Synthetic Biology in the Press

Media Portrayal in Sweden and Italy

Mirko Ancillotti and Stefan Eriksson

1 Introduction

1.1 The Role of the Public

Synthetic biology is an emerging field, still in its infancy in light of difficulties in defining it (Arkin et al. 2009), legal disputes about intellectual ownership (Nelson 2014), and calls for regulation before it is given free reign (Schmidt 2008; Kelle 2013). The Global Network of Science Academies has recently issued a positional statement in which they acknowledge the need for specific regulation, encourage the dissemination of guidelines, and call for assuming scientific responsibility. A point of special interest is the importance assigned to the public: science outreach and public engagement are heavily promoted (Global Network of Science Academies 2014).

It is a trend that technology assessment should involve the public. This seems particularly true in the case of synthetic biology; given the potential the field holds to affect everyone's life. When scientists reach out to society, however, there is a risk for spinning (i.e. giving a biased view of) anticipated results or future applications. Andrew D. Ellington, Professor of Molecular Biosciences, has observed that "synthetic biology's key utility is to excite engineers, undergraduates and funding agencies" (Arkin et al. 2009). This-coupled with some ethicists focussing on anticipative or even speculative ethics (of what might come to be) and media focussing on drama—can put the public and policy makers at a disadvantage

M. Ancillotti (✉) · S. Eriksson
Centre for Research Ethics and Bioethics, Uppsala University, Uppsala, Sweden
e-mail: Mirko.Ancillotti@crb.uu.se

S. Eriksson
e-mail: Stefan.Eriksson@crb.uu.se

K. Hagen et al. (eds.), *Ambivalences of Creating Life*, Ethics of Science and Technology Assessment 45, DOI 10.1007/978-3-319-21088-9_7

regarding their ability to properly assess and its possible applications. Therefore, the way the public is addressed and the way synthetic biology is made addressable are key factors for public involvement.

Some of the rather problematic, albeit central, issues in technology assessment are then how and to which extent the public should be involved in it. Two main impulses can be recognized: on the one hand a tendency to rely on experts' analyses, on the other the drive for public deliberation, i.e. to include the views of the public and social interests in the determination of the path of science and technology (Hennen 2013). Ideally, public engagement facilitates that particularly sensitive scientific research and fields develop in accordance with public interest and in a way that makes sense of common moral intuitions.

The strive for public engagement is not immune from criticism and, as remarked by Richard A.L. Jones, there will always be resistance to public engagement influencing the process of setting priorities (Jones 2014). The reasons for resistance can be many. Jones pinpoints three political reasons. First, it can be assumed that politics and science are separate spheres and that the scientists providing advice are reliable while external opinions are expressions of non-objective and biased positions. Second, the idea of the engaged public influencing policy is contrary to representative democracy, since they are not answerable to Parliament. Third and foremost, the free market might be considered a better way to aggregate public preferences about new technologies (Jones 2014).

There is also resistance rooted in the individual integrity of citizens. There might be a risk that both governments and lobbying groups, in their attempt to influence and ameliorate things, become "oppressors" of others and make them feel obliged to embrace a specific view (Hansson 2008). Sociological studies have pointed to the fact that public engagement can lead to a hasty acceptance and justification of new technologies or research programs (Irwin 2001; Árnason 2012).

Nonetheless, there has been an increase in the last 10–15 years of calls for more public engagement. This tendency can be spotted among scholars (e.g., Hennen 2013; Wareham and Nardini 2013), professional societies (e.g., Global Network of Science Academies 2014), funding programmes (e.g., Horizon 2020), and governmental organizations (e.g., Synthetic Biology Roadmap Coordination Group (SBRCG) 2012).[1]

Science outreach is mostly beneficial for scientists (Bentley and Kyvik 2011). The reason for this is that science outreach not only fills a perceived knowledge gap or enhances citizens' scientific literacy, but legitimates the research. Adrian Mackenzie recognizes two ways in which synthetic biology can be furthered by appeals to the public (Mackenzie 2013). First, by scientists announcing that their research is "momentous and vital" (exemplified by J. Craig Venter), second, by scientists including in "doing" science the task of rendering it more accessible or

[1]For a deeper analysis of the role of public engagement in the assessment of synthetic biology see Seitz, this volume.

interesting to the public. The difference lies not merely in a more or less hyperbolic communication style, but in the extent to which and the way one conceives of science as a social enterprise.

The investigation of the ethical and social implications of synthetic biology can benefit from empirical data about the public perception of the field. There are basically two ways to conceive of this task; either to investigate and try to measure the public reception, for example by conducting group interviews (e.g., see Steurer in this volume) or by analyzing how information is presented to the public. The present work is based on the latter strategy and studies the media portrayal of synthetic biology.

