

Holland's Next Embryo Model

In dialogue about stem cell research with festival visitors



Report

Authors

Thomas Verra, Lotte van Dijk and Rosanne Edelenbosch

Editing

Communications department

Illustrations and photos

DigiDaan

Cover photo

DigiDaan

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This research came about in collaboration with NEMO Science Museum, at the request of the Netherlands Organisation for Health Research and Development (ZonMw).



Preface

Last summer, I went to see Holland's Next Embryo Model (HNEM) at Lowlands. It was great to witness festivalgoers engaging in playful conversation about a serious topic: developing embryo-like structures in the lab. A colourful space featuring a real catwalk for various 'embryo models' provided the backdrop for festivalgoers to form and discuss opinions with each other. In addition to Lowlands, HNEM also attended four other festivals. We did this together with NEMO Science Museum, at the request of the Netherlands Organisation for Health Research and Development (ZonMw). We gained insights from over six hundred people in total.

In this report, we analyse the results. The report reveals a wide range of hopeful visions, questions and concerns among Dutch people. Concerns include the need to protect the embryo models themselves and the interests of any resulting children. Participants saw opportunities for new treatments for serious diseases and infertility. They also identified potential implications for Dutch and global society.

I sometimes hear scientists say that they don't really understand the need for a public discussion about a new technology that is still in the lab. At this early stage, there is still much uncertainty around what the technology can do, and the risks involved. On top of that, sometimes the claim is made that the subject matter is too complex for the general public to take part in the conversation. HNEM and much of our other research shows that the general public is well able to take meaningful part in public debate concerning new science and technology. In fact, it is essential to start public dialogue at an early stage, precisely because there is still room and time to influence technological developments and make them more amenable to societal values, concerns and interests.

The House of Representatives is soon to debate a potential amendment to the Embryo Act. It is important that the wide range of arguments raised through our research are duly taken into account. Biotechnological developments are changing our society, and political decisions in this area must be made with input from everyone who is potentially affected. This is an ongoing process. That's why the development of responsible medical biotechnology is one of our long-term programme lines. We will continue to work with cooperation partners to translate complex technology into accessible forms of communication, so that people with very different backgrounds, interests and knowledge can take part.

Prof. Eefje Cuppen

Director of the Rathenau Instituut

Summary

What if biomedical researchers could create something in the lab that resembles a human embryo, even though it does not originate from an egg and sperm cell?

Researchers can turn donated human body cells into stem cells in the lab and grow them into something similar to an embryo. These embryo models allow researchers to mimic different stages of embryonic development in the lab, opening up all kinds of opportunities for research into the development of genetic diseases and infertility. In the future, some of these models may be indistinguishable from the 'real embryo'. Embryo models could therefore expand the potential for non-natural human reproduction.

Purpose of this report

The Rathenau Instituut considers it important that perspectives within society are taken into account in guiding and regulating this development, for example in the revision of the Dutch Embryo Act. This report aims to contribute to political opinion-forming and democratic decision-making on the use of embryo models for research.

In this report, we answer the following research question: 'What do Dutch people think about research with embryo models, based on which values and arguments?' To answer this question, the Rathenau Instituut and NEMO Science Museum engaged in a broad public dialogue under the title Holland's Next Embryo Model (HNEM) in 2024. At five different events, we talked to a total of 613 festival visitors about the use of embryo models.

Alongside this research goal, HNEM also aimed to support the formation of public opinion and spark public discussion about embryo models. We informed people about what research is being performed in the labs, and about the latest scientific findings.

Insights

Much of the academic debate on embryo models concerns finding a balance between scientific progress versus religious or philosophical arguments. Our research shows that, for many people, the debate is broader, and other topics are equally important when it comes to making a judgement on this issue.

Many participants were enthusiastic about the possibilities of research with embryo models. At the same time, participants were aware that scientific progress does not necessarily lead to social advancement. In the reasoning given for this, we have

identified three overarching themes: worthiness of protection, naturalness / perfection, and expectations / trust. These themes were a common thread that ran through the dialogues, forming the core arguments on the basis of which participants considered the promises of the research.

Worthiness of protection is about the extent to which participants felt embryos should be treated with respect due to their inherent value. Participants based their assessment on criteria of viability, humanity, and the origins of the embryo model. For instance, a large majority of participants named the ability to feel pain and self-awareness as clear boundaries for embryo research. Only a very small minority did not consider it acceptable under any circumstances to create 'human life' in a lab solely for research purposes. A very small minority was fundamentally and absolutely opposed to all research with embryo models, based on the moral status they attributed to these models, even at the early development stages permitted under current legislation.

The theme of naturalness / perfection concerns the extent to which nature may be modified for our own interests. A large group of participants saw reproductive opportunities for people who are currently unable to have a biological child of their own through existing fertility treatments. A frequently mentioned condition for research with embryo models was that the offspring should not be modified in the pursuit of perfection. Participants also stated that human suffering is, to some extent, part of life.

The expectations/trust theme concerns the forces (science, policy) at play in the development and application of this technology and how this development should be adjusted and regulated. Participants frequently told us that the course of science is unstoppable. Some considered the ability of the public and other parties to participate in decision-making and influence policies to be limited, due to a power imbalance favouring those representing commercial and economic interests. Many participants felt it was important to allow research with embryo models to take place in the Netherlands, but under strict conditions.

During the dialogues, participants pointed to different interests at stake: those of the embryo model, the future child, family, Dutch society, the international context, the planet and humankind (see figure 1).

Figure 1 Overview of key public considerations surrounding research with embryo models during our dialogues.



Based on the research conducted, we draw the following conclusions:

1. Public debate on research with embryo models extends beyond scientific progress versus religious or philosophical arguments.
2. Participants' concerns about naturalness and making perfect life are often balanced against the goals of research. For what purposes is it acceptable for us to intervene in nature in this way?
3. Most participants believe the research can be carried out responsibly in the Netherlands and consider this important.

Reflection

Meaningful public engagement in scientific and technological developments is an important but challenging task. In the case of HNEM, this involved creating an attractive and practical installation, making science relevant to a wide audience, establishing a dialogue at various festivals, as well as focusing on the quality of the research. Public dialogue does not provide easy answers but rather adds depth and nuance to the debate.

HNEM alone is not enough: incorporating public perspectives into science and policy is an ongoing process. This needs to be done on a long-term rather than a one-off basis to ensure meaningful public engagement in the development of science and technology. The public and those representing public interests should have a say in setting the agenda for research, developing research programmes, decision-making on research funding, assessing research proposals and supervision of projects. It is also necessary to look at how the outcomes of such dialogues, and the values they reveal, can be adequately embedded in innovation policy.

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1 Introduction

What if biomedical researchers could create something in the lab that resembles a human embryo? Around the world — including in the Netherlands — scientists are already conducting research to make this possible. To achieve this, researchers in the lab use donated human body cells that they convert into stem cells, cells with the ability to develop into almost any cell type. Researchers then allow the stem cells to divide and organize themselves further into structures similar a particular stage of embryonic development. In parallel, scientists are developing sex cells from stem cells, which could be also potentially used to create an embryo.

Box 1 Choice of the term 'embryo model'

We have chosen to use the term 'embryo model' in our communication with participants and in our reporting. We use it as an umbrella term to refer to embryo-like structures used as models of embryonic development. The models differ from the 'real' embryo in their origin as they have been created in the lab using stem cell technology. Each embryo model mimics a particular stage of a human embryo.

In the future, some types of embryo models may become indistinguishable from embryos created with egg and sperm cells. The term 'model' could in that case be misleading, when used to downplay the human nature of these entities. A 'model' can be interpreted as 'not real', or something that is mainly 'for science' (M'hamdi 2025). Nevertheless, we choose to use this term here because we feel it is the easiest to understand for those with no background knowledge on the subject, and because it fits in well with the concept of Holland's Next Embryo Model.

Embryo models open up new opportunities

Researchers aim to use embryo models to mimic the early stages of human life in the lab, opening up all kinds of research opportunities. One of the advantages mentioned is that the models can be produced on a large scale to ensure that research material is always available (Devlin, 2023). At present, research with

embryos is limited due to the limited material available for this purpose. The use of embryo models would boost research into the development of genetic diseases and infertility. In the future, some of these models may be indistinguishable from the 'real embryo'. If these models could develop into humans, this would open up new possibilities for reproduction.

Box 2 **Want to read or hear more?**

Further background information can be found in a number of places, such as the following:

Rathenau Instituut online dossier

This dossier includes the report in Dutch *Zaadjes voor een maatschappelijk debat* (Seeds for public debate) and a Message to Parliament on the 14-day limit in the Embryo Act.

