

The story is that there is no story: media framing of synthetic biology and its ethical implications in the New York Times (2005–2015)

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Abstract

Despite low public knowledge of synthetic biology, it is the focus of prominent government and academic ethics debates. We examine the *NY Times* media coverage of synthetic biology. Our results suggest that the story about synthetic biology remains ambiguous. We found this in four areas — 1) on the question of whether the field raises ethical concerns, 2) on its relationship to genetic engineering, 3) on whether or not it threatens ‘nature’, and 4) on the temporality of these concerns. We suggest that this ambiguity creates conditions in which there becomes no reason for the public at large to become involved.

Keywords

Public perception of science and technology; Science and media

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Introduction

On February 11, 2005, *The New York Times* published the op-ed “Biology’s New Forbidden Fruit,” its first piece engaging directly with the emerging field of synthetic biology (SB). The title, ripe with religious metaphor, foreshadows what became one of the most prevalent aspects of media-reported public debate — whether or not this new science was “playing god.” Most interesting for the purposes of our study, in this first article, Morton [2005] calls for wide public engagement. However, in the decade following this inaugural article, there were few publications on this topic in *The New York Times* and other major media outlets, while SB and the ethics surrounding it became a major topic in research and policy arenas. In this study we analyze news articles about synthetic biology in the first decade of *The New York Times* reporting on the field. We focus on the curious relationship between the low volume of reporting on the field, low public knowledge of the field along with the high level of attention to ethical, moral and political implications of the field by the practitioners and the government. We know from media studies that media plays a large role in how public understands science. Hence, we are interested in how SB is presented in the media. In this study, we asked the broader research question: “How is synthetic biology being reported in the media?” Emerging from the central question is a set of ‘problems’ concerning potential issues, relationships to nature, relationship to genetic engineering, and the temporality of synthetic biology.

Ethical question and public awareness

In 2006, a major multi-campus center, the Synthetic Biology Engineering Research Center (SynBERC), was established through National Science Foundation (NSF) funding. Ten years later (2016), the NSF has provided more than 37 million dollars to SynBERC. As a post-Human Genome Project endeavor with genetic engineering as its foundation, it is not surprising that public concern was anticipated and a major goal of the center was ethics (“Social Issues”) and a complementary education aim was to “educate the general public about the benefits and possible risks of synthetic biology.” In the first several years of the project, a trained anthropologist/critical ethicist, Paul Rabinow was a co-PI and director of one of the four main “thrust areas” of the center. Rabinow and Bennett [2009] argued that ethics would be worked on alongside and developed with the science, creating an integrated approach to ethics. Perhaps more evidence of a visible ethics discussion was that news of Rabinow’s 2010 resignation was important enough to warrant *NY Times* coverage. Further, the first Bioethics’ Commission of President’s Obama tenure focused on the synthetic biology. In European contexts, questions of ethics and governance of synthetic biology has also become an important topic [Engelhard, 2016; Hagen, Engelhard and Toepfer, 2016]. For example, Responsible Research and Innovation (RRI) which has become a popular way in Europe to think about ethics through a more integrated, “upstream” approach, has become a central part of synthetic biology ethics discussions and been integrated into synthetic biology centers. Similarly, however, it is unclear how the language and discourses of responsibility will impact the field [Li, Owen and Simakova, 2015]. Clearly, ethics was and is important to scientists and policy makers. However, ethics, which ultimately has meant in science, accountability to the public at large, has not appeared to hit the radar of the “public” in terms of synthetic biology developments. In fact, synthetic biology itself is not a term or field with which the public is familiar.

Studies continue to show that public awareness of synthetic biology is low with estimates in some cases more than 80% of the public stating that they have never hear the term at all and as low as 2% stating that they knew “a lot” about synthetic biology [Pauwels, 2009; Gaskell et al., 2010; Nerlich and McLeod, 2016]. At the same time, interest in what the public *will* think continues [e.g. Ancillotti et al., 2016; Starkbaum, Braun and Dabrock, 2015; Pauwels, 2009; Pauwels, 2013; Torgersen and Schmidt, 2013]. And policy meetings continue to be held on behalf of public safety [Cho and Relman, 2010; Kuiken, 2015]. As might be expected based on the agenda-setting function of media [Protess and McCombs, 1991], popular news reports also remain low [Ancillotti et al., 2016].