1.2 The Role of the Media

The media can be considered the primary arena in the selection both of which issues to bring forth and of the form for bringing them to the attention of the public, decision makers, and interest groups (Nisbet et al. 2003). According to Dorothy Nelkin, media do not only frame issues to be served as news to the recipients, they also frame social relationships and shape the public consciousness on science events (Nelkin 2001). According to some authors, these are indeed the *effects* of media communicating science and technology to a wide audience, but this should not be confused with media's primary function, which is to set agendas and bring issues to the public attention (McCombs and Shaw 1972; Nisbet et al. 2003). Media do have social impact but an undetermined one, as they attract the attention of a non-committed, fragmented, busy audience that is looking for entertainment (Dunwoody 1987). Reporters usually work under deadline pressure and deal with complex issues. Much of the content of their stories depends on the way their sources provide the information to them (Kruvand 2012). Let's take the case of press releases; journalists should use them to attain knowledge about a certain scientific development and communicate it to news consumers, but they are also consciously used by researchers to attract media and funding bodies' attention to positive results of their research (Yavchitz et al. 2012).

The media should not be given a role that they do not and should not have; to wit, to educate citizens, but they can surely be helpful in attracting the attention of a broad audience on important scientific and technological issues, such as synthetic biology. In this they can give a more or less adequate picture of the issue and its consequences and thus shape future deliberations. It is therefore interesting to investigate how an issue such as synthetic biology has been portrayed and from where depictions find their substance.

The present chapter presents empirical data on the relationship between the media (the daily press) and synthetic biology and investigates how the public of two countries, Italy and Sweden, are faced with this new field.

2 Aims and Research Questions

The overall aim of the study is to investigate how the media have been portraying synthetic biology to the public in the light of the idea that mass media contribute not only to informing the public but can also contribute to shape ideas about the issues they write about.

In order to understand how the media in the examined countries have been portraying synthetic biology, and—as a consequence of that—what news consumers have been told about it, the following research questions were formulated:

- What were the reasons for coverage?
- What figures of speech were recurrent and what were the most used framing words?
- Are there notable differences in how synthetic biology was covered in Sweden and Italy?
- How was synthetic biology described?
- What were the featured risks and benefits?
- Was public engagement promoted?
- Does the press coverage mirror the contents of the academic debate?

3 Materials

Three major Swedish and Italian newspapers were analyzed. The press was chosen over other kinds of media as print media are easily accessible and the tools and methods for analyzing them are consolidated. In addition, the newspapers that were chosen can be considered newspapers of record, which means that they are not tabloid, they are not only entertaining, and although their readers are not particularly committed to deal with issues of science and technology, they can still be considered more critical than the recipients of many other media. Adopting a different terminology, the selected newspapers can be defined in their countries as *elite media*; they are those kinds of media capable of setting the frameworks into which other media operate (Chomsky 1997). Also, the audience of a mainstream and traditional medium such as newspapers is quite broad and probably more representative of the lay public than the audience of alternative and new media. The audience of, e.g., a scientific blog need to put in more effort to get and to stay in touch with its preferred media outlets and thus it represents an already attentive public.[2]

[2]The lay public is here used to describe people, including scientists, who are no experts in the field. An attentive public is "the part of the general community already interested in (and reasonably well-informed about) science and scientific activities" (Burns et al. 2003).

This analysis concerns two European countries that are quite different in terms of cultural roots, social dynamics, media freedom,[3] and probably also regarding attitudes towards science and technology.[4] What they have in common is that they have not, or have only marginally, been considered in previous studies on synthetic biology public reception, and neither Sweden nor Italy has proceeded with a structured involvement or engagement of its citizens with regard to synthetic biology. Thus, the media coverage of synthetic biology in these countries has probably not been influenced by any political agenda promoting science outreach or public engagement. This is in contrast with, for example, the UK, where there are important governmental programs to inform and engage the public (Bhattachary et al. 2010; SBRCG 2012), or with Germany, where there is a considerable amount of bottom up public participation on biotechnology, since research in life sciences is deemed particularly ethically sensitive (Gloede and Hennen 2002; Peters et al. 2007; Hansen 2010).

The three largest (by circulation) paid-for newspapers in Sweden and Italy from January 1, 2009 to December 31, 2013 were considered. The data about print media circulation were obtained from TS Mediefakta for Sweden[5] and Accertamenti Diffusione Stampa for Italy.[6] The Swedish newspapers are *Dagens Nyheter*, *Svenska Dagbladet,* and *Göteborgs-Posten* (all in Swedish) and the Italian are *Corriere della Sera*, *la Repubblica*, and *il Sole 24 Ore* (all in Italian). Both printed and online versions were considered.

4 Methods

The present work was designed and conducted as a qualitative content analysis following Mayring (2000). This research method was preferred mainly for the reason of completeness and because it is suitable for answering several different kinds of research questions (Bryman 2006).

Articles were retrospectively collected using the media databases *Mediearkivet* and *PressText* and through the archives of each newspaper. Articles were found using search terms, which were selected deductively from the scientific literature (Cserer and Seiringer 2009; Gschmeidler and Seiringer 2012; Pauwels et al. 2012) and inductively (Table 1). In the search were also included the names of renowned

[3]Freedom—from 2009 to 2013—ranks Italy as a nation whose press is defined as "partially free" and Sweden as "free" (Freedom House 2009, 2010, 2011, 2012, 2013). The same conclusions are supported by the yearly index from Reporters Without Borders: http://en.rsf.org/. Accessed 05 Jun 2015.