NEMO Kennislink online dossier

This includes a story in pictures of HNEM at the Libelle Margriet Summer Week plus a coverage of HNEM at the Zwarte Cross festival.

Podcast

In the Verrekijkers podcast ('Binoculars'), researchers from the Rathenau Instituut talk to biomedical researcher Geert Hamer about the social and ethical aspects of research into reproductive cells from the lab.

Societal questions

To ensure the responsible development of research with embryo models, it is important for society to broadly reflect on and discuss this topic. This is because the use of such models raises questions that involve a large number of interests. Is an embryo model really that different from a 'traditional' embryo? If so: what makes it different? How great is the importance of biological offspring? How far should researchers be allowed to go in modifying living material in the lab? Should it be allowed to edit DNA of embryo models? What conditions should apply to this research, and for what purposes should it be carried out? And what are the

potential long-term social consequences of this kind of research? Who benefits and who does not?

Certainly, given that researchers are already working on these embryo models, it is important that perspectives within society are taken into account in guiding and regulating this development in the near future, for example in the revision the Embryo Act.

This report aims to contribute to political opinion-forming and democratic decision-making on the use of embryo models for research, by answering the following research question: 'What do Dutch people think about research with embryo models and what values and arguments play a role?'

Holland's Next Embryo Model (HNEM) festival tour

To answer this question, the Rathenau Instituut and NEMO Science Museum engaged in a broad public dialogue in 2024. At five different events, we talked to a total of 613 festival visitors about the use of embryo models. Our aim is to contribute to the socially responsible development of research with embryo models.

Part of the ZonMw PSIDER programme

HNEM is part of ZonMw's PSIDER programme.¹ A number of labs in the Netherlands are conducting research into embryo models, including within this PSIDER programme. This programme seeks to provide alternatives to research with embryos with the aim of learning about the development of serious hereditary diseases. In addition to scientific research, the programme also places a strong focus on responsible research and innovation (RRI). Several research groups focus on engaging specific audiences on ethical and social issues raised by the research. These audiences include patients, people from migrant backgrounds, students, people with different religious or philosophical perspectives and those with literacy difficulties.

Reading guide

Chapter 1 provides background information on research with embryo models. Here, we discuss the opportunities and limitations of embryo research and provide an overview of different types of embryo models. In Chapter 2, we briefly explain the set-up of the public dialogue. Chapter 3 describes the insight provided by HNEM. Finally, in Chapter 4, we reflect on the dialogue method used, and on the value of having conversations with the public for democratic decision-making.

¹ For more information on this programme, visit <https://www.zonmw.nl/nl/programma/psider>

2 Research with embryo models

2.1 Limitations to current research with embryos

The formation of the embryo can be seen as the beginning of human life. It is also a source of fascination for many scientists. Research into embryo development has been taking place for a number of centuries. Yet much is still unknown about the very early stages.

Box 3 *What is an embryo?*

From a biological point of view, we talk about an embryo up to around eight weeks after fertilisation (Findlay et al. 2007). When an egg and a sperm cell fuse, the fertilised egg begins to divide into a group of identical cells. After a week, the number of cells is around sixteen and they are not yet visible to the naked eye. The embryo should start implanting in the womb around this time. After two weeks, the embryo consists of several thousand cells. At this time, it is less than one millimetre in size and just visible to the naked eye as a tiny dot. In the third and fourth weeks, the embryo grows to around four millimetres, the organs are formed, and different sides of the embryo can be distinguished (the body axes are formed). After eight weeks, the embryo is around the size of a raspberry.

Embryo research received an enormous boost in the 1980s with the introduction of IVF (in vitro fertilisation) to improve chances of becoming pregnant. In IVF treatment, fertilisation of the egg cell with a sperm cell takes place in the lab. This requires egg and sperm donation, which can be an invasive and painful experience for women. Multiple embryos are created, with only one or a small number chosen for placement in the womb to subsequently grow into a baby. The remaining embryos are called supernumerary embryos.

What are scientists allowed to do with embryos?

The Dutch Embryo Act defines what kind of research is and is not permitted with embryos. For example, embryos may not be created for research and must be destroyed 14 days after fertilisation. In addition, approval for embryo research requires demonstrating that there are no alternative ways to obtain comparable knowledge, such as research using abortion material or laboratory animals. The Act aims to balance the expected benefits of medical advances with the need to protect early life.

In the Netherlands, because embryos cannot be created for research, research is only carried out with supernumerary embryos. Embryos left over after IVF can potentially be used for research if the donors grant informed consent.

Many scientists consider the possibilities for research with supernumerary embryos to be too limited. They argue that firstly, the number of embryos donated for research is low, which means that research material is scarce. Secondly, the supernumerary embryos are not always of the desired 'quality'. This is because the most suitable embryos are replaced in the womb to grow into a baby. Thirdly, the supernumerary embryos are already several days old when they are donated for research, since IVF treatment involves waiting several days to see how the different embryos develop, before one is placed in the womb. Supernumerary embryos therefore cannot be studied during the very first days after fertilisation. Finally, embryos must be destroyed fourteen days after fertilisation. This means that it is not possible to study the phase after these fourteen days in which elements such as the blood, muscle and heart cells develop.

At the same time, the use of embryos for research is a sensitive issue in society. Many people consider an embryo to be the beginning of human life. Even at a very early stage of development, an embryo has the capacity to grow into a person. Because of this sensitivity, research with supernumerary embryos can therefore only be carried out under strict conditions.

2.2 Embryo models as an alternative to embryo research

Following the Dutch government's 2017-2021 Coalition Agreement, and in response to the practical and ethical dilemmas that are impeding progress in embryo research, the government aims to stimulate the development of alternatives to research with embryos. That is why funds are currently being invested in research into embryo model development. We use the term embryo model in this

report to refer to structures grown from stem cells that partially or fully mimic a stage of embryonic development.

To make embryo models, researchers use pluripotent stem cells. These can be reprogrammed from human body cells obtained from for example a supernumerary embryo or by donation from an adult human. These stem cells can develop into all kinds of specialised cell types in the human body (Landecker et al. 2023). Under certain conditions, these stem cells can form into a clump that closely resembles an embryo at a certain stage of embryonic development. Research on how to develop these embryo models is rapidly progressing. Scientists have already succeeded in creating an embryo model from mouse stem cells that remained alive in an artificial womb until half the normal development time (Hayashi et al. 2011; Hikabe et al. 2016; Hayashi et al. 2017).

Stem cells can also be developed to form into sex cells, or gametes (in vitro gametogenesis, IVG). These IVG gametes could in future be used to create embryos in the lab, also known as IVG embryos. This research is still at a very early stage.

Scientists hope these embryo models will be sufficiently similar to 'normal' human embryos to provide useful biomedical knowledge, but at the same time 'different' enough that some of the ethical concerns surrounding the use of supernumerary embryos for research can be avoided. A number of ethical arguments are put forward in favour of research with embryo models. One idea is that certain embryo models are less worthy of protection compared to supernumerary embryos, as they mimic the human embryo to a lesser extent. Research with embryo models that are not viable (because they lack certain elements, which prevents them from maturing) would potentially be more desirable than research with embryos that are viable. Researchers would also potentially require fewer laboratory animals.

Research with embryo models also has a number of practical advantages over research with supernumerary embryos. For example, embryo models could offer a solution to the scarcity of research material in embryo research. Large-scale production of embryo models could enable comparative research between different treatments. Secondly, creating embryo models does not require egg donation, a stressful and painful procedure for women. Thirdly, IVG gametes enable researchers to create an embryo that can be studied during the first days after fertilisation- something that is not possible with supernumerary embryos. Finally, researchers are attempting to develop embryo models that mimic stages of development after fourteen days. This will allow them to study embryonic growth after that period, potentially providing insights into the development of elements such as the blood, muscle and heart cells. Such research is not permitted with

supernumerary embryos. In these ways, research with embryo models could improve our understanding of the earliest stages of development of genetic diseases or infertility.²

2.3 Goals of research with embryo models³

Gaining knowledge about congenital conditions and infertility

Research with embryo models leads to knowledge about the process of gamete development and early embryonic development. Researchers are particularly interested in the development of infertility and congenital conditions. This research may lead to more effective treatments for infertility and certain hereditary conditions in the future.