Agenda-setting theory in media studies

The media has been used as a predictor or proxy for public opinion on biotechnologies [e.g. Ancillotti et al., 2016; Protess and McCombs, 1991; Nisbet, Brossard and Kroepsch, 2003]. However, debate remains as to the direction of flow between public opinion and media reporting — that is, does the media determine what the public thinks or does the media report on what the public thinks [Terkildsen, Schnell and Ling, 1998]. Most critical media studies have agreed that instead of asking about the flow of information between the public and media, we should understand the media as an institution that produces and is produced through dominant

perspectives [McCombs, 2004; Cook, 1998; Horst, 2007; Fürsich and Lester, 1996]. These dominant perspectives are strengthened, given more credibility through their publication in the news, thereby forming individual and collective public opinions. An overeducated, wealthier and whiter public will rely more on the media to represent the views they wish to have on topics, particularly specialized topics such as scientific developments [Fürsich and Lester, 1996; Scheufele and Lewenstein, 2005]. Therefore, studying the media's presentation of a scientific development can give us information as to the dominant discourses circulating.

In this paper, we draw on agenda setting theory [McCombs, 2004; McCombs, Shaw and Weaver, 2014] to understand the role that news media has on public opinion. Over the years agenda setting theory has been articulated as first degree and second degree agenda setting. First degree agenda setting has to do with the salience of an object (such as a political candidate or issue). The frequency and placement of topics in newspapers is most important for first-degree agenda setting. The framing or orientation towards that object is labeled second-degree agenda setting. For example, being pro or con an issue or having concern or not over a health epidemic are examples of second-degree agenda setting. In the case of synthetic biology, clearly it has not been a salient topic evidenced by the low reporting. This null result — that the media is not pushing synthetic biology to be an object of interest through first degree agenda setting — is where we begin this study. What we focus on in this article then is, despite not being an issue for widespread attention, what second degree agenda setting is occurring in the small number of articles that are published (for a selective audience described above). And what do these two levels of agenda setting (or lack of agenda setting) mean for public opinion, policy and ethics debates on this new biotechnology.

Another aspect of agenda setting theory is considering who is being influenced by the second degree agenda setting. One way that this has been explored is through examining the relationship between “need for orientation” and a topic's relevance and level of uncertainty for an individual or community [McCombs, Shaw and Weaver, 2014]. In the case of biotechnologies and specifically those related to genetic engineering, we argue here that these topics have been relevant for a widespread public. For example, in California a ballot proposition to mandate labeling of genetically engineered foods was just slimly defeated in 2012. Therefore, we suggest that how synthetic biology's relationship to genetic engineering is presented, matters for whether the public develops a “need for orientation” around synthetic biology. This raises the question of how the media may take on a role of reassurance when there is the potential for public alarm [Colby and Cook, 1991; Ungar, 2008]. In cases of “hot crises,” Ungar [2008] suggested that contradictions in news reporting are used to reassure the public. Although not a health crisis like SARS or Ebola or HIV/AIDS, there has been public concern about GMOs and genetic modification of humans.

We argue that the lack of reporting which we see in the case of synthetic biology means that the public is not encouraged to learn more or become involved and that within the stories that are published, there is a reassurance through ambiguous reporting that synthetic biology is not something with which the public should be concerned. We end by suggesting that this matters because there are current policy and ethics debates and decisions being made by the government and researchers, as the public is silent.

