terms of control and costs. The issue of selection, which is a common theme in the literature on assisted reproduction techniques, is also a source of concern in this case, because while it may be a way to monitor fetal growth accurately, it also raises the issue of designing children who, at the end of the process, would all be “the same.” A theoretical construct based on the same

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<sup>13</sup> It should be noted that, compared to these two dichotomous positions, the 25-30 age group data shows a very different scenario. 8.5% declare total disagreement (values 1-2) and 12.8% total agreement (values 9-10).

<sup>14</sup> They indicate minimum agreement values (1-2) of 8.5%.

criteria, which, for this reason, generates the same product. With ectogenesis and selection, any possible imperfection, which generates difference and uniqueness, would be eliminated to make way for perfection. The ‘naturally become’ could be preferred to the ‘technically produced’ (Habermas, 2010).

The judgment about items concerning possible transformations for those involved in ectogenesis outlines clear positions. Still, it is less defined than the imaginary that emerges around the body-technology relationship, which has more clearly defined boundaries. The issue of greater freedom for women and men is certainly considered necessary with the use of the artificial womb. Still, doubts arise as to how much this technique may affect the mother-child relationship and the child’s psycho-social-emotional growth. The physicality of the body, which biologically defines gender differences, is also based on the different functions of these bodies, and seems to be accepted in some way when viewed through the lens of conception and birth. The subjects involved in the study declare themselves to be pretty ready to transform their social gender imaginary, which until now has also been defined by the possibility or otherwise of conceiving a child. The imaginary that emerges seems to tolerate the idea that sexuality and reproduction may not necessarily be considered strictly linked.

In analyzing the data collected, gender, age, and parenting experience emerge as variables correlated with arguments about ectogenesis.

Particular attention to the fetus and the child emerges in the opinions expressed by the women involved in the study, who express concern about the problems that ectogenesis may create in the mother-child bond and the fact that this technical intervention may create “test-tube babies.” For the women participating in the study, there is a risk that gestation will go beyond the boundaries of human unpredictability and emotional relationships and, as a result, become a rational, programmed, and planned mechanism aimed at ‘creating’ children who may all be the same. The women’s responses seem, in a way, not to raise any concerns about the childbirth experience. They do not think that ectogenesis will help to reduce the pain of childbirth. This position could be interpreted as an acceptance of the fact that it may, in some way, be legitimate for women to experience such pain because it is an experience that has always been attributed to this moment in a woman’s life (Filippini, 2017).

The other two independent variables that emerge as correlated with the judgment expressed for these items are the age of the study participants and whether or not they have experienced parenthood.

The data analysis shows that older people and those who have experienced parenthood agree with these statements. This could, in some way, outline a tentative profile, in the sense that it is very likely that those who are adults may also have experienced parenthood. Obviously, this correlation is not specific,



but in any case, the trend in judgment runs parallel to the age of the participants and the presence of children in the family.

Let's consider these two groups of individuals. We see that they are the ones who appear most attached to a traditionalist view of parenthood, rejecting or disagreeing with any new elements that ectogenesis might introduce, such as the absence of the pain of childbirth or the increased freedom of women and men in terms of conception. In this scenario, the skepticism of both groups of individuals translates into a fear that ectogenesis could destroy the relationship that develops between mother and child during pregnancy, taking away the naturalness of birth.

This fear translates into a general suspicion of this technique, as it could be used as a tool reserved for the wealthiest individuals or as an instrument of power for multinational corporations. These biogenetic discoveries could produce a form of capitalism that transforms life into a consumer good for profit and trade (Braidotti, 2014).

These concerns are also expressed about possible future scenarios. While young people are open to the idea that ectogenesis could be a valuable tool for gestation and appear optimistic about its future implications, older individuals and/or those who have experienced parenthood have many doubts about it. These individuals question whether children born through ectogenesis will be healthy. The fact that we still do not know the consequences reinforces this skepticism.

## 5. Conclusions

The study of the social imaginary surrounding the use of artificial wombs in the gestation process highlights two different scenarios, which are also confirmed by the analysis of the correlations between the items.

The arguments on which the assessments focus are parenthood and the use of technology.

Firstly, about the transformations that ectogenesis could bring to the family unit and the mother-child relationship, it can be seen that a less definitive social imaginary is emerging in terms of agreement or disagreement. Enthusiasm for greater freedom of conception for men and women is quite widespread (Tripodi, 2024). This confirms that individuals, regardless of gender, have the right to reproduce. Reproduction can be a fundamental part of a person's life plan. The inability to produce can deny individuals an experience that gives meaning to constructing their identity. If we consider that, in the past, women who were unable to have children were socially stigmatized, now this inability determines the lack of full self-realization (Di Nicola, 2024). For this reason, in

the social imagination, the artificial womb emerges as a tool that allows anyone to fulfill their right to reproduction.