Researchers also hope to make IVF more effective by developing knowledge about the best conditions to grow embryos in a lab. They also hope to gain an understanding of what can go wrong during embryo implantation. The IVF success rate is currently below 50%⁴. Finally, embryo modelling could also boost research into gene function. This is because embryo models can be used to conduct preclinical research on the safety and consequences of editing DNA.

Increasing possibilities for reproduction

In a distant future, embryos from IVG gametes could grow into a human being. They would then be transferred back into the womb after fertilisation in the lab. Or they would be further developed in an artificial womb in a lab. This opens new possibilities for reproduction for people who are unable to have a biological child of their own, and for whom IVF is not an alternative. It could enable various new forms of biological parenthood, providing opportunities for people such as prospective single parents, menopausal women and same-sex couples.

Boost for Dutch science

Research with embryo models could give a boost to Dutch science. Researchers hope that the Netherlands can take on a leading role in the international scientific field conducting research on embryo models. This would not only help the country to attract and retain scientific talent but would also benefit the economy.

² The way the different models are described in this text is close to the audio people heard during the dialogue. The script for the audio was submitted to scientists working on research with these embryo models.

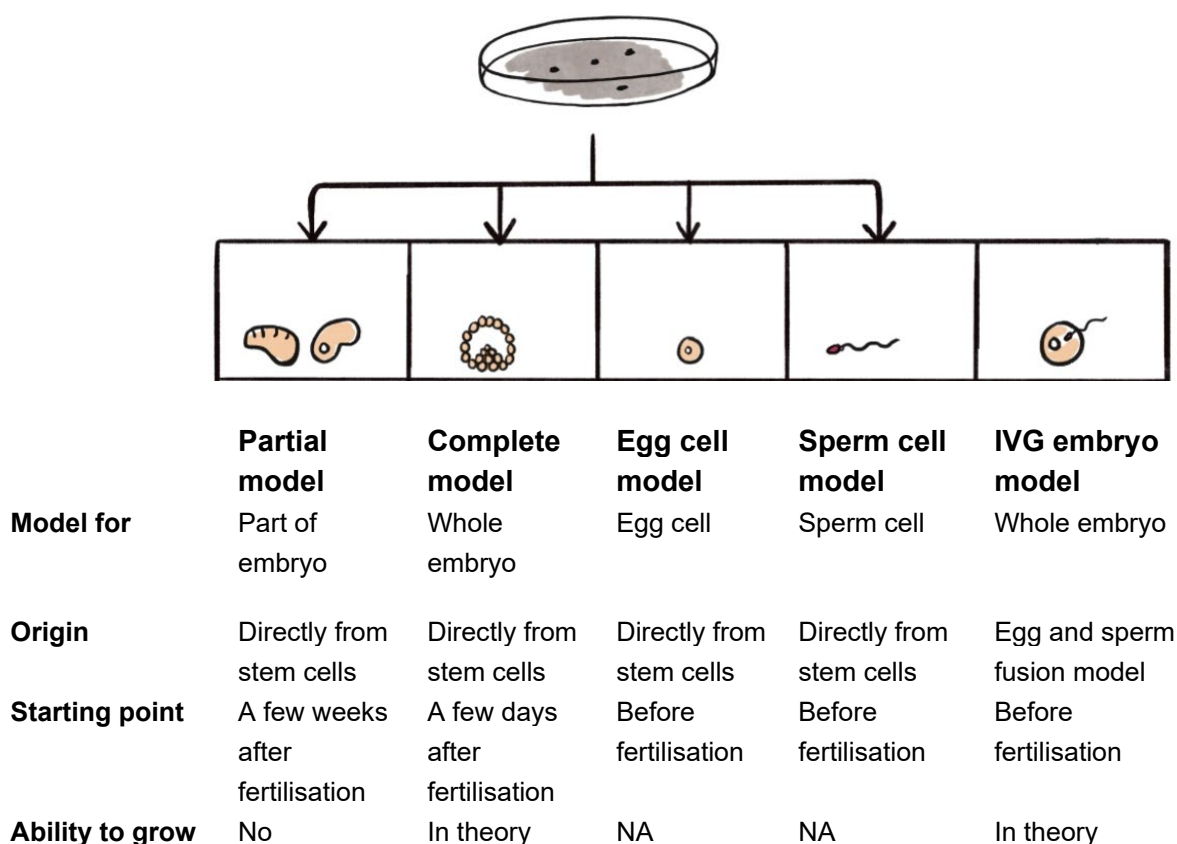
³ <https://www.zonmw.nl/nl/programma/psider> (In Dutch)

⁴ <https://www.nvog.nl/ivf-cijfers-2021-meer-ivf-behandeligen-en-meer-ivf-babies/>

2.4 Different types of embryo models

We distinguished between four different types of embryo models in our dialogues (see Figure 2): partial embryo models, complete embryo models, egg and sperm cell models and IVG embryos.

Figure 2 The different models we talked to the public about:



Partial embryo model

Partial embryo models mimic part of an embryo. They are developed directly from stem cells into structures similar to embryo structures from around two weeks after fertilisation. These models are suitable for research into human development and the development of certain conditions. For example, these models provide insight into how heart cells are formed, and how blood and muscle cells develop. These models cannot grow into human beings. Many different types of partial embryo models are possible, depending on how they are made and the purpose of the research.

Complete embryo model

Complete embryo models mimic the whole embryo. They are also developed directly from stem cells and mimic the stage from a few days after fertilisation. Unlike partial embryo models, precursors of all organs, including nerve cells, and the placenta grow in these models. In theory, these models could grow into human beings. This makes the model suitable for research into implantation in the womb or in an artificial womb in a lab. Researchers hope to use these models to better understand why some women cannot get pregnant. This model can also be used to study conditions that occur in early embryonic development.

Egg and sperm cell model

Egg and sperm cell models mimic sex cells, or gametes. They are developed directly from stem cells. This process is known as vitro gametogenesis (IVG). These models provide insight into egg and sperm development. Egg and sperm cell models could be a future solution for people who are unable to produce their own gametes.

IVG embryo

IVG embryos are embryos created by fusion of egg cell models and sperm cell models. No egg and sperm cells are donated for this purpose; instead, both cell types are made from stem cells. This model makes it possible to study the first days after fertilisation. An IVG embryo could theoretically grow into a human being. Egg or sperm cell models can also be genetically modified so that the resulting IVG embryo cannot develop beyond a certain stage.

3 Approach to the dialogue

The aim of the dialogue was to map out the variety of different considerations and arguments when it comes to embryo model research. How the public foresees the potential implications of emerging science and technology reflects the desired direction of social advancement. The dialogues did not try to draw general conclusions about what people in the Netherlands think of embryo models-quantitative research methods are better suited to this purpose. The dialogue addressed the more qualitative question of how the public give meaning to research with embryo models. In this chapter, we take a closer look at our approach, the different festivals we visited and the people we spoke to at these events.



Photo 1 HNEM in action (photo: Rathenau Instituut)

3.1 What is Holland's Next Embryo Model?

To initiate a dialogue with festival visitors, we worked with a special installation designed by Fillip Studios. The installation consisted of a long table with room for four participants to sit on either side. At one end was the presenter, who led the discussion. At the other end was an observer who only listened and took notes on the conversation. Each participant wore headphones to enable them to hear what was said at the table despite the festival noise. The presenter first introduced themselves and briefly talked about the purpose of the dialogue. Participants then had the opportunity to introduce themselves to the others around the table before the dialogue began in earnest.

Before the discussion, our recruiters gave passing festival visitors a brief explanation about embryo models and the purpose of our research. This often started as a pleasant and informal conversation and, as the conversation progressed, participants were asked if they wanted to take part in our research. Some visitors did not want to sit at the table but were eager to engage with us to share their views. We have also included these opinions in our research where possible. All jury members (participants) answered some questions on an iPad about their background before the discussion. Once visitors had 'checked in' and the table was free, they could take their seats and put on their headphones.

At the centre of the table was a mini catwalk on which the three models in a petri dish were paraded one by one. These were replicas of:

- a partial embryo model
- a complete embryo model
- precursors of egg and sperm cell models (and the IVG embryo that can be developed from them).

Participants were given a magnifying glass to view the passing models (see photo 2). The models in the petri dishes were very small and difficult to see with the naked eye. We therefore also displayed enlarged models on boards (see photo 3).



Photo 2 Participants use their magnifying glasses to examine the passing models (photo: DigiDaan)



Photo 3 Boards displaying enlarged models are shown while participants listen to the audio clips (photo: DigiDaan).