Previous media studies of SynBio

Previous studies conducted have focused more on European than United States media. Studies of news reports in Italy, Sweden, Denmark, Finland, and Norway all showed that overall synthetic biology was presented in a positive light — with a maximizing of potential benefits and minimizing of potential risks [Ancillotti and Eriksson, 2016; Ancillotti et al., 2016]. A few studies that focused on U.S. media also suggested that there was “unbalanced” coverage with more focus on benefits than risks [Pauwels and Ifrim, 2008; Pauwels, 2013; Kruvand, 2013] despite Pauwels’ [2013] argument that comparatively there was an increase in mention of negative consequences of SB over time. This matches previous research on science communication that found the news tends to focus on the benefits more than the risks when reporting about nanoscale science and new technology [Racine et al., 2006; Weaver, Lively and Bimber, 2009; Anderson et al., 2005; Friedman and Egolf, 2005; Wilkinson et al., 2007]. While in a study of German news coverage, Gschmeidler and Seiringer [2011] found a similar trend, they also report on the presence of ambivalent messages that swung between “Frankenstein” fears of unnatural organisms out of human control being created to “Knight in Shining Armour” promises of synthetic biology solving major health and environmental problems. They concluded that this ambivalence left open room for public opinion to still be formed. Another study focused on U.S. news during the period of 2008–2010 focused on whether there were changing metaphors from genetic engineering to synthetic biology. They did find some differences in the metaphors and of particular note for this study, found that there was a move away from more extreme metaphors of interfering with life and nature to more “benign” metaphors of “sewing, stitching, and tinkering” [Hellsten and Nerlich, 2011]. Hellsten and Nerlich’s data fit the ambivalence of other studies, in that there were metaphors of revolution tempered by more innocuous metaphors throughout the articles. In all of these studies, it was clear that the number of published news articles that specifically mentioned synthetic biology remained low. Further, these previous studies all seem to suggest that it is still unclear what public opinion will be on SB. Along similar lines, Torgersen and Schmidt [2013] in the study of framing synthetic biology argue that we are at a moment when a dominant frame for debates surrounding SB is undecided. This study appears to suggest that it is important for the field to have an active role in defining debates surrounding and definitions of SB. What has not been considered is how limited coverage and ambiguity itself might influence the debates about synthetic biology.

Methods

We analyzed 32 articles in *The New York Times* from January 2005 to July 2015. News articles were collected using LexisNexis by searching the key word “synthetic biology.” Eighty-two articles were found, 42 were excluded. The excluded articles were book reviews, corrections, obituaries, or only mentioning SB as minor examples in passing. Eight articles were further excluded after additional screening due to repetition (revisions of the same article published under different titles), leaving a total of 32 articles for content analysis. Our content analysis of the 32 articles focused on four main areas 1) on the question of whether the field raises ethical concerns, 2) on the temporality of these concerns, 3) on its relationship to genetic engineering, and 4) on whether or not it threatens ‘nature’.

The New York Times was chosen for its impact on both other media outlets and public opinion. Media plays an important role in influencing policymaking, especially when it comes to biotechnology, and it is a ground of inherently political competition in which different actors seek to maximize their impact [Nisbet and Lewenstein, 2002]. With that, the *NY Times* has been found to be an influential media agenda-setting tool in general. Specifically, it has taken a lead in science news with the long-running dedicated science news section [Clark and Illman, 2006]. Its readership tends to be an overeducated, liberal population, meaning that a large number of scientists, professionals, policy and decision makers are reading the paper [Fürsich and Lester, 1996; George and Waldfoegel, 2006]. With one of the most widespread readerships across the United States, it is likely to have an impact on public opinion [Protess and McCombs, 1991]. When we looked at news articles over the top read papers around the world, we found that overall there was a small amount of coverage on synthetic biology. The *NY Times* had the most stories of any U.S. newspaper. The only international news that had a similar number of hits was the U.K.'s *Guardian*. Although it may be interesting to see whether there were differences between the two papers, the purpose of this study was not to look for these differences. We decided to stick with one news source only so that there were not other confounding factors such as the political leanings of a particular newspaper or geographic context that might confuse our results of a small sample size.

We looked for articles that discussed the technology, made the technology its main focus, and explicitly identified the technology as “synthetic biology.” The naming of “synthetic biology” was important, because we were particularly interested in the definition of this “new” science, and we were aware of debates as to whether or not it was the same as genetic engineering. We sought to determine what the naming of a “new” field might mean for genetic/biological sciences and ethics.

Our analysis was done in three stages. In the first two stages, both researchers read through all the articles and recorded data. The first focused on broad themes and the article’s tone, while the second set of data produced more specific results about the explicit word choices made by the journalists and scientists. In the graphs that show quantitative data, we only include results from the second stage in which the coders had at least 80% agreement. In the final stage, the researchers independently conducted close readings of certain articles or parts of articles of interest at the same time, stepping back to look again at the broader themes across articles. We then integrated our findings and interpretations, along with further close reading and discussion about the articles, to produce the final results that we present here.