[4]The 2013 Eurobarometer on the extent to which European citizens feel well informed about developments in science and technology ranked Sweden very high, with a score of 61 %, and Italy very low, with a score of 29 % (European Commission 2013).

[5]TS Mediefakta: http://www.ts.se. Accessed 05 Jun 2015.

[6]Diffusione Stampa: http://www.adsnotizie.it/. Accessed 05 Jun 2015.

Table 1 Search terms, ordered by the best hit rate

Search terms	
Terms	Scientists
[synthetic biology]	Venter Craig (JCVI, US)
[artificial OR synthetic] life	Keasling Jay (UC Berkeley. US)
[artificial OR synthetic] bacterium	Church George (Harvard University, US)
[artificial OR synthetic] DNA	Luisi Pier Luigi (Roma Tre, Italy)
[artificial OR synthetic] cell	Endy Drew (Stanford University, US)
[artificial OR synthetic] protein	Collins James (Harvard University, US)
artemisinin	Stano Pasquale (Roma Tre, Italy)
designer AND organism	Benner Steven (FfAME, US)
[artificial OR synthetic] virus	Chen Bor-Sen (NTHU, Taiwan)
bioterrorism	Forster Anthony (Uppsala University, Sweden)
iGEM	Fussenegger Martin (ETH Zürich, Switzerland)
biobrick	Knight Tom (MIT, USA)
minimal [organism OR genome]	Larsson Christer (Chalmers, Sweden)
bioengineer	Mansy Sheref (University of Trento, Italy)
[artificial OR synthetic] gene	Nielsen Jens (Chalmers, Sweden)
[artificial OR synthetic] genome	Silver Pamela (Harvard University, US)
XNA	Smolke Christina (Stanford University, US)
biosafety	Weber Wilfried (Freiburg University, Germany)
biosecurity	Weiss Ron (MIT, US)

international scientists, selected deductively from the literature and inductively, including three prominent scientists active in Sweden and three in Italy (Table 1) (Oldham et al. 2012; Mackenzie 2013).

Inclusion criteria were the following: all newspaper articles that included a search term and had even a slight connection to synthetic biology as a subject were considered. The absence of the term "synthetic biology" did not represent a discriminating factor. The relevance of the stories found through the search was instead rated on the basis of how much the content engaged with synthetic biology as it has been defined by Benner and Sismour (2005), the Royal Academy of Engineering (2009), and the Global Network of Science Academies (2014).

Each article was read twice. After the first reading articles were formally coded, and after the second reading they were content coded, as detailed below. Both deductive and inductive development categories were applied. Thus, new issues (primarily new topics and metaphors) that recurred in many articles were added to a set of pre-identified categories.

Articles were formally coded with regard to their date of publication, length, and media type. Word counting was performed using QSR International's NVivo 10 software, and three categories were applied: short (0–299 words), medium (300–999 words), and long (1000 words or more). Three main article types were identified: news, feature articles, and—as one type—editorials, columns, and opinion pieces (ECOs).

Content wise, articles were divided into three categories according to the extent to which synthetic biology was central to them: weak, medium, or strong. Articles barely mentioning synthetic biology or giving it just a few words were subsumed

under weak connection stories. Medium and strong categories were those in which synthetic biology was given moderate or extensive space, respectively.

For each article it was considered whether the reason for coverage was a specific event, such as a conference or a scientific publication, or whether the story was about an issue or a certain argument. Articles were also put into four categories according to the narrative: thematic (T), episodic (E), thematic with episodic discussions (TE), and episodic with thematic discussions (ET). The thematic narrative approaches issues in a general context and focuses on long-term outcomes; the episodic refers to case studies, events, and focuses on concrete outcomes; thematic with episodic discussions were the articles whose narratives were mainly thematic, but involved episodic parts; episodic with thematic discussions were the articles whose narratives were mainly episodic, but involved thematic parts (Iyengar 1991; Morgan 2002).

Another aspect investigated concerned the clarity with which synthetic biology was described and whether its characterization was clear enough to enable recipients to distinguish it from other biotechnologies. From this analysis newspaper articles with a weak connection to synthetic biology were excluded. Four categories were assigned: clear, not clear, misleading, and missing (when it was not possible to assess the clarity of the description; in most cases, due to its absence).

A further topic for investigation concerned the language. QSR International's NVivo 10 software was used for producing a frequency word list from all of the articles. A set of framing key words was then selected from the most frequently recurring words employed by the journalists to describe synthetic biology. Besides the framing key words, the type of metaphors used was noted. In this context, the overall tone of the article was also assessed, with the intention of describing the general normative impression given by the articles. The following labels were assigned to each article: positive, neutral, negative, skeptical, or cautious.

Other aspects investigated were the topics of the articles, as well as risks and benefits thought to be related to these. Several topics might have occurred in a single article, thus they are not mutually exclusive. In order to describe the way specific topics were communicated, an evaluative label was assigned to how each topic was portrayed: as positive, neutral negative, or absent. Only articles that had a medium or strong connection to synthetic biology were considered in this particular analysis.

The last aspect investigated concerned the number of times calls for oversight or public interest or public engagement were mentioned (even if only in passing) in the articles.

