

Dutch Media are no agents of change for synthetic biology yet

Elisabeth de Bakker¹

Freudenthal Institute, Utrecht University, Utrecht, The Netherlands

Marie-Christine Knippels

Freudenthal Institute, Utrecht University, Utrecht, The Netherlands

Abstract

Recent years have seen an increased interest in and demand for public communication of science. Grant proposals these days are not complete without a societal paragraph in which the researcher sets out how the study will be socially relevant and how the findings will be communicated to the public. Often a public engaged in open dialogue about science and technology seems to be the ultimate goal to strive for. This commentary presents the 'state of affairs' of the public debate about the emerging science research field of synthetic biology in the Netherlands, and the contribution of the Dutch media to it. Given the fact that one wishes science communication to be effective, and that a public, balanced and open dialogue about synthetic biology will emerge, advice will be given based on lessons learnt from Dutch science education.

Introduction

Researchers, policy makers and science communication professionals alike would like science communication to be an agent of change. However, when it comes to science communication about emerging technologies, this proof is often still to come. Especially as the goals that are aimed for are challenging and hard to meet: raising awareness, empowering people and engaging them in social debate and open dialogue about new and rapidly developing fields of science and technology.

One of these new and rapidly developing areas of research is synthetic biology. It is a field of science that could draw a lot of attention in the future and has the potential to evoke controversy. Synthetic biology is "the application of science, technology and engineering to facilitate and accelerate the design, manufacture, and/or modification of genetic materials in living organisms." (SCENIHR, SCCS, & SCHER, 2014).

In synthetic biology concrete segments of DNA that are made from scratch or that are taken from different species, can be put together to make new DNA structures. These novel biological systems may be applied in the areas of health, sustainability, scarcity of resources, and energy security. Products in the making include new medicines and vaccines, and bio-fuels.

Synthetic biology is often compared to, or referred to as an 'extreme form of genetic engineering'. Genetic engineering, years ago, when it was an upcoming research field in the 1980s and 1990s, created a lot of controversy and triggered a diversity of social and ethical

¹ Corresponding author, email: e.p.h.m.debakker@uu.nl)

questions amongst the public, resulting in general social resistance against the technology (Boerwinkel, Swierstra, & Waarlo, 2014). For instance, scientists were being viewed as 'playing God', and concerns about safety and risks were aired. There were and still are worries about the potential impact of genetically modified organisms on the environment, impacts such as monster species or new uncontrollable plagues. And as synthetic biology is so closely related to genetic engineering, it is expected that similar sentiments will develop around synthetic biology as well.

As a matter of fact, there is evidence that such sentiments already exist. In France, in 2013, a public debate about synthetic biology did not take place due to protests by an activist group which was well-known for its opposition against any public debate in the field of nanotechnology (ECSITE, 2014, p.43). And more recently in The Netherlands in 2016 at a stakeholder forum on synthetic biology an open letter was handed out by a member of the 'synbiodialogue' group, asking scientists to stop their synthetic biology research efforts.

Social debate and open dialogue

Hoping to avoid the stalemate discussions which are still ongoing about biotechnology, genetic engineering and GMOs, the European Commission decided to invest in a number of projects focusing on synthetic biology. One of these projects is SYNENERGENE (SYNENERGENE, 2014) with its main goal of empowering and engaging people in social debate and open dialogue about this emerging technology. All voices can and should be able to participate, pro's and con's should be voiced, and listened to. Mutual learning ideally should take place.

The project's goal is of course truly laudable but as it appears now, five years down the line, it is very hard to get people to discuss something that they don't yet know about. Synthetic biology is so new, and still so much under development that at this stage there are very few concrete products entering society. In 2010 83% of Europeans had never heard about synthetic biology (Gaskell et al., 2011). It's just the scientists themselves that discuss the potentials and impacts of the research field. And now, eight years later, the situation does not seem to have improved much. Partners in the SYNENERGENE project all report having difficulty finding people from different stakeholder groups willing and able to participate in public debate and dialogue.

So despite the fact that the media did report, albeit not in huge quantities, about synthetic biology over the past 12 years, the public apparently still doesn't feel empowered, informed or engaged enough to be willing to participate in public dialogue about this emerging field of science. So, what's going on here?