Results

Amount of coverage in NY Times over 10 years

In total, we found 32 articles published in the *NY Times* between 2005–2015. The number of articles published each year was low; varying between 1–4 articles in most years except for in 2009 when there were none published and in 2010 when there were 9 articles. There were mostly long articles (> 999 words) and no short articles (< 300 words) published during this time period. We used same categories definitions as Gschmeidler and Seiringer [2011] for short, medium and long so we could compare our results in discussion.

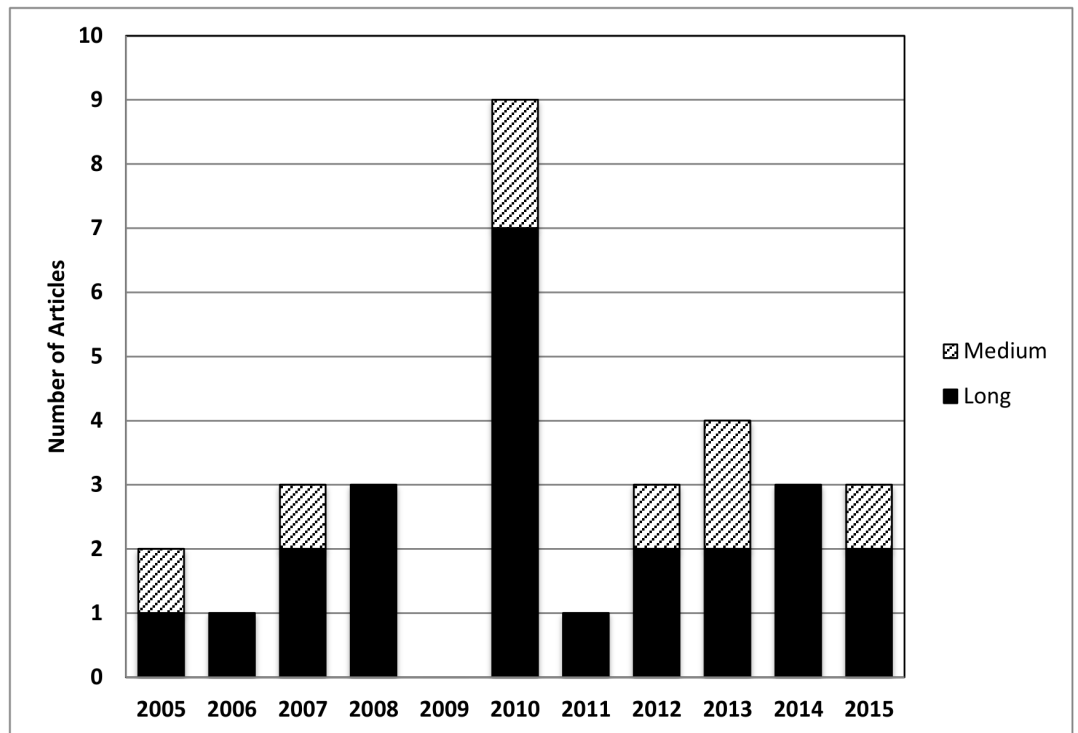


Figure 1. Length of articles by year.

We explore possible explanations for the scarcity and lengthiness of these articles in the discussion. Despite the rarity, some themes permeate the reporting of synthetic biology news. They are as follows.

Potential Issues

In 28 out of 32 articles, there was at least some mention of a potential issue raised by the development of the field of synthetic biology. In the majority of articles, there was only a brief mention of potential issues and they were non-specifically or vaguely described. The potential issues that were most frequently mentioned (Figure 2) were the possibility of bioterror (11/32 articles), bioerror (9/32 articles), safety (10/32 articles), and philosophical or moral issues (9/32 articles). Bioterror is the concern that “others” will use or develop technologies to use as biological weapons. Bioerror is the concern that scientists will unwittingly create something that may cause harm to our environment and/or public health, and that it will then be out of their control. Other less frequently raised issues were: concern over the fair/unequal distribution of good and harms, global impact, environmental impact, consumer rights, ethics of corporate-science connections, public health impact, eugenics, labor issues, and economic impact/cost. Address of these issues explicitly as “ethical” issues was only seen in 10 out of 32 articles.