5 Results

Between 2009 and 2013 the Swedish newspapers considered in this study covered synthetic biology in 36 articles and the Italian ones in 95 articles (131 in total). The percentage of articles weakly connected to synthetic biology was in both countries about 17 % (Table 2). With 65 articles (50 % of the total), 2010 was the most

Table 2 Articles on synthetic biology in Sweden and Italy from 2009 to 2013: strength of connection with synthetic biology

	Weak		Medium		Strong		Total #
	(#)	(%)	(#)	(%)	(#)	(%)	
Italy							
Corriere della Sera	8	27	7	23	15	50	30
Repubblica	2	6	11	30	23	64	36
Sole 24 Ore	7	24	11	38	11	38	29
Tot	17	18	28	30	49	52	95
Sweden							
Dagens Nyheter	3	16	7	37	9	47	19
Svenska Dagbladet	3	30	3	30	4	40	10
Göteborgens-Posten	0	0	2	29	5	71	7
Tot	6	17	12	33	18	50	36
Italy and Sweden	23	18	41	31	67	51	131

productive year (Fig. 1). It is noteworthy that 33 out of the 65 stories were issued between May 20th and May 22nd, 2010. They represent 31 % of all the articles that had medium or strong connection to synthetic biology, and all of them relate to the Venter group's *Science* publication (Gibson et al. 2010) detailing their success in transplanting a synthetic genome into a recipient cell. The length of the articles in Sweden was distributed as follows: 22 % short, 64 % medium, and 14 % long. In Italy the result was comparable: 16 % short, 71 % medium, and 13 % long. The article types were distributed as follows: in Sweden 19 % news, 53 % feature articles, and 28 % editorials, columns, and opinion pieces (ECOs), while Italy had 29 % news, 51 % feature articles, and 20 % ECOs.

Driving reasons for coverage in both countries were events (publications, press releases, conferences, etc.) rather than issues (synthetic biology itself or issues related to it), with a score of 67 % in Sweden and 69 % in Italy. Concerning the

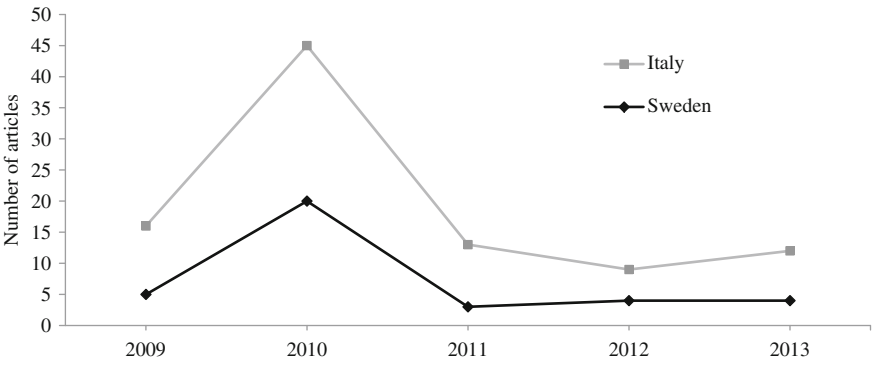

Fig. 1 Press coverage of synthetic biology in Sweden and Italy from 2009 to 2013

narrative, Sweden had 31 % thematic, 8 % episodic, 39 % thematic with episodic discussions, and 22 % episodic with thematic discussions articles, while Italy had 20 % thematic, 33 % episodic, 24 % thematic with episodic discussions, and 23 % episodic with thematic discussions articles.

With regard to the clarity with which synthetic biology was described, in Sweden, 33 % of the descriptions were categorized as clear, 6 % as not clear, 3 % as misleading, and 58 % as missing. In Italy, 34 % were clear, 18 % not clear, 3 % misleading, and 45 % missing. The term "synthetic biology" appeared in 25 % of the Swedish articles and in 46 % of the Italian articles.

The language of Italian articles copiously resorted to models and metaphors to explain issues, but also to express opinions. Although this is an aspect hardly quantifiable, it can be said that approximately 60 % of the stories with medium or strong connection to synthetic biology made heavy use of such stylistic devices. The most common were metaphors of computers and software, creativity, construction, and machines. Swedish stories adopted a more sober language in communicating synthetic biology; stylistic devices were found in about the 25 % of the stories with medium and strong connection to synthetic biology. In Sweden the most commonly used metaphors were those of religion and design. Expressions like "made/created artificial life" were equally pervasive in Sweden and Italy. One of the preferred expressions in Sweden was "milestone in the history of biology/science" with reference to the "creation" of the first synthetic cell. Indeed, there was lot of coverage and great value given to this event. Nonetheless, one of the major preoccupations in many of the Swedish and Italian articles was to not overestimate its scientific or ethical importance.

In the Swedish stories the most used framing key words were *bacteria*, *creation*, and *artificial*, while in the Italian stories they were *bacteria*, *synthetic*, and *artificial* (see Fig. 2). It is noteworthy that in both countries the most recurring term was *Venter* with about 50 % more occurrences than the otherwise most used framing key words. Venter was not considered a framing key word because it is not a term used to describe synthetic biology, but the finding nevertheless gives an idea of what journalists wrote about the field.