As each model passed, participants listened to an audio clip providing information about the models. The audio texts used were checked for factual accuracy by various experts from the PSIDER programme. How were they made? Why do scientists want to use them for research? What can researchers do with one model and not the other? Participants were also given the opportunity to ask questions, where applicable to the scientists present who work with embryo models themselves.

After each model, participants were given time to reflect for a moment and could write down their initial reaction on their own whiteboard. They were then asked to hold up a sign that most accurately reflected their feelings about the model in question. Participants could choose from a sign showing a thumbs up, a thumbs down, an exclamation mark and a question mark (see photo 4). Each time, the moderator asked some participants to explain their opinions. The presenter made sure that (where possible) participants holding up different signs had a chance to speak.



Photo 4 Participants writing their initial response on the whiteboard.

After all the models had passed by, the presenter asked another in-depth question on which all participants were allowed to give their opinions. These questions concerned one of five topics: worthiness of protection, donating cells yourself, goals of the technology, conditions of use or the importance of viability. Finally, from

every table one participant was asked to answer a few questions on the iPad about his/her experience for evaluation purposes.

The events featured a team of ethical, social and biomedical researchers. Each dialogue session lasted around 15 to 30 minutes, depending on the number of participants and the discussion at the table.

3.2 What data was collected?

Our data consists mainly of key words and key phrases of what participants thought was important, written down by a note-taker sitting at the table. The data from the whiteboards and raised signs was also included in the analysis. Finally, the reactions of passers-by were noted as much as possible.

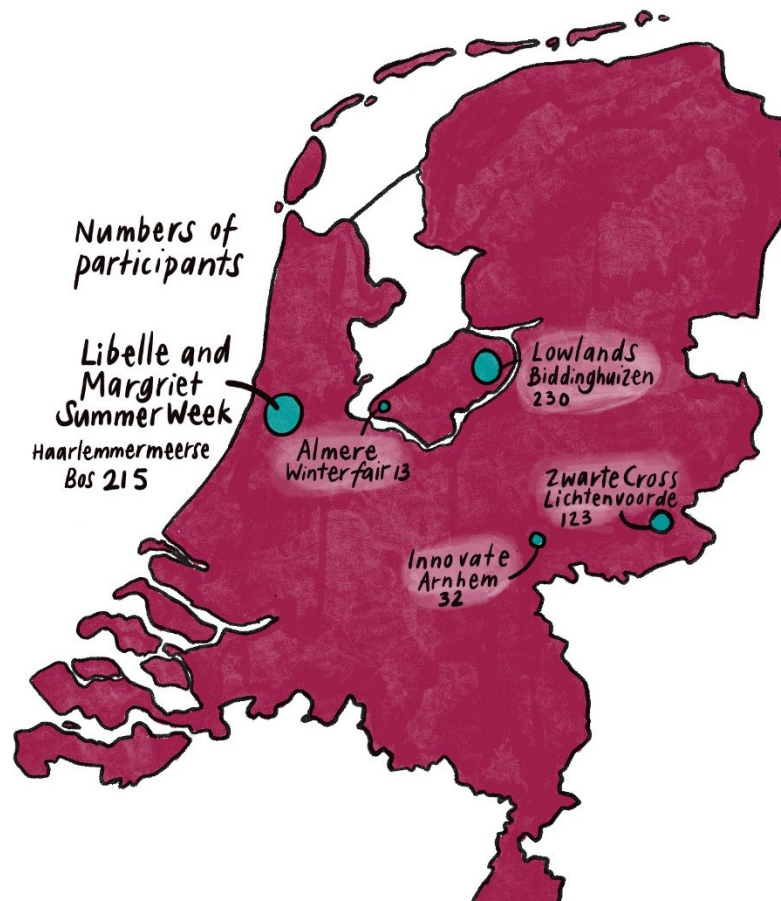
All this data was collated in Microsoft Excel, keeping whiteboards, signs and notes linked together. We then conducted a thematic analysis of the data (see Braun & Clarke, 2006), looking for recurring themes. We eventually came up with a categorisation of three main themes: naturalness and making perfect life, the need to protect the embryo, and trust and expectations. For each theme, we took stock of the various arguments and considerations that participants used to determine their opinions. These arguments and considerations related to different interests, which we also identified. The result of this analysis can be found in the next chapter.

3.3 Who took part?

The aim of HNEM was to reach a wide audience. We chose to engage the public at festivals due to the large numbers of people who can be reached there. We wrote to several festivals. We also looked at the festivals' target groups. And vice versa, HNEM also had to fit in with the festivals' programming.

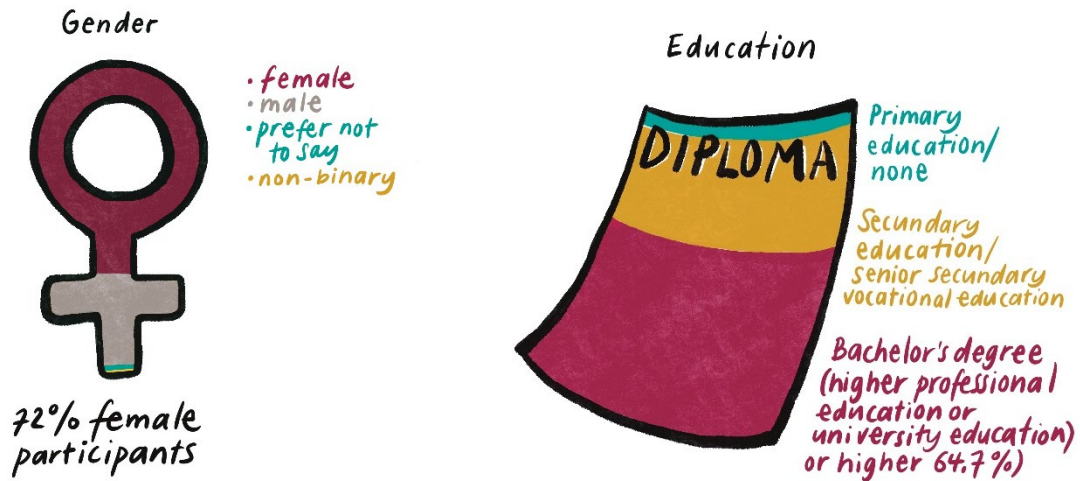
We ended up attending Libelle Margriet Summer Week, Zwarte Cross, Lowlands, INNOVATE Experience and Almere Winter Fair. At these events, we conducted a total of 133 mini dialogues with 613 participants. The vast majority of our participants were visitors to one of the three larger festivals - see Figure 3.

Figure 3 Overview of events and number of participants.

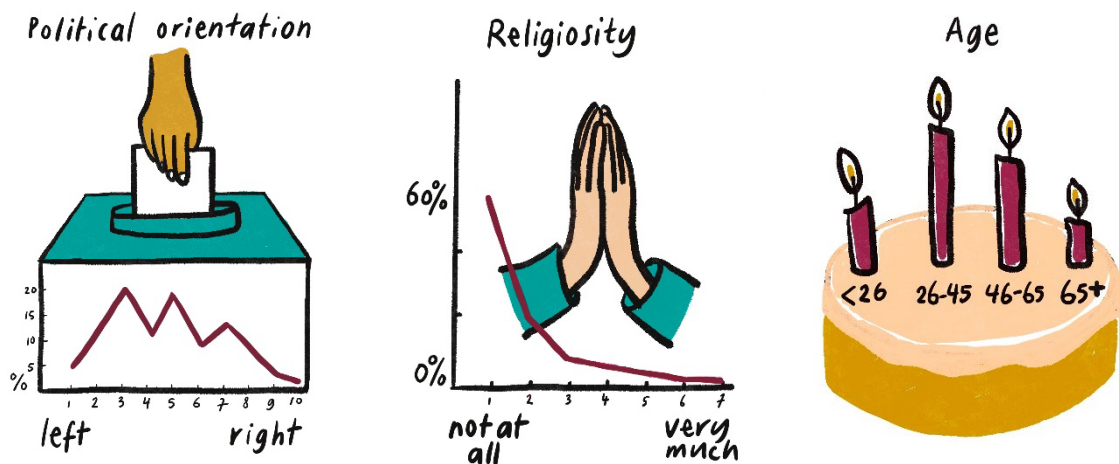


Libelle Margriet Summer Week and Zwarte Cross both attract mainly a practically trained audience, while Lowlands is visited more by theoretically educated individuals. Libelle Margriet Summer Week targets women of all ages, while Zwarte Cross and Lowlands are aimed at both men and women predominantly aged between 25 and 35.