Likeness to genetic engineering

In twenty-one articles genetic engineering was mentioned by name or made reference to without using the exact term. In those articles, the relationship

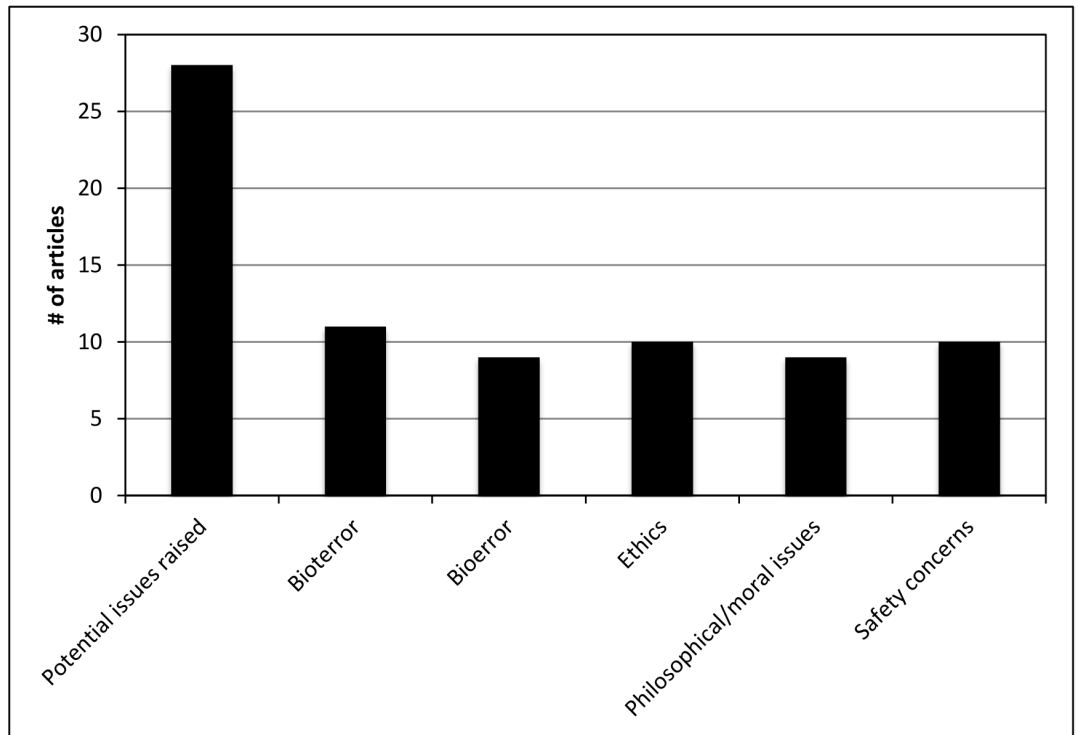


Figure 2. Total number of articles that raised potential issues and the most frequent issues raised.

between genetic engineering and synthetic biology was often unclear. In Table 1 we show examples of several different types of relationships that were presented across the articles.

In Table 1 we characterized statements about the relationship between genetic engineering and synthetic biology as 1) essentially the same, 2) totally different or, 3) a chronological progression to a more advanced science. Statements about genetic engineering and synthetic biology being pretty much indistinguishable insisted that there was nothing too new about SB. Other articles explained the two as not the same “kind” of thing — we characterized these as “Apples and Oranges” statements. It was common to find the third explanation for their relationship — that synthetic biology has progressed from genetic engineering. In this third case we found phrases such as “sophisticated”, “radical”, and “more powerful” that suggested that synthetic biology was more advanced. The progression was framed as somewhat a natural and necessary evolution to move the science of genetic engineering in a more useful, efficient and productive direction.

In Table 1 we see through the examples that often times one or more characterizations of the relationship between genetic engineering and synthetic biology were folded into a statement. For example, the first quote shown in table 1, from a scientist who is interviewed in the article, suggests 1) that there is not anything that is *really* new about the field of synthetic biology, 2) that it “applies” genetic engineering techniques (so perhaps we are mixing up new fields and techniques) and finally 3) that synthetic biology is a more purpose-driven endeavor that aims to solve “more complex problems.” The co-occurrence of each of these explanations for the difference between the fields was likely to be found within the same article if not within the same quote as shown above.

Table 1. Descriptions of the relationship between synthetic biology and genetic engineering in news articles.