The media are often the public's first port of call for information. In addition the media can empower the public to have a dialogue about synthetic biology, for instance by influencing views that people may have (Oliveras, Marquez, & Sanmarti, 2013). For this, media use a variety of frames for their messages, thereby possibly affecting the views and opinions of readers.

Also, media can shape the public agenda (Sharpe et al, 2016) and different frames used by journalists and the tone of their articles influence people's views and opinions about synthetic biology. Therefore it is interesting to study media coverage of synthetic biology, which in 2016 Kim Hartman and in 2017 Maaïke Borgers did for their master research projects at Utrecht University.

Dutch synbio media coverage

Hartman's study mainly focused on the frames used. Frames can be defined as "collections of perceptions and thoughts that people use to define a situation, organize information, and determine what is important and what is not" (Kaufman, Elliott, & Shmueli, 2003). Media frames focused on in this study are those often applied to technological innovations (emerging technologies): Progress, Economical, Ethical, Risk, Nature-Nurture, Laws and regulation, Globalisation (Overbeek, Knippels, & Waarlo, 2014; based on Nisbet & Lewenstein, 2002, Kaufman, Elliott, & Shmueli, 2003, and Carver, 2012). For a more elaborate overview of the frames used, see table 1.

Media frames	Description/questions
Progress	What can the innovation bring in terms of progress? Does this have any negative aspects? Progress can be prosperity, welfare, doing good or it can be about preventing damage.
Economical	What can the innovation bring in terms of economic progress? Does this give any benefits to people or society? Or does the innovation has a negative influence on the economy?
Ethical	Is the innovation responsible in terms of ethics? Are ethical principles concerned? What are the boundaries? What are possible consequences of accepting – or <i>not</i> accepting – the innovation?
Risks	What risks does the innovation entail? Are these risks <i>hard impacts</i> , where the innovation has measurable consequences, or <i>soft impacts</i> , where the consequences cannot be measured. Hard impacts can be about bio-safety and bio-security, or possibly unknown risks. Soft impacts can be about the influences of the innovation on persons or society.
Nature-nurture	Does the innovation have any influence on nature-nurture? Does it, for example, influence the environment or genetic variation?
Laws and regulation	Who controls the innovation? Who regulates it? Who makes the rules? Does the public have any influence on the regulation, are they responsible for it? Are different stakeholders involved?
Globalization	What are the consequences of the innovation worldwide? Do Third World countries profit as well? Does our own country benefit from it?

Tab. 1: Media frames for technological innovations (Overbeek et al., 2014).

In the analysis of the coverage of synthetic biology in the Dutch media, the majority of the items found were print articles. They came from a variety of the most important quality daily newspapers. The first articles about synthetic biology appeared in 2007. Ever since then 177 articles were published in daily newspapers. Ninety articles were studied by Hartman (2016) and the outcome of that analysis was that 60% of the articles contained the 'progress' frame. The 'risk' and 'ethics' frame came second and third with 16% and 13%. The other frames were rarely present in the analysed articles.

Hartman's study prompted a more in-depth and a more elaborate study by Borgers (2017). She also studied the representation of synthetic biology in Dutch media but this time using a framework which had already been used in similar studies in other European countries, and which largely included the frames used in Hartman's study (German-language countries: Gschmeidler & Seiringer, 2012; Scandinavian countries: Ancilotti et al, 2015, and Sweden and Italy: Ancilotti and Eriksson, 2016).

Five aspects were studied of news articles dealing with synthetic biology: publication date; motive for publication; normative impression; mentioned application, risks and ethical issues; metaphor use. In the period of the years 2000 – 2016, 261 articles were found dealing with synthetic biology. Also Borgers found that most of the articles were published after 2007.

Most motives for publication were event-led, so a competition on synthetic biology or the opening of a new synbio research facility. In general the articles had a positive normative impression and most often dealt with (future-oriented) medical and environmental applications. The metaphor most often used was 'engineering and building'. Only one in four articles mentioned risks or ethical issues and in general these issues were dealt with superficially rather than in depth.