Significantly more women (72.2%) than men (26.3%) participated in the dialogues. We were at Libelle Margriet Summer Week for seven days, with a mainly female audience. However, we also attracted more women than men at the other festivals such as Zwarte Cross (37 men out of 123 participants). It is possible that the topic of 'embryos' or 'catwalk' appeals more to women, but we cannot provide a definitive explanation for this imbalance.



It is also notable that the majority (64.7%) of participants were theoretically educated (university of applied sciences or research university graduates), and not religious (78% of all participants selected 1 or 2 on a scale of 7). Participants' political preferences (left-centre-right) were diverse, leaning slightly more to the left of the spectrum. There was also a spread in the ages of participants, with 26 to 45 being the largest age group (40%), followed by 46 to 65 (31%). Most participants came from provinces near the festivals.



4 Insights from the dialogue

First impressions

HNEM attended five festivals, each with its own atmosphere and audience. At the Libelle Margriet Summer Week, we were one of many stalls, with others selling items such as clothing, beauty products and snacks. At Zwarte Cross, we were located next to the outdoor stage on the Theatre Meadow. At Lowlands, there was a special science area where various research was being carried out. At the INNOVATE Experience, we were part of an exhibition of innovative products at the Musis concert hall in Arnhem. At the Almere Winter Fair, we were located outside at a Christmas market in a shopping area.

Many people lingered curiously for a moment on seeing our installation. The installation and dialogue were the first introduction to the concept of embryo models for most festival visitors.

Many people's initial reaction to HNEM was a combination of fascination and amazement, but also bewilderment and concern. People often lingered for a moment in surprise in front of our installation and expressed their initial feelings about what they saw. Although the subject can be quite complicated, the public – despite their potentially limited background knowledge – are quite capable of taking part in discussions on the subject. Input based on their own religion or philosophy, values and interests produced many rich conversations about the potential implications of embryo model research.

Overall picture

Many people were enthusiastic about the possibilities of research with embryo models. Many expressed hope of learning more about the origins of infertility and genetic conditions, and of improving medical treatments. The majority were also positive about the idea that fewer laboratory animals would be needed for medical research. Many believed that medical advances will alleviate or even prevent human suffering due to infertility and genetic conditions in the future.

At the same time, participants were aware that scientific progress does not necessarily lead to social advancement. In the lines of argument that were set against this idea, we distinguished three overarching themes: 1) the need to protect, 2) naturalness and perfection, 3) expectations and trust. These themes were a common thread that ran through the dialogues, together forming a framework against which the research promises were considered. Overall, we found that the HNEM participants have very different views on the use of embryo

models, and everyone weighs up the issues surrounding the above themes in their own unique way.

In this chapter, we take a closer look at the perspectives collected from our participants for each overarching theme (see table 1 for an overview). Viewed as a whole, these perspectives give an indication of aspects that various people consider to be important in steering research with embryo models, and the conditions that should apply.

Worthiness of protection	Naturalness and making perfect life	Trust and expectations
Fundamental limits	Opportunities for reproduction	Expectations regarding scientific progress
Viability	Biological clock	Trust in actors in the Netherlands and abroad
Humanity	Human enhancement and perfection	Conditions for research with embryo models
Origin	Life is suffering	
The need to protect life	Wider interests	

Table 1 An overview of the perspectives by overarching theme.

Quantitative analysis

In addition to clarifying the different types of arguments put forward by participants, we also try to give an indication of how often certain issues were raised. While we are unable to defend this quantification of arguments with hard numbers, and they do not represent a cross-section of society, we feel it is transparent and relevant to distinguish between considerations that were raised on a regular basis and those that were mentioned only once in all of the interviews. In autumn 2025, the Rathenau Instituut is set to publish the results of a survey – a follow-up to the report *Gewicht in de Schaal* (2019) – with quantitative data on what a cross-section of Dutch society thinks about research with embryos and embryo models.

4.1 Worthiness of protection

What is the moral status of an embryo model? How should researchers treat early human life? And when does human life actually begin? The concept of worthiness of protection refers to the idea that embryos should be treated with respect because they have inherent value. For example, because embryos are viewed to be already human life, or from the potential they hold to develop into a person. An embryo can in itself be worthy of protection, and also because of the value it represents in society. Considerations surrounding the worthiness of protection are often balanced against other considerations, such as the expected scientific and social progress that research with embryos makes possible.

When forming an opinion on the degree to which embryo models should be protected, an important question is how these models compare to 'normal' or traditional embryos. Is it acceptable to create embryo models for research purposes? Do people have a preference for one model or the other? How important are certain characteristics of the embryo models?

In this section, we set out what the participants said about the need to protect different types of embryo models. We describe a number of frequently occurring themes in discussions on worthiness of protection, namely the sensations felt by the embryo, viability, humanity, origin, and the need to protect 'life'.

If this embryo model develops, will it have consciousness?



Characteristics that constitute a fundamental limit

A large majority of our participants found the use of embryo models for research acceptable as long as they would not exceed a certain stage of development. They found it difficult to imagine the embryo models in the developmental stages presented to them because “they saw so little”⁵(the models in the petri dishes were difficult to see with the naked eye). As a result, they saw little worth protecting. Many characteristics that participants viewed as fundamental limits are consistent with characteristics frequently cited to be worthy of protection in traditional embryos: self-awareness or the ability to think, the ability to experience stress or pain, a beating heart, and brain development. Therefore,

⁵ These quotes have all been translated from Dutch. For the original quotes, see the original Dutch version of the report: <https://www.rathenau.nl/nl/gezondheid/naar-verantwoorde-medische-biotechnologie/hollands-next-embryo-model>

many participants stressed the importance of regulation and control to prevent embryo models from reaching this stage of development.

Viability

Many participants reacted positively when they heard that partial embryo models would not be able to grow into a human being. This ability was often mentioned as a concern in the interviews, and many participants also noted it on their whiteboards after hearing it in the audio recordings. We often heard statements such as: "As long as it stays in the lab", "Not to create people", or "Not to be placed back into a womb".

Yet for most participants, concerns around viability, in other words the 'potential' to grow into a human being, were not of primary importance in evaluating whether embryo models could be used for scientific research. Many participants considered the non-viability of the partial embryo model to be "reassuring" but, given the early stage of development of the embryo model, but not essential in considering the desirability of the research. Only a minority of participants were principally opposed to research with complete embryo models and IVG embryos due to their theoretical (or inherent) ability to grow into a human being. They therefore preferred research with the partial or non-viable embryo models.

At the last two festivals (INNOVATE Experience and Almere Winterfair), we spoke to participants about genetically modifying IVG gametes in such way that the resulting embryo cannot continue to grow and be born. For example, by ensuring that it cannot develop a nervous system. There was much support for this as it would put a technical constraint on the research. Some participants also felt better about removing this potential to grow in this way rather than artificially aborting the 'life' of the embryo model. For other participants, it made little difference whether the potential for life was ruled out by technical intervention, or whether the models were destroyed by the researchers.

Humanity

In addition to concerns about growth, there was also the idea that partial embryo models – which can take many different forms – would be further removed from the 'real' embryo. These models were deemed considerably less 'human' and therefore less worthy of protection. As a result, it would be more desirable to conduct research on these models. Our participants did not appear to deem egg and sperm cells specifically worthy of protection.

At the same time, many expressed doubts about the value of knowledge gained from partial embryo models. Is this knowledge as valuable as that gained from 'real'

supernumerary IVF embryos? Some therefore preferred the complete model or the IVG embryo precisely because there 'was nothing missing', which would make it more 'natural' and more valuable for science.

Origin

Our participants found gamete development in the lab exciting because of the possibility of eventually using these gametes to form embryos. Most participants talked about IVG embryos as 'real embryos' or "humans", and they were therefore considered more worthy of protection than the other embryo models. For many people, IVG embryos were not substantially different from embryos left over after IVF treatment. Many



people consider how embryo models are created to be important in determining the need to protect. However, it was not clear from the dialogues whether and how this affects the perceived desirability of research on IVG embryos.

A very small group was fundamentally opposed to the fusion of gametes obtained from IVG. They felt it was unethical to create life purely for research, only to 'discard' it after fourteen (or in future, possibly twenty-eight) days. The act of fusion may be highly symbolic for these people. For a large group, research was acceptable, but under strict control and regulation. For example, of the types of research that are and are not permitted, and how long embryo models can be used in the lab for research.