Same Old/Nothing New	
Synthetic Biology <i>is</i> Genetic Engineering	“This has a catchy new name, but anybody over 40 will recognize it as good old genetic engineering applied to more complex problems.” (17 January 2006, <i>The New York Times</i>)
The difference is hard to determine	“Synthetic biology is a nebulous term and it is difficult to say how, if at all, it differs from genetic engineering.” (8 May 2013, <i>The New York Times</i>)
Apples and Oranges	
SB is a field, GE is a technique that SB uses	“Synthetic biology uses genetic engineering and other techniques to create novel organisms tailored for particular tasks.” (17 December 2010, <i>The New York Times</i>)
Progressive Science	
SB is a more advanced form of GE because it is:	
more purpose-driven science	“Now a powerful form of genetic engineering could revolutionize the production of some of the most sought-after flavors and fragrances.” (21 October 2013, <i>The New York Times</i>)
allows for more predictability/control	“Synthetic biology aims to allow more extensive changes, and in a more efficient and predictable way.” (5 September 2010, <i>The New York Times</i>)
creates new organisms instead of simply relying on tinkering with naturally occurring ones	“This also entailed building the bacteria itself — redesigning a living organism, using the tools of a radical new realm of genetic engineering called synthetic biology.” (14 February 2010, <i>The New York Times</i>)

Relationship to “Nature”

In 20 out of 32 articles there was some discussion about synthetic biology’s relationship to nature; including whether or not scientists in the field were “playing god,” whether or not the genetically modified organisms or the products made from them were natural and/or whether or not synthetic biologist could or have indeed created new life. We characterized the statements within a Nature vs. Science debate where some statements focused more on the power of scientists, and others tempered this excitement for the power of science with certain awe of nature. Examples of each can be found in table 2.

Table 2. Descriptions of synthetic biology (SB) and its relationship to “nature” in news articles.

SB aims to improve on nature and/or create new “natures” (Science/scientists)	SB is in awe of “nature” and/or could never create anything close to what nature has (Nature/God)
“...technologies that allow them to write genes and genomes from scratch, to alter and surpass nature’s vocabulary.” (11 February 2005, <i>The New York Times</i>)	“The synthetic genome made by Dr. Venter’s team was not designed from scratch, but rather was a copy, with only a few changes...” (25 January 2008, <i>The New York Times</i>)
“‘Agriculture as we know it needs to disappear,’ Venter said. ‘We can design better and healthier proteins than we get from nature.’” (3 June 2012, <i>The New York Times</i>)	“In any case, there are many hurdles to overcome before Dr. Venter’s vision of “life by design” is realized.” (25 January 2008, <i>The New York Times</i>)
“Scientists reported Wednesday that they had taken a significant step toward altering the fundamental alphabet of life — creating an organism with an expanded artificial genetic code in its DNA.” (8 May 2014, <i>The New York Times</i>)	“The Vatican, somewhat surprisingly, cautiously praised the work as a potential way of treating diseases, saying it did not regard the synthesis of DNA as the creation of life” (5 September 2010, <i>The New York Times</i>)
“Hoping to give new meaning to the term ‘natural light,’” (8 May 2013, <i>The New York Times</i>)	“And he {Venter} acknowledged that none of his group’s work would have been possible without a lot of help from the parents — Mother Nature and Father Time.” (1 June 2010, <i>The New York Times</i>)
“...transforming cells to give them powers not found in nature...” (28 May 2010, <i>The New York Times</i>)	“While the feat raised concerns that man was now playing God, the {President’s Bioethics} commission’s report says that Dr. Venter’s team did not create life... Nor, the report says, are truly novel creatures on the immediate horizon.” (17 December 2010, <i>The New York Times</i>)
“...you should be able to make its cells do and produce things that nothing in nature has ever done or produced before.” (14 February 2010, <i>The New York Times</i>)	“Scientists who seek to imitate living cells say they can’t help but be perpetually dazzled by the genuine articles, their flexibility, their versatility, their childlike grandiosity.” (5 February 2008, <i>The New York Times</i>)

We found that although the idea of “playing god” was mentioned a couple of times and evoked without the exact phrase more than that, there was *not* an explicit Religion vs. Science argument. Rather, “nature” and “god” seemed to be collapsed as the Nature vs. Science debate took place through the articles. Along with the promises of how this new science (SB) is “more powerful” than anything we’ve seen before, there were many reassurances that nature was the most powerful and

that scientists were respectful and what we read as “in awe” of nature/god. For example, a topic that many articles focused on was Craig Venter’s announcement that his research team had created a cell “from scratch.”