The overall normative tone of the articles was neutral to positive in both countries (differences between the two countries were negligible): 33 % were positive, 4 % negative, 52 % neutral, 5 % skeptical, and 6 % cautious. In this count weakly connected articles were also included because it was deemed useful to know in which context slight references to synthetic biology emerged as well.

Table 3 shows the ten most discussed topics in the Swedish and Italian newspaper articles from 2009 to 2013.

The major benefits envisioned in the articles of both countries concern *the environment* (depollution, bioremediation): Italy 24 % and Sweden 13 % of articles; *production of energy* (biofuels): Italy 20 % and Sweden 22 %; *healthcare related improvements* (vaccines, pharmaceutical products): Italy 3 % and Sweden 22 %; and lastly *economic*: Italy 4 % and Sweden 8 %. These percentages refer to openly positive considerations of what synthetic biology is expected to contribute, not merely to the fact that synthetic biology may or can find an application in these fields.

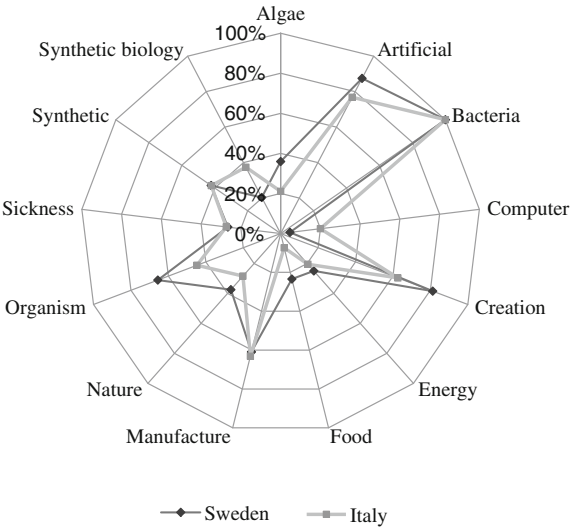

Fig. 2 Specific framing key words mentioned in Italian and Swedish newspaper articles from 2009 to 2013; frequencies are expressed as a percentage of the highest word recurrence for each country, 64 for Sweden and 190 for Italy, respectively

Table 3 The ten most discussed topics in the Italian and Swedish newspaper articles (total n = 95 and 36, respectively) from 2009 to 2013, differentiated by their normative tone. Note than one article might include several topics

Topic	Positive		Negative		Neutral		Mention		Total It and Sw
	Italy	Sweden	Italy	Sweden	Italy	Sweden	Italy	Sweden	
Healthcare	3	8	1	0	1	1	37	10	61
Environment	23	5	1	1	10	5	6	2	53
Energy/biofuels	19	8	1	0	5	6	10	3	52
Ethics	1	0	3	0	19	10	7	3	43
Economy	4	3	2	1	10	1	8	9	38
Biohazard	1	0	0	0	10	3	4	1	19
Religion	0	0	0	0	10	2	4	1	17
Food/GMO	4	0	0	0	1	0	5	7	17
Agriculture	6	0	0	0	5	3	2	0	16
Research Ethics	0	0	2	0	9	0	3	1	15

The major risks mentioned were *biohazard* (accidental release of pathogens): Italy 15 % and Sweden 11 % of articles; and *bioterrorism*: Italy 4 % and Sweden 5 %. It is noteworthy that none of the articles considering these risks displayed a negative stance towards synthetic biology because of them; the risks were mentioned just as possible issues.

Calls for oversight (direct, or a report of it, or just a mention of this issue) were seen in 13 % of the articles while a mention of or promotion of public engagement occurred in 7 % of the articles.

6 Discussion

Swedish and Italian press coverage of synthetic biology in the period from January 2009 to December 2013 differed only sporadically in terms of articles' length, types, and the strength of connection to synthetic biology. However, the countries' press coverage markedly differed in quantity: Italian newspapers covered the theme approximately three times more than Swedish newspapers throughout the period. One possible reason could have been different financial resources. As the three largest newspapers by circulation of each country were considered this can hardly be the sole explanation for such a marked difference in coverage. More likely, the difference is caused by editorial interests or agenda-settings. The high level of social trust typical of Nordic countries may also have contributed to the particularly low presence of synthetic biology in Swedish newspaper articles (Delhey and Newton 2005). This high level of trust, which can be extended to science and technology as well, might have induced Swedish reporters and editors to not pay greater attention to synthetic biology because it was not perceived as particularly dangerous or controversial.

It is currently not possible to properly assess whether the press coverage of SB in Sweden and Italy was substantially different from other countries or not. This is due to a lack of basis for direct comparison. The few existing studies cover different periods and countries, and are differently designed. Pauwels et al. (2012) studied press coverage in the US and some European countries (including Italy, but not Sweden) from 2008 to 2011. They found no significant difference between Italy and other countries. Although the experimental design of the study was different from ours, this does suggest that the Swedish press may have under-covered synthetic biology. Overall, synthetic biology has hitherto not found much media interest; only sporadically it has gained resonance. The main drivers for the attention of the media in both countries were prominent events. Craig Venter undoubtedly represented the major catalyst of media attention; he was mentioned in 68 % of the articles that were medium or strongly connected to synthetic biology. These two aspects, event driven coverage and the massive attention on one scientist (often controversially described) embodying the field, suggest that the role of synthetic biology in media coverage is, according to a trend in science popularization described by Burnham (1987), that of a media commodity, easily replaceable with the next big thing from the life sciences.