The need to protect life

A very small minority was fundamentally and absolutely opposed to all research with embryo models, because of the moral status that these participants attributed to these models, even at the early stage they would be in (under current legislation). These participants cite arguments such as "This is playing God", or "Life must arise out of love" and argue for the need to protect in the sense of protecting integrity and sanctity of every human life, which should not serve any extrinsic interest. In some cases, they preferred research with supernumerary IVF embryos because these are still created for the purpose of assisting pregnancy. Others, mostly those with a strong religious background, were against any kind of embryo research.

4.2 Naturalness and making perfect life

In what ways is it acceptable for us to influence nature for our own interests and how far are we willing to go? References to nature, naturalness and unnaturalness are often part of the public debate on biomedical innovations. 'Natural' usually refers to a situation as found in nature, 'as it should be'. At the same time, humans are technological beings who have always shaped the world (including themselves) to their own will. This is a tension that participants in the dialogues had to navigate.

The theme of naturalness and perfection covers questions about what we can and cannot use this technology for, and why. The dialogues show that it is impossible to determine a clear divide between 'giving nature a hand' (restoring the way nature should be functioning) and 'reversing nature' (going against the natural course of life). Almost all participants were positive about the potential of embryo model research to help reduce human suffering due to severe congenital diseases and infertility. However, there was a widely shared fear that society could become highly 'engineerable' in a distant future, to make perfect life.

How does the development of embryo models interfere with 'how things should be'? What interests can be justified? Where do participants want to draw the line? This section looks at these questions in great detail. Themes covered include new opportunities for reproduction and reproductive research, curing diseases, limits to the pursuit of perfection, and broader interests at stake for humans and nature in the long term.

Opportunities for reproductive research

A large group of participants considered unwanted childlessness due to infertility to be a serious social problem. Many people shared their own experiences or those of others on this topic during the dialogues. On a few occasions, participants expressed the expectation that unwanted childlessness due to infertility will only increase in the future. These participants felt that research with embryo models could potentially help address this problem, for example by improving existing fertility treatments and expanding reproductive options. However, participants set different conditions regarding how the technology should be used and who should have access to it.



Many people experience sadness and pain because they are unable to have children.

Opportunities for reproduction

In the previous section, we mentioned that many participants expressed concerns about the potential development into a human being of embryo models. Common statements were that the models should be “restricted to research”, that they “should not be placed in a womb”, and that they should “not be used to create any human beings”. At the same time, most of the same people expressed their hope for a future in which embryo models can be used for people who are unable to have a biological child of their own with current fertility treatments. People can have both sentiments at the same time.

In particular, participants were very divided on the issue of developing egg cells from male skin cells and sperm cells from female skin cells. This could, in a distant future, enable same-sex couples to have a biological child of their own. While a large group was in favour of such a development, there was also a significant group that felt this was a step too far. Comments such as “Interfering with nature”, “Manipulating egg and sperm cells”, “Turning the world upside down”, or “Reversing nature” were written down on the whiteboards.

Biological clock

Occasionally, people questioned a possible increased age gap between generations as a result of stretching the age at which people have children. They felt it was important to respect the human biological clock.

Human enhancement and striving for perfection

Human enhancement is the process of improving the innate qualities of human beings. Developing embryo models can provide new opportunities for embryo selection and making genetic changes to offspring through germline modification (altering embryo DNA). This could help to prevent serious diseases, but also offers opportunities to make people stronger, smarter or faster. How do the public want future generations to be shaped? What risks are they willing to take?

No one was in favour of human enhancement, similar to the findings of the DNA dialogues (Rathenau Instituut, 2021). A frequently mentioned condition for research with embryo models was that the offspring should not be modified too much in the pursuit of perfection. Many people specifically mentioned that manipulation or selection on the basis of gender, hair or eye colour and intelligence is undesirable. Many expressed a fear that embryo models could be used to improve the gene pool and, another step further, even for warfare. The word 'übermensch' also came up several times, as well as references to World War II. Some worried that research will lead to such applications in the long run, and that this will have negative consequences for society.

Suffering is life/life is suffering

Some participants worried that development of embryo models could also lead to unintended human enhancement. They asked how far we want to go in bringing 'healthier' people into the world. The majority felt that this technology should only be used to prevent diseases that are sufficiently severe. People commented that suffering and imperfection are to a certain extent part of life, and part of what makes life special.

Wider interests at stake

There were participants who felt that this development prioritised the interests of future parents over those of future children. Areas of concern included genetic relatedness and identity. For example, one or two wondered whether there could also be negative consequences for children when they learn they were born "from a skin cell" or even that their DNA has been modified. Another question was "Is this child still mine?".



Some participants were also concerned about what this development would mean for humankind in the long run. The implications for human evolution were discussed with considerable caution. Some looked at the perspective of the global community and shared their concerns that research, and reproductive applications in particular, may have unforeseen or negative consequences for the 'natural' evolution of humankind. These concerns included potential long-term human health risks that would arise from this technological development. For example, participants were concerned that the use of embryo models would weaken human evolution, amongst other things through a decline in natural selection. Another concern was reduced genetic diversity if parents have a genetically related child on their own. This could make future generations increasingly dependent on biomedical science and technology.

Overpopulation and scarcity were also named as reasons not to prioritize this technology. Some participants felt that human interests are already given too much precedence over those of the earth or nature. They struggled with the question of whether it is responsible to further boost reproduction in a world where overpopulation and resource depletion are already a problem. Finally, it was mentioned that science keeps creating new expectations and hope to solve human

flaws, which could lead to a reduced societal acceptance of the way nature charts its own course.

A minority stated that they did not think the research was the right solution to the current problems facing society. For example, they saw more promise in (natural and less invasive) alternatives such as prevention and lifestyle changes to promote health. Or, for them, the importance of a genetically related child was outweighed by the interests of existing children who do not yet have a safe home (“Will it have a negative impact on adoption?”). Some also mentioned that people with disabilities can also live happy lives and that a society in which these disabilities are filtered out can be stigmatising for people with disabilities or their parents. These applications were seen as a luxury reserved for people in wealthy countries.

4.3 Expectations and trust

In addition to the aforementioned values and ideals, expectations and trust -in relation to science, innovation, policy, agencies and potential misuse- also played an important role in shaping how our participants felt about embryo model research. In this section, we discuss in greater depth our participants’ comments about trust and expectations in the context of research with embryo models. This gives an insight into what our participants expect from policies and regulations. We describe two themes that came up a lot in the discussions, namely expectations regarding scientific progress and trust in actors at home and abroad.

Expectations regarding scientific progress

While the majority of participants thought that fundamental research with embryo models could not in itself do much harm, at the same time many people thought that it would not stop there. A frequently heard comment was that scientific progress is unstoppable (“They do it anyway”) and can only be partially influenced by society and politics.

Firstly, this was due to the huge curiosity of researchers, who could bend the rules if they get in the way of new findings. And secondly, due to the interest scientists and companies have in their intended innovation. Many participants felt this was a worrying development because of the complex nature of technology, where not all effects can be foreseen or prevented.

I feel it's naive to think that this technology will stay in the lab.



The ability of the public and other parties to participate in decision-making and influence policies was considered limited, due to a power imbalance favouring those representing commercial and economic interests. For instance, participants expressed concerns about how developer interests could contribute to unequal access to the technology within Dutch society or at global level.

Trust in actors at home and abroad

At the same time, many participants also have considerable faith in the integrity and ability of Dutch scientists, policymakers and ethics committees to ensure that embryo model research is conducted in socially responsible ways. This is in contrast to the expectations that many participants expressed about countries with non-democratic political systems such as China and Russia, who might use this innovation for their own geopolitical interests in a distant future, crossing all kinds of moral boundaries. Examples given include the development of embryo models into human beings, improvement of the gene pool and warfare.

Conditions for research with embryo models

Many people stated that they felt it was important that this research take place in The Netherlands, but under 'the right' conditions. Participants also felt that Dutch science and politics should play an important role in setting 'a good example' by imposing limits on this research at both national and international level. Other important conditions that were mentioned are:

- A focus on research that helps to alleviate severe suffering.
- A limit to the stage of embryo model development, through modification of the embryo model or by law.
- Informed consent and transparency about the purposes of the research. Where new research objectives are introduced, informed consent should be required again.
- The ability to withdraw your donated cells, including in the event of death.

4.4 The main perspectives

In this chapter, we have analysed the various arguments and values mentioned by participants based on three themes. Alternatively, this analysis can also be approached in terms on the different interests at stake: those of the embryo model, those of the future child, the family, Dutch society, the international context, and even those of the planet and humankind. The next page features an overview of the main perspectives, grouped by importance.