“After all, that stalwart pair was responsible for designing and gradually refining the real cells that brought the Venter team’s synthetic constructs to life. There is, as yet, no escaping the cell. Every past and present lodger on the twisted bristlecone tree of life is built of cells, every cell is a microcosm of life, and neither the Venter team nor anybody else has come close to recreating the cell from scratch. If anything, the new report underscores how dependent biologists remain on its encapsulated power.” (31 March 2010, The New York Times)

Therefore, at the same time as the accomplishment was being celebrated, we can read reassurance about the limits and respect that the science and scientists will have to bring towards what Nature has created.

We also found that in some articles assertions about the power of SB to create new forms of life were combined with an argument that it is similar to other ways that we have already changed nature and that these modifications have become commonplace and good. For example, the history of synthetic chemistry in the 19th century is cited analogically to synthetic biology. In other articles, the comparison to genetic engineering that is already commonplace is cited. Even the debates over regulatory and economic justice issues were similarly discussed over whether the organisms and their products can be considered “natural”. For example, in one article about using synthetic biology to produce spices and flavorings such as saffron and vanilla, this is brought up:

“The advent of synthetic biology raises thorny economic and regulatory issues, such as whether such yeast-made ingredients can be called natural and whether developing countries dependent on these crops will be hurt.” (20 October 2013, The New York Times)

While the economic justice issue of harm to developing countries is mentioned in this article, the article overall focuses on the issue of whether or not these can be considered “natural” products.

Another common thread in articles that touched on the Nature vs. Science debates surrounding synthetic biology, claimed that the most important aspects of the field are the basic science that is being done in better understanding what nature already exists. For example,

“There are many ways we could use designer organisms, some good and some bad. But the most fundamental aspect of the enterprise is that by trying to build life, we gain a more profound understanding of its evolved nature.” (28 May 2010, The New York Times)

This fits in to the portrayal of scientists as being in “awe of nature” and supports an understanding of synthetic biology as not threatening nature.

Temporality

In our review of the articles we marked whether each article suggested that the technologies of synthetic biology 1) have already been developed, 2) could happen in the near future, or 3) are far off from being developed and perhaps will never be realized. We found that there was great ambiguity in discussing the time frame of the technologies being developed. Sometimes within the same article there was disagreement and the fact that there was debate to the novelty/newness of the field was sometimes discussed. Throughout the articles the main point about temporality was: whether or not synthetic biology is of immediate concern is debated.

Based on this finding, it made sense that we saw statements by reporters and interviewees suggesting conflicting information about the time frame of the field. We found statements that suggested either 1) synthetic biology is happening “rapidly” and/or very soon (or has already started) or 2) synthetic biology is unlikely to happen and/or is developing very slowly. In Table 3, we show examples of the language used.

In some articles we found that the readers were reassured that the aspect of synthetic biology that could be reason for public attention was something that is already possible through another method. For example:

*“Scientists, of course, have been adding foreign genes to cells for three decades, and the distinction between synthetic biology and more conventional genetic engineering is not always clear.” (underline added) (24 November 2005, *The New York Times*)*

And

*“Scientists have long made glowing creatures for research purposes, using including one or more monkeys, cats, pigs, dogs and worms. Glowing zebra fish have been sold in some aquarium shops for years.” (underline added) (8 May 2013, *The New York Times*)*

Or even that the “bad things” are already possible,

*“It’s a frightening prospect. But the fear needs some perspective. First, the ability to make biological weapons with cut-and-paste technologies is already widespread. . .” (11 February 2005, *The New York Times*)*

Or that it has already been around for a significant amount of time and is only getting press now:

*“Synthetic biology, originally aimed at producing biofuels, has been around for about 20 years, but applications have only recently begun to emerge across several industries including cosmetics, flavorings and scents.” (31 May 2014, *The New York Times*)*

It was clear in several articles that what was at stake in arguments about the newness and reality of this field was ethical interventions and regulations. For example,

Table 3. Descriptions of the time frame of synthetic biology research in news article.(underline added.)