So, Borgers' findings were in line with Hartman's study and the other studies focusing on media representation of synthetic biology in other European countries. Overall the 'progress' frame is very dominant. Many articles deal with a (future) environmental or medical application, so they report on 'promises for the future'. In contrast, very little information is given about current developments and applications. This is understandable as at this stage of development of the synthetic biology very few concrete applications have come about that are directly relevant for society. At the same time this is problematic if one's communicative aim is to facilitate and support public dialogue about synthetic biology. If the public doesn't have concrete applications to talk about, if the bulk of the information is about future promises, then simply no public dialogue will come about.

Lessons to be learnt from science education

In search of possible answers or solutions to the current lack of public discourse about synthetic biology, the science education domain may be a good place to investigate. Science educators have to deal with similar challenges, as they are making lesson modules aimed at opinion forming and open dialogue in class rooms about synthetic biology. As very few concrete applications are present in synthetic biology, teachers and researchers in the Netherlands decided to write them themselves: future scenarios or so called techno-moral vignettes.

Studies show that the scenarios that helped the students forming an opinion and that could be used in classrooms to aid and support the discussion, had the following characteristics: The scenarios should be concrete enough, they should focus on a synthetic biology applications the students could identify with, for instance an anti-ageing pill. They also should contain a good, empathic, imaginative narrative that helped the students depict a realistic future with synthetic biology for themselves (Boerwinkel, Swierstra, & Waarlo, 2014). Scenarios that met these criteria were successfully used in lessons modules aimed at opinion forming and facilitating open dialogue about synthetic biology in classrooms (Ripken, 2015; Slegers, 2014).

With regard to the 'risk' and 'ethics' frames science education studies (e.g. Boerwinkel, Swierstra, & Waarlo, 2014) show that these frames are among the most complex to understand and discuss and form an opinion about, since they are so multifaceted. Ethics, for

instance, involves personal values and beliefs, and in risk, next to 'hard impacts' (quantifiable risk), the non-measurable consequences of an innovation, like unpredicted side effects on individuals and society (i.e. soft impacts) play an important role.

Lessons to take away from the science education research field are therefore threefold: for good elaboration or public discourse on an emerging science and technology, the public needs to have good, concrete examples, some support in opinion forming and a grasp of all the aspects, frames and social issues involved.

When we look at the way synthetic biology currently is represented in the Dutch media, we see several potential problems arise. For one, synthetic biology is not much of an issue yet in Dutch science news coverage and very few concrete examples have entered the market. In addition, there is the fact that ethics and risk are aspects that are not often mentioned in the media, and if present, they are only dealt with superficially. As issues of risk and ethics are very important and complex, it is exactly that elaboration that is important and necessary if one wants to get a good grasp of what synthetic biology is and entails. An additional worry is that frames like 'globalisation', 'laws and regulations', and 'economics' are not even present yet in the representation of synthetic biology in the Dutch media.

A good preparation

So, at the moment there is no public dialogue about synthetic biology to speak of in the Netherlands. But given the fact that synthetic biology can easily be seen as 'extreme genetic engineering', it is plausible to say that society is at the brink of a such a public debate taking off. If governments, opinion leaders, and the broader society would like this debate to be an open, balanced dialogue about where society wants to go with all the potential applications of this research field, there is work to be done in order to start this process well prepared.

The public needs to be well informed and feel empowered. Clearly the science education field feels they have a role to play in this process. The question is however, if the media (should) feel the same way. They have other aims, other publics to serve. But just in case they want to join in this effort of supporting public debate, then several suggestions can be kept in mind.

At the moment, at least in the Netherlands, their coverage is not yet broad and balanced enough. So, more stories please about concrete, actual applications, more in-depth coverage of risk and ethics related issues, and attention for the globalization, law and regulations, and economics frames. If there is a lack of concrete, actual applications, then future scenarios that are evocative, relevant and concrete for the public may be of help.

If the media decide to facilitate synthetic biologists and science communicators, and invest now in a more broad and balanced coverage of synthetic biology, then, hopefully, in about 5 to 10 years, it may become possible to empirically prove that science communication, in the form of offering and supporting well-balanced public dialogue about emerging technologies such as synthetic biology, indeed can serve as an agent of change amongst the citizens.