Figure 1 An overview of key public considerations surrounding research with embryo models during our dialogues

4.5 What we learned about perspectives on embryo models

Figure 1 shows that HNEM participants consider many different arguments surrounding the use of embryo models to be important. These arguments concern various and often conflicting interests. Different ideas about the need to protect the embryo, intervention in nature and the limits of making perfect life, as well as expectations and trust in technology and its regulation, play a role. These different types of interests can coexist and often mean that people can only give a nuanced and conditional answer to what they do and do not consider to be important and acceptable. Each person makes their own assessment, so HNEM participants have very different views on the use of embryo models.

The insights presented in this chapter teach us a number of things about how the participants perceive the use of embryo models.

Public debate on this technology extends beyond scientific progress versus religious or philosophical arguments.

The public dialogues that have taken place differ from the current political dialogue, which seems to focus mainly on balancing the need to protect the embryo with scientific progress. The dialogues show that the public have greater concerns, namely: where will the research lead to? What will the different embryo models ultimately be used for? To what extent will this research be prioritised over other research? These considerations are related to the importance attached to having a genetically related child, but also to the role the Netherlands aspires to within an international arena driving this development forward.

Concerns about naturalness and perfection are often balanced against the goals of research.

Participants frequently shared concerns about pushing natural limits. In scientific debate, it is sometimes suggested that the terms natural and unnatural have no real meaning or value (Nuffield, 2015). If we look at the arguments put forward by HNEM participants on naturalness, it is clear that naturalness is part of the assessment of what embryo models should and should not be used for. For what purposes is it acceptable for us to intervene in nature in this way? The answer is very rarely that the creation of embryo models is not justified for any purpose.

Most participants believe the research can be carried out responsibly in the Netherlands and consider it important.

Although a large group of participants have trust in scientists, policymakers and ethics committees in the Netherlands, concerns were raised about possible misuse

of this technology. Participants often placed the research within a broader international context and also pointed out the commercial interests that play a role.

Many participants felt that strict regulation and control was important to ensure that embryo models are protected and to prevent scientists from crossing the regulatory limits set. Another frequently expressed view was that only research expected to help alleviate *severe* suffering caused by congenital conditions and infertility should be fostered. Participants often stated that the Netherlands could take on a leading role in the responsible development of this technology, setting an example to the international community.

5 Reflection on the dialogue method

Why a dialogue?

With Holland's Next Embryo Model, we aimed to contribute to political opinion-forming and democratic decision-making on the use of embryo models for research. Giving the public a voice in scientific and technological developments is important for four reasons.

Firstly, the public have the democratic right to a say in developments that affect them. The development of embryo models is unlikely to have an immediate impact on the lives of most residents in the Netherlands. Yet such technological developments touch on important societal issues: what life is worth protecting? How important is a genetically related child, how much should we spend on research that can contribute to this? Citizens are entitled to a say in these matters. How scientists use embryo models, the resulting knowledge, and how the technology will be applied have consequences for society. Particularly when embryo research can also affect future generations.

Secondly, dialogue can help steer scientific developments toward addressing societal challenges. Dialogue is not a means of creating support for a predetermined goal, but a way of exploring and reconsidering goals, practices and alternative paths with stakeholders in order to guide technological development.

Thirdly, public consultation can help to legitimise and generate wider support for scientific and technological developments. Not just to inform the public about the latest scientific insights and what they can mean for them, but also to shine a light on public interests that may be served by science and technology. Reducing the distance between science and society (in which dialogue can play a role) can lead to broader support and greater trust between the two. This way, public participation establishes stronger links between science and the challenges, practices and needs of society.

And finally, engaging in dialogue provides insight into opinion formation itself. For example, an understanding of the kind of information the public needs to have a meaningful conversation about emerging science and technology. We saw that many people were still forming their opinions during the conversation, constantly relating them to what their discussion partners were saying. A broad public dialogue can thus be seen as an intervention that gets people to think and form opinions.

Engaging citizens meaningfully in scientific and technological developments is important, but it requires careful effort to ensure that dialogue truly reflects the considerations outlined above. With HNEM, we approached this through a broad public dialogue at different events with different audiences. On the one hand, HNEM has stimulated public opinion forming and triggered public debate about embryo models. On the other hand, it has also allowed us to gain insights into citizens' perspectives on the use of embryo models, which we can bring into the political debate. In addition, we informed people about what research is being performed in the labs and the latest scientific findings.

To genuinely influence the development and regulation of the technology, it is important to conduct the dialogue at the right time – namely at a point when these developments are still being shaped. Since the Embryo Act is being debated in the House of Representatives in 2025, and research into embryo models is already taking place in the Netherlands through projects such as the Netherlands Organisation for Health Research and Development (ZonMw) PSIDER programme, this dialogue could not wait.

This project can be regarded as a successful and informative experiment that can be built on for future scientific and technological developments that call for broader reflection within society. In this final chapter, we consider how HNEM has helped to spark public debate and research on public perspectives.

5.1 Sparking public debate

Reaching a wide audience

We chose to attend several events to reach a broad and varied audience. As the creation of embryo models is not yet a prominent topic within society, we tried to inspire curiosity in festival visitors towards this development with a colourful stand with an eye-catching name. A key requirement in the design of the installation was that it must be fun to take part. We therefore turned HNEM into a real show, with a lively presenter, a smoke machine and enthusiastic supporting staff. The hosts, researchers and scientific experts were dressed in yellow and green lab coats, and there was always someone available to speak to curious passers-by. The fact that people were able to take part in the dialogue together probably lowered the barrier to participation.

Despite the festive atmosphere, the discussions had to be conducted in a serious manner. The moderator and the tone they used was very important. Because the cheerful audio clips provided the show with ambience, the moderator could assume the role of curious interviewer. The moderator held the microphone, controlling the

discussion. The moderator also made clear that they had no scientific interest or even expertise in this development. Questions about work in the lab or science could be posed to the scientific experts present. Scientific experts were available and identifiable by their green lab coats.

In addition to the 613 people who took part in our dialogues, our support staff spoke to a large number of people in front of the booth who ended up not participating in the dialogue. Sometimes because a round had just started and they did not want to wait, other times because they wanted to share their opinions with us but had no desire to take a seat at the catwalk table.

The installation has also been covered in various media and academia⁶. HNEM has therefore helped to stimulate public dialogue on this issue outside the festival setting, and we hope also around the kitchen table.

Public information

For many festival visitors, this was the first time they had heard about research with and on embryo models. The information provided to participants enabled them to form opinions or ideas about new scientific developments surrounding embryo models. People do not need to understand all the technical details of the development to engage in dialogue. However, we wanted to give participants a realistic picture of what this development looks like in the lab. People often reacted to the petri dishes with surprise or were confused because they saw 'nothing'. It sometimes made people laugh. The enlarged photos were also difficult for some people to interpret. Nevertheless, our impression is that the combination of the petri dishes and the imagery helped participants to imagine the different embryo models.

Together, the audio clips and the moderator told the story of embryo models from the scientific perspective, without representing the interests of science itself: 'Scientists think that...' For technical details, participants could talk to the lab researchers wearing green lab coats. Participants were given information on the research purposes of the different embryo models: to carry out research into the origin and treatment of diseases, to increase possibilities for reproduction, and to study reproduction itself. We also provided information on what the models can or cannot yet do.

⁶ See:

(1) <https://www.medischcontact.nl/actueel/laatste-nieuws/nieuwsartikel/zijn-kunstmatige-tweelingembryos-hollands-next-embryo-model>

(2) NPO Focus podcast: <https://npo.nl/luister/podcasts/101-focus/111909>

(3) Lowlands: where science meets music, Nature, 634(8032), 251-253 (Docter-Loeb, 2024)

It is important to realise that as a researcher, providing information is itself an intervention in the discussion, and this must be approached with caution. Petri dishes and photographs, for example, are a scientific way of presenting information, which has been preceded by all kinds of decisions of which the participant has no knowledge. What is being depicted? How is this done, for example is staining used? Which text do you highlight? What information do you provide? Which photos do you not show? These aspects had to be taken into account for the different components of the installation, the signs featuring photographs and audio clips. We got scientific experts to check our texts, but only for factual inaccuracies.

A collective dialogue

A conversation around the table is not only fun but also helps to form opinions. Responding to each other brings the topic alive. People sat around the table with others who they did or did not know, creating a different dynamic in each group. Sometimes people were very much in agreement and built on each other's perspective, while other times people had conflicting opinions. Some people also adjusted or qualified their opinions during the conversation.