One of the aims of this study was to discuss the results of the analysis in the light of the idea that mass media contribute not only to informing the public but also to the shaping of ideas about a number of issues (Scheufele 1999; Valkenburg et al. 1999; Kronberger et al. 2012). Media frame issues and thus influence the opinions of the public by underscoring specific facts or values and providing interpretation schemes (Nelson et al. 1997; Scheufele 1999). The most frequent framing key words give an idea of the way synthetic biology was depicted to the public: one main subject are bacteria, on which—or starting from which—some creational or manufacturing procedures are performed, and the bacteria are described either as

artificial or as synthetic. The framing key words and, more specifically, the description of synthetic biology found in most articles were appropriate to depict to the public what synthetic biology is about without excessive hypes.

It can be considered an established fact that media resort to figurative language in describing scientific and technological contents and this has also been seen in studies about two of the most recent emerging issues, nanotechnologies and synthetic biology (Scheufele and Lewenstein 2005; Hellsten and Nerlich 2011; Gschmeidler and Seiringer 2012). The present study reveals a marked difference between the Italian and Swedish recourse to metaphors, where Italian articles were rich in figures of speech and Swedish articles mostly preferred basic representations. This might be due to the different rhetoric of the two countries or to different ways in which media interpret their role of informing the public about scientific developments.

The pervasiveness of the expression "creation of artificial life", however, was common to the two countries. This is not surprising: on the one hand it represents a *leitmotiv* of media communication of biotechnologies, on the other hand this is the language (design and creation of life, computer as parents, etc.) adopted by many influential scientists communicating with the media. Craig Venter used it in his highly storied press release and speech announcing the "creation" of the first synthetic cell (J. Craig Venter Institute 2010; Venter 2010). What the media did in such cases was simply to echo these words, which make good copy. The obvious point here is that the way the same words are meant and used by scientists on the one hand and by the media and the public on the other hand, can vary (Pauwels 2013).

The relation between Venter and the media appears to be a mutually beneficial relationship. On one side there are the media, interested in new appealing stories, and on the other there is a scientist-entrepreneur (as Venter is often presented) who values publicity. As Marjorie Kruvand has commented on Arthur L. Caplan, whom the media have turned into a sort of bioethics' "Dr. Soundbite"; such experts shape the news by providing stories with comments and context (Kruvand 2012). Venter is synthetic biology's "Dr. Soundbite"; the language he uses and the aspects that he draws attention to heavily contribute to the way media communicate synthetic biology.

We found that media presented synthetic biology as a field with high potential, which is in line with other studies (Gschmeidler and Seiringer 2012; Pauwels et al. 2012). Almost no emphasis on the component of novelty was found. This may be due to the fact that synthetic biology is not perceived as very different from other biotechnologies (Kronberger et al. 2012). That synthetic biology is not clearly distinguished from other fields does not appear to be related to poor media descriptions. It is more likely an effect of the fact that many elements that are interesting about synthetic biology and its applications coincide with the elements that feature in other biotechnologies. Another point of convergence, as pointed out by Gschmeidler and Seiringer (2012), is the vocabulary, as many key words used are part of the basic biotech jargon.

The most frequent topics to which synthetic biology was related in our study were healthcare, the environment, and energy production. These topics are public

issues of great interest, and effective communication strategies "[…] necessitate connecting a scientific topic to something the public already values or prioritizes, conveying personal relevance" (Nisbet and Scheufele 2009, p. 1774). However, in the way they are framed and presented in relation to synthetic biology, they actually represent expectations about the positive potential of synthetic biology. As observed by Kronberger et al. (2009), there is a tendency for journalists writing about synthetic biology to focus on its practical applications. In doing so, they run the risk of conveying to readers the notion that synthetic biology is already fulfilling, or will soon fulfill these practical expectations, which is far from reality. Indeed, in relation to human health and to the environment, we saw merely four and one negatively inclined articles, respectively. The remaining articles in our study were neutral or positive regarding bioremediation or new drugs/vaccines, such as the semi-synthetic production of the anti-malaria drug artemisinin. In addition, the tone about ethical and religious issues was neutral, in most cases only mentioning the fact that synthetic biology, as a field or through its applications, may create certain moral tensions. So we can see that the major benefits envisioned in the articles of both countries overlap with the most treated topics; they were emphasized both in quantity (recurrence) and weight (positively presented).

The possible risks in relation to synthetic biology, mainly biohazards and bioterrorism, were only mentioned a few times in the articles, receiving much less consideration, both in quantity and weight (neutrally presented) than the positive topics. In marked difference to the media portrayal, academic studies and policy reports usually display a balanced view and consideration of both benefits and risks involved with synthetic biology. Similarly, the involvement of the public or the need for an oversight of synthetic biology research was very rarely mentioned in the newspapers, although in academic and other settings the debates about the ethical, societal, and legal dimensions of synthetic biology often raise the necessity of involving the public. This tendency can be spotted among social scientists and philosophers (Hennen 2013; Wareham and Nardini 2013), but also professional societies (Global Network of Science Academies 2014), funding programmes (e.g., Horizon 2020), and governmental organizations (SBRCG 2012).