In the social imagination, ectogenesis emerges as a possibility for both genders to fill the existential void that the inability to reproduce could create. Furthermore, it can also give men the opportunity to procreate and father a child, to experience conception without the presence of a female body. In this sense, this reproductive technology can be interpreted as male interference in the supremacy of the female body, which is the only one capable of conceiving another living being (Ciccone, 2009). The female body becomes a public place (Duden, 1994), accessible to men, (almost) replaceable with the male body. Traditional reproduction ceases to be recognized as the only possible way to have children (Roesner, 2023).

On the one hand, therefore, the social imagination accepts the fact that technologies such as ectogenesis would allow everyone to experience procreation, overcoming the idea that the family is composed solely and exclusively of natural and traditional assumptions, mainly linked to physicality. On the other hand, the theme of the childbirth experience remains anchored to a conventional view.

In the emerging social imagination, the pain a woman experiences during childbirth is understood, accepted, and an essential part of the experience, even for women themselves. So is the idea that the mother-child relationship is formed during pregnancy and that, in either case, it cannot be annulled. Indeed, suppose the womb is recognized not only as having the task of hosting the embryo and providing it with what it needs to grow, but also as having an influence and conditioning on its psycho-emotional growth. In that case, a particular fear and perplexity emerge in the social imagination of individuals.

A scenario is created in which, in the context of parenthood, it seems the common opinion to accept that men and women can conceive children within boundaries that are not yet so clearly defined, but that move between contradictions. In fact, when the focus shifts to the child, pregnancy is re-proposed as a natural experience, with unexpected events, such as pain during childbirth, but which could benefit from the intervention of technology in protecting the child from diseases (Eichinger & Eichinger, 2020; Golombok et al., 2013; Kennedy, 2024).

The use of technology and its power in the procreation process shapes a much more defined social imaginary. While we accept and believe that ectogenesis's contribution to disease control and prevention is essential, the possible future scenarios that could emerge, of which there is still no certainty, are what most hinder this confidence in this technique.

First, ectogenesis is recognized as having great power, which instills in the social imagination the fear that it could be used for exclusively economic

purposes by individuals who can access this power and who, therefore, cannot understand how it could be applied. We can glimpse the artificial womb's entry into the consumerist logic of the market, to the advantage of a few and the richest (Balzano, 2017; Spar, 2006). If this technique allows men and women the same possibility of having children, this condition could become a valid status symbol, raising a series of doubts regarding the importance of the gamete partner, which could be the partner, but also a donor, an employer, insurance, etc. (Bulletti & Flamigni, 2017; Eichinger & Eichinger, 2020; Kennedy, 2024).

The traditional resistance that reproductive techniques have always generated seems somewhat diminished. There remains, undoubtedly, the fear of pregnancy shifting to the artificial dimension, created not to eliminate unexpected events or health problems, but rather to raise doubts about the outcome of this process, which could render the birth of a child completely artificial, from conception through genetic selection to birth.

The idea that everything can be planned and engineered is frightening. The naturalness of a child's birth is increasingly approaching the artificial dimension. On the one hand, it signifies control and perfection. Still, this perfection, born from a carefully planned and designed project, is frightening because it increasingly lacks the uniqueness of human nature.

Beyond machines and synthetic chemical products, biological artifacts are now appearing on the scene. Their strength, or limitation, lies in their no longer being mere imitations of nature. It's no longer the questionable possibility of cloning a living being, but rather the power to generate it. It's not the reproduction of a copy, but human reproduction that reproduces from a nonexistent point of origin, because genetic selection and guided fertilization transcend the boundaries of tangible human corporeality. A simulacral logic (Viviani, 2008) in which the individual becomes the absolute referent of reality (Camorrino, 2024), the new dominator and controller of nature.

This reproductive right, however, requires us to remain focused and not to look away from the child, from his rights to be even imperfect. In this reflection, the test-tube baby emerges, distancing him not only from his (possible) nature but also from any denial. He is called to realize a life project that, from birth, promotes the ought to be, not the being. A project that does not tolerate deviation from the goal of final performance. That does not tolerate difference, that, from the beginning, seeks to erase diversity by bringing the masculine closer to the feminine. The dialectic between the self and the other (or the possible self), the binary logic of identity and otherness implode, starting from the idea that this otherness is the negative and specular counterpart of the self (Benasayag, 2021; Braidotti, 2011, 2014; Viviani, 2021). The boundaries between the categories of the natural and the artificial, between the given and

the constructed, become blurred, entering a continuum that feeds on an autopoietic force that can become difficult to interpret and judge.

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