The presence of scientists at each event who themselves work with this technology in the lab played an important role in ensuring meaningful discussions. Their presence allowed them to answer questions about the technology and quite literally brought scientists and citizens closer together. Participants saw that the scientists were hearing what they were saying, and the scientists themselves got a better understanding of the considerations that the public make in arriving at an opinion.

Participants' evaluation of HNEM

Finally, how did taking part in HNEM affect the participants? At the end of the dialogue, many participants appeared to have at least learned more about what is possible with embryo models. After each round, we asked someone to fill in an evaluation on the iPad, which resulted in a sample of 82 participants. The majority had never heard of research with embryo models and said they learned new information during the dialogue. The vast majority found the dialogue easy to follow. We saw that almost half of the participants had changed their minds as a result of the dialogue. Some had a more negative opinion about embryo models afterwards (14), others a more positive opinion (26).

5.2 Research into public perspectives

Who did we talk to?

The aim of HNEM was to identify the different types of arguments and values that people in the Netherlands consider relevant. Because it was important to speak to

people from different backgrounds, we attended five different events, which we tried to approach as broadly as possible.

The aim of this study was not to quantify the opinions of a cross-section of Dutch society, so we may have missed out on arguments or nuances that are important to certain groups. We will also have spoken to a selection of the audience at the events. At Lowlands, for example, part of the site was dedicated to science, which mostly attracts people who have an interest in science. At the Libelle Margriet Summer Week, a relatively small proportion of the people we tried to recruit ended up taking part. Those who did not participate included a group that found the development to be quite scary. In many cases, these people were willing to have a brief conversation with us, and we took notes of these conversations to enable us to include their concerns or thoughts in this report.

Decisions had to be made when selecting suitable locations to engage with people. Prior to these decisions, we looked at who attends the various events.

Most of our participants were visitors to one of the three larger festivals: Libelle Margriet Summer Week, Zwarte Cross and Lowlands. Naturally this means that we only reached a specific section of the public in the Netherlands. We plan to publish the results of a survey in spring 2026⁷, which will also provide us with quantitative data on what a broader group of Dutch people think about research with embryo models.

Conducting research at a festival

There are preconditions that must be met when conducting research at a festival. Limitations included time: visitors mostly come to shop or to watch an artist perform, so HNEM had to be fairly short. Still, because we conducted a large number of dialogues overall, we collected a broad set of arguments. We did have to make concessions in terms of exploring the arguments in depth and thoroughly considering the preconditions for this research. In that respect, HNEM needs to be supplemented by other research and dialogues on the ethical, legal and social aspects of embryo model development. This is being done in the context of projects such as the ZonMw PSIDER programme.

Attending events presents practical challenges. A great deal of work was required in advance of the festivals, first to qualify for a place at the festivals, and then to fine-tune arrangements for each festival. A substantial team effort is required to assemble the installation on site each time and remove it at the end. It also takes a lot of teamwork to transport and man the installation. In addition, we faced different conditions at the different festivals while conducting the dialogues. At Zwarte Cross,

⁷ This is a follow-up to the report *Gewicht in de Schaal* (2019).

for example, we were next to a stage that was regularly playing loud music. Fortunately, with the headphones on, we could still carry on a conversation.

Festival visitors have limited time to join in a dialogue. Participants take part on a voluntary basis. The experience must be stimulating and informative and not require too much energy and time from visitors. This meant that we were not able to present the topic to participants from all the different perspectives, and there was limited time for discussion. Research at festivals is therefore particularly suited to a broad, exploratory research question like ours in this case. By contrast, the other studies in the PSIDER programme do allow for longer and more in-depth dialogues with more specific target groups⁸.

The advantage of collecting data at festivals is that there are a large number of potential participants walking around, many of whom approached the installation openly and with interest. As a result, there was a constant flow of new participants which made the research very labour-intensive. To keep the show running continuously at the event, there had to be at least six people from HNEM: a presenter or moderator, two assistants, a researcher and two people recruiting participants. In practice, eight to ten people were present as the days were long and breaks were also needed.

5.3 Lessons on dialogue with a wide audience

This report shows that public dialogue can provide a great deal of insight, but also that it requires a thorough and time-consuming approach. The types of insights provided by HNEM give an indication of where public dialogue can and cannot be used. We have drawn the following lessons from this experience with the HNEM experiment:

Collaboration between different partners is essential for a proper dialogue

When different goals are being pursued, as in the case of this project, it works well to collaborate with different partners who each have their own expertise and perspective. In this case, NEMO Science Museum took care of production and information (translation to the public), Fillip Studios provided an attractive and practical installation, while the Rathenau Instituut was responsible for the scientific quality of the research.

⁸ See, for example, our article on focus groups (in Dutch) <https://www.rathenau.nl/nl/gezondheid/nederlanders-genuanceerd-over-eicellen-en-zaadcellen-uit-het-lab>.

Our scientific partners also played a key role in the success of the dialogue. It is important that the public can voice their opinions to a party that has no direct interests (in this case, the Rathenau Instituut and NEMO Science Museum), but at the same time, the discussions should not detach from scientific practice. The dialogue goes both ways: scientists need to be part of the public dialogue, and dialogue can also help to better align science with social objectives.

Make science tangible and stimulating for a wider audience

Specific preconditions must be taken into account when organising a dialogue at a festival or event. The dialogue experience must be fun and engaging or enjoyable. HNEM's installation was a source of much surprise and curiosity among passing festival visitors. It looked colourful and the title was catchy and raised questions in people's minds. Passers-by approached to see what was going on. The festive atmosphere and lab coats also added to the festival experience, lowering the threshold for people to join in.

Public dialogue is needed on sensitive political issues, but does not provide easy answers

In The Netherlands, where the development of new technologies is socially sensitive, we see increasing calls for public dialogue. On the one hand, the growing focus on public interests is a positive development, for the reasons presented at the start of this chapter. On the other hand, public dialogues do not provide easy answers. Really engaging with the public always reveals how different opinions are, even among people who seemingly belong to the same target group. We have seen many examples of family members disagreeing among themselves, or groups of friends disagreeing with each other.

Public dialogues do not provide easy answers, but they do reveal societal aspects that need to be considered in political decision making. They do not give clear direction to science and science policy but provide depth and nuance to the debate. It is therefore important for policymakers and politicians to take on board the full breadth of the dialogue, rather than just highlighting salient or opportune results from the report.

The aim of a dialogue is to gather values and views from within society so that policymakers can take them into account when designing policies. It should not be used as a means of delaying political discussion and decision-making.

In conclusion

Although conducting a meaningful dialogue with different target groups requires considerable labour and financial effort, there are important reasons to keep organising such dialogue on technological developments. Our festival installation

enabled us to speak to many people who would otherwise never have joined this conversation. HNEM was a way of bridging the gap between people and scientific institutions, an arena in which society and science could come together.

Yet the HNEM dialogue alone is not enough: incorporating public perspectives into science and policy is an ongoing process. This needs to be done on a long-term rather than a one-off basis to ensure meaningful public engagement in the development of science and technology. The public and those representing public interests should have a say in setting the agenda for research, developing research programmes, decision-making on research funding, assessing research proposals and supervision of projects.

At the same time, not every new, ethically sensitive technology or sub-technology requires an extensive dialogue like HNEM. People react based on a broader framework of values, which also applies to other technological developments. It would therefore be useful to also draw broader lessons from the values on which the public focus, such as grasp of technology, fairness and accessibility, and embed these in political and policy processes.

Finally, we thank all parties who helped to produce this report (see Appendix 1), in particular NEMO Science Museum, Fillip Studios, and the scientists involved. And above all, we thank all the participants who wanted to engage with us at the various festivals.

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Appendix: HNEM staff

The following people took part in Holland's Next Embryo Model:

NEMO Science Museum

Eef Grob, Janneke Kluvers, Jeroen Wiegertjes, Marcia van Woensel

Fillip Studios

Tom Kortbeek, Roos Meerman

Rathenau Instituut

Sophie van Baalen, Lotte van Dijk, Rosanne Edelenbosch, Luuk Ex, Michelle Habets, Simone Harmsen, Thomas Verra, Freek van der Weij

Team Festival

Emile van den Akker, Danique Bax, Thijs van Boxtel, Mike Broeders, Marit Coppens, Liza Dijkhuis, Gert-Jan van den Dorpel, Joost Gribnau, Eline Groen, Annika de Jong, Kim de Kleijn, Sabine de Klein, Marieke van Leeuwen, Annet Linders, Hendrik Marks, Callista Mulder, Ana Pereira Daoud, Isabelle Pirson, Amy Scheren, Marien van der Stel, Jeske Strik, Joelle de Visser

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