Lastly, the influence of the sources (individual scientists, press releases and papers, etc.) of the articles on how they are shaped must be considered strong. As previously mentioned, Sweden and Italy are two countries rather different in cultural and social terms as well in terms of media freedom and public consideration of science and technology. The marked similarities of language, selection of topics, and risks and benefits envisioned suggest that the common sources of Swedish and Italian stories are responsible for this common framing. Essentially, Swedish and Italian readers have been told the same things about synthetic biology. This signifies at least two things; first, that reporters didn't filter or process substantially the information received from their sources, and second, that those who are the sources can heavily influence the framing of how synthetic biology is communicated to the public and, as a consequence, to a certain degree, the public perception and shaping of ideas about synthetic biology.

7 Conclusions

Synthetic biology has until now not gained a big media resonance in Sweden and Italy. There are not many articles, drivers for attention are mainly events, and the overall impression is that the field is treated as a media commodity. The portrayal of synthetic biology offered to the public is very positive and is that of a biotechnology holding great potential to improve our life at many levels, with only minor risks that relates to malicious external agents or accidental events. While Swedish and Italian newspapers were generally adequate in their choice of language when describing synthetic biology, they were rather unbalanced in the choice and presentation of topics evoked by it.

The differences between the countries were principally quantitative, where Italian papers devoted much more space to synthetic biology. This may be explained by considering the different financial resources of the newspapers and the different attitudes towards science (Swedish trust). The similarities in contents and forms seem to be strongly related to a marked dependence on the way scientists frame their accomplishments and the lack of critical scrutiny on the behalf of the media.

References

Arkin A, Berry D, Church C et al (2009) What's in a name? Nat Biotech 27(12):1071–1073
Árnason V (2012) Scientific citizenship in a democratic society. Public Underst Sci 22(8):927–940
Benner SA, Sismour AM (2005) Synthetic biology. Nat Rev Genet 6(7):533–543
Bentley P, Kyvik S (2011) Academic staff and public communication: a survey of popular science publishing across 13 countries. Public Underst Sci 20(1):48–63
Bhattachary D, Calitz JP, Hunter A (2010) Synthetic biology dialogue. TNS-BMRB Report
Bryman A (2006) Integrating quantitative and qualitative research: how is it done? Qual Res 6 (1):97–113
Burnham JC (1987) How superstition won and science lost: popularizing science and health in the United States. Rutgers University Press, New Brunswick
Burns TW, O'Connor DJ, Stocklmayer SM (2003) Science communication: a contemporary definition. Public Underst Sci 12(2):183–202
Chomsky N (1997) What makes mainstream media mainstream. Z Magazine. October
Cserer A, Seiringer A (2009) Pictures of synthetic biology. Syst Synth Biol 3(1–4):27–35
Delhey J, Newton K (2005) Predicting cross-national levels of trust: global pattern or nordic exceptionalism. Eur Sociol Rev 21(4):311–327
Dunwoody S (1987) Scientists, journalists, and the news. Chem Eng News 65(46):47–49
European Commission (2013) Eurobarometer Responsible Research and Innovation, Science and Technology. Special Eurobarometer 401. Brussels: European Commission
Freedom House (2009) Freedom of the Press 2009. https://freedomhouse.org/sites/default/files/FOTP%202009%20Full%20Release%20Booklet.pdf. Accessed 05 Jun 2015
Freedom House (2010) Freedom of the Press 2010. https://freedomhouse.org/sites/default/files/FOTP2010–Final%20Booklet_5May.pdf. Accessed 05 Jun 2015
Freedom House (2011) Freedom of the Press 2011. https://freedomhouse.org/sites/default/files/FOTP%202011%20Full%20Release%20Booklet.pdf. Accessed 05 Jun 2015