References

Ancilotti, M., & Eriksson, S. (2016). Synthetic biology in the press. In K. Hagen, M. Engelhard & G. Toepfer (Eds), *Ambivalences of Creating Life – Societal and Philosophical Dimensions of Synthetic Biology* (pp. 141-156). Springer International Publishing. Doi: 10.1007/978-3-319-21088-9_7

Ancilotti, M., Holmberg, N., Lindfelt, M., & Eriksson, S. (2015). Uncritical and unbalanced coverage of synthetic biology in the Nordic press. *Public Understanding of Science*, 26(2), 235-250. doi:0963662515609834

Boerwinkel, D.J., Swierstra, T., & Waarlo, A.J. (2014). Reframing and articulating socio-scientific classroom discourses on genetic testing from an STS perspective. *Science & Education*, 23(2), 485-507.

Borgers, M. (2017) Representation of synthetic biology in Dutch newspapers. *Master thesis*, Freudenthal Institute, Utrecht University.

Carver, R.B. (2012). *Framing the gene: A science communication study of how newspapers frame different meanings of the gene concept, with applications for science education*. (Doctoral dissertation). Oslo: University of Oslo.

ECSITE (2014). D2.4 *Toolkit*, Synenergine, co-funded by the European Union under the 7th Framework Programme, Karlsruhe, Germany / ECSITE, Belgium.

Gaskell, G. et al (2011). The 2010 Eurobarometer on the life sciences, *Nature Biotechnology*, 29, 113-114.

Gschmeidler, B., Seiringer, A. (2012). "Knight in shining armour" or "Frankenstein's creation"? The coverage of synthetic biology in German-language media. *Public Understanding of Science*, 21(2), 163-173. doi:10.1177/0963662511403876

Hartman, K. (2016). The representation of synthetic biology in the Dutch media. *Master thesis*, Freudenthal Instituut, Utrecht University. <http://dspace.library.uu.nl/handle/1874/327880>

Kaufman, S., Elliott, M., & Shmueli, D. (2003). Frames, framing and reframing. In G. Burgess & H. Burgess (Eds.), *Beyond intractability*. Colorado: Conflict Information Consortium, University of Colorado, Boulder.

Nisbet, M.C. & Lewenstein, B.V. (2002). Biotechnology and the American Media: The Policy Process and the Elite Press, 1970 to 1999. *Science Communication*, 23(4), 259-391.

Oliveras, B., Marquez, C., & Sanmarti, N. (2013). The use of newspaper articles as a tool to develop critical thinking in science classes. *International journal of Science Education*, 35(6), 885-905.

Overbeek, M., Knippels, M.C. & Waarlo, A.J. (2014). Docententool voor het voeren van de klassikale dialoog (Teacher tool for classroom dialogue). Unpublished internal document, Freudenthal Instituut, Utrecht University.

Ripken, G.C. (2015). Supporting opinion-forming of secondary biology students on SynBio-related SSIs. *Master thesis*, Freudenthal Instituut, Utrecht University. <http://dspace.library.uu.nl/handle/1874/316593>

SCHER, SCENIHR, & SCCS (2014). *Opinion on synthetic biology I Definition*. European Commission, Brussels, Belgium.

Sharpe, K., Di Pietro, N., & Illes, J. (2016). In the kno and in the news: how science and the media communicate about stem cells, autism and cerebral palsy. *Stem cell reviews and reports*, 12(1), 1-7. Doi: 10.1007/s12015-015-9627-3

Slegers, A.M. (2014). Techno-moral vignettes in socio-scientific issues-based education on synthetic biology. *Master thesis*, Freudenthal Instituut, Utrecht University.
<http://dspace.library.uu.nl/handle/1874/293033>

SYNERGENE (2014). What is Synenergene? Retrieved from
<https://www.synenergene.eu/information/what-synenergene>

Acknowledgements (when applicable)

The authors thank all the students and colleagues that have been involved in the research projects concerning synthetic biology education and communication over the past 8 years here at the Freudenthal Institute of Utrecht University. We also want to thank our colleagues of the SYNERGENE project.