Freedom House (2012) Freedom of the Press 2012. https://freedomhouse.org/sites/default/files/Booklet%20for%20Website_0.pdf. Accessed 05 Jun 2015
Freedom House (2013). Freedom of the Press 2013. https://freedomhouse.org/sites/default/files/FOTP%202013%20Booklet%20Final%20Complete%20-%20Web.pdf. Accessed 05 Jun 2015
Gibson DG, Glass GI, Lartigue C et al (2010) Creation of a bacterial cell controlled by a chemically synthesized genome. Science 329(5987):52–56
Gloede F, Hennen L (2002) A difference that makes a difference? Participatory technology assessment in Germany. In: Joss S, Bellucci S (eds) Participatory technology assessment. European Perspectives. Centre for the Study of Democracy, London, pp 92–107
Global Network of Science Academies (2014) IAP Statement on Realising Global Potential in Synthetic Biology: Scientific Opportunities and Good Governance. IAP Report
Gschmeidler B, Seiringer A (2012) "Knight in shining armour" or "Frankenstein's creation"? The coverage of synthetic biology in German-language media. Public Underst Sci 21(2):163–173
Hansen J (2010) Biotechnology and public engagement in Europe. Palgrave Macmillan, Basingstoke
Hansson MG (2008) The private sphere. An emotional territory and its agent. Springer, Dordrecht
Hellsten I, Nerlich B (2011) Synthetic biology: building the language for a new science brick by metaphorical brick. New Genet Soc 30(4):375–397
Hennen L (2013) Parliamentary technology assessment in Europe and the role of public participation. In: O'Doherty K, Einsiedl E (eds) Public engagement and emerging technologies. UBC Press, Vancouver
Irwin A (2001) Constructing the scientific citizen: science and democracy in the biosciences. Public Underst Sci 10(1):1–18
Iyengar S (1991) Is anyone responsible? How television frames political issues. University of Chicago Publisher, Chicago
J. Craig Venter Institute (2010) First self-replicating synthetic bacterial cell. [Press release] Retrieved from: http://www.jcvi.org/cms/press/press-releases/full-text/article/first-self-replicating-synthetic-bacterial-cell-constructed-by-j-craig-venter-institute-researcher/home/. Accessed 05 Jun 2015
Jones RAL (2014) Reflecting on public engagement and science policy. Public Underst Sci 23 (1):27–31
Kelle A (2013) Beyond patchwork precaution in the dual-use governance of synthetic biology. Sci Eng Ethics 19(3):1121–1139
Kronberger N, Holtz P, Kerbe W et al (2009) Communicating Synthetic biology: from the lab via the media to the broader public. Syst Synth Biol 3(1–4):19–26
Kronberger N, Holtz P, Wagner W (2012) Consequences of media information uptake and deliberation: focus groups' symbolic coping with synthetic biology. Public Underst Sci 21 (2):174–187
Kruvand M (2012) Dr. Soundbite: the making of an expert source in science and medical stories. Sci Commun 34(5):566–591
Mackenzie A (2013) From validating to objecting: public appeals in synthetic biology. Sci Cult 22 (4):476–496
McCombs ME, Shaw DL (1972) The agenda-setting function of mass media. Public Opin Q 36 (2):176–187
Mayring P (2000) Qualitative content analysis. FQS 1(2) Art. 20. http://nbn-resolving.de/urn:nbn:de:0114-fqs0002204. Accessed 05 Jun 2015
Morgan D (2002) A content analysis of media coverage of health care and the uninsured 2002. Frame Works Institute, Washington, DC
Nelkin D (2001) Beyond risk: reporting about genetics in the Post-Asilomar Press. Perspect Biol Med 44(2):199–207
Nelson B (2014) Cultural divide. Nature 509(7499):152–154
Nelson TE, Clawson RA, Oxley ZM (1997) Media framing of a civil liberties conflict and its effect on tolerance. Am Polit Sci Rev 91(3):567–583

Nisbet MC, Brossard D, Kroepsch A (2003) Framing science: the stem cell controversy in an age of press/politics. IJPP 8(2):36–70

Nisbet MC, Scheufele DA (2009) What's next for science communication? Promising directions and lingering distractions. Am J Bot 96(10):1767–1778

Oldham P, Hall S, Burton G (2012) Synthetic biology: mapping the scientific landscape. PLoS ONE 7(4):e34368. doi:10.1371/journal.pone.0034368

Pauwels E (2013) Communication: mind the metaphor. Nature 500(7464):523–524

Pauwels E, Lovell A, Rouge E (2012) Trends in American and European Press coverage of synthetic biology. Synbio 4 (Synthetic Biology Project). Wilson Center

Peters HP, Lang JT, Sawicka M et al (2007) Culture and technological innovation: impact of institutional trust and appreciation of nature on attitudes towards food biotechnology in the USA and Germany. Int J Public Opin Res 19(2):191–220

Royal Academy of Engineering (2009) Synthetic biology: scope, applications and implications. The Royal Academy of Engineering, London

Scheufele DA (1999) Framing as a theory of media effects. J Commun 49(1):103–122

Scheufele DA, Lewenstein BV (2005) The public and nanotechnology: how citizens make sense of emerging technologies. J Nanopart Res 7(6):659–667

Schmidt M (2008) Diffusion of synthetic biology: a challenge to biosafety. Syst Synth Biol 2 (1–2):1–6

Synthetic Biology Roadmap Coordination Group (SBRCG) (2012) A synthetic biology roadmap for the UK. Research Councils UK. Technology Strategy Board, Swindon

Valkenburg PM, Semetko HA, Vreese CHD (1999) The effects of news frames on readers' thoughts and recall. Commun Res 26(5):550–569

Venter CJ (2010) Craig venter: watch me unveil "synthetic life". [Video file] Retrieved from: http://www.ted.com/talks/craig_venter_unveils_synthetic_life#t-38502. Accessed 05 Jun 2015

Wareham C, Nardini C (2013) Policy on synthetic biology: deliberation, probability, and the precautionary paradox. Bioethics 29(2):118–125

Yavchitz A, Boutron I, Bafeta A et al (2012) Misrepresentation of randomized controlled trials in press releases and news coverage: a cohort study. PLOS Medicine 9(9):e1001308. doi:10.1371/journal.pmed.1001308