<p><i><u>SB is happening fast and/or very soon</u></i></p> <p>"But <u>very soon</u>, perhaps within a year, the poppy will no longer be the only way to produce heroin's raw ingredient." (19 May 2015, <i>The New York Times</i>)</p>	<p><i><u>SB is unlikely to happen and/or is developing very slowly</u></i></p> <p>"'We're still <u>really early</u>,' Endy said. 'Or to say it differently, we're still really bad.'" (3 June 2012, <i>The New York Times</i>)</p>
<p>"The first practical applications of synthetic biology <u>may not be so far off</u>." (8 July 2007, <i>The New York Times</i>)</p>	<p>"Realizing this dream is <u>still some way off</u>." (28 May 2010, <i>The New York Times</i>)</p>
<p>"Evolva, a Swiss company, <u>is about to start marketing yeast-made vanillin</u>, the main component of vanilla. <u>It is also working on saffron</u>, now obtained mainly from crocuses grown in Iran." (20 October 2013, <i>The New York Times</i>)</p>	<p>"A spokesman for the Drug Enforcement Administration said his agency <u>"does not perceive an imminent threat"</u> because <u>no modified yeast strain is commonly available yet</u>." (19 May 2015, <i>The New York Times</i>)</p>
<p>"It was clear that synthetic biology - which involves the engineering of life - was <u>advancing rapidly</u> and inevitably could impact the world's biodiversity - and could be either a positive or negative." (12 April 2013, <i>The New York Times</i>)</p>	<p>"In a report issued Thursday, the Presidential Commission for the Study of Bioethical Issues said that at present the technology... poses few risks because it is <u>still in its infancy</u>." (17 December 2010, <i>The New York Times</i>)</p>
<p>"'This is an area where things will <u>happen at an exponential pace</u>,' he said. 'Once people know you can do chromosomal transplants, that will trigger new approaches.'" (29 June 2007, <i>The New York Times</i>)</p>	<p>"Considered together, the modern cell is dauntingly complex, which is why most researchers in the <u>youngish field</u> of synthetic biology address only one or two pieces of it at a time." (1 June 2010, <i>The New York Times</i>)</p>
<p>"Synthetic biology is <u>already being used</u> to engineer micro-organisms to manufacture a malaria drug and produce biofuels..." (16 December 2010)</p>	<p>"But <u>the path is long, with no guarantee of success</u>." (5 September 2010, <i>The New York Times</i>)</p>

*"Advances in technology have also strained the regulations. Scientists can now alter the genes of organisms in a far more extensive way than they once could, using techniques called synthetic biology." (underline added) (3 July 2013, *The New York Times*)*

And,

*"This rapid progress in synthetic biology has set off a debate about how — and whether — to regulate it." (underline added) (19 May 2015, *The New York Times*)*

We found the ambiguity about when synthetic biology technologies were/would being/be developed intersected with the ambiguity in whether synthetic biology

was different and if so how from genetic engineering. We can see this in previous examples that compare it to what is already happening/possible in science. We also saw intersection with discussions about the relationship to Nature vs. Science debate (which envelops the concern of scientists “playing god”).

*“Just pick up your baton, hum a few bars, and give it three billion years.” (underline added) (1 June 2010, *The New York Times*)*

This excerpt, which is in the last paragraph of a news article, the suggestion is that it will be a very long time before synthetic biology’s promises come to fruition. The idea is that scientists have a long way to go to do anything as amazing as nature has done through evolution in the last 3 billion years.

Evidence of citing the lack of immediacy or success of synthetic biology to counter arguments for regulations can be found in some articles:

*“Other biotech experts counter that raising the specter of fermenting heroin like beer, jokingly known among insiders as “Brewing Bad,” is alarmist and that Dr. Oye’s proposed solutions are overkill.” (19 May 2015, *The New York Times*)*

Or that the way synthetic biology fits into already in motion sciences makes it less of a threat than some might argue:

*“Mr. Erickson said the report recognized that synthetic biology ‘is not something radically new and threatening, but is part of an ongoing continuum of biotech innovation that has resulted in safe and successful products and public benefits for the past 15 or 20 years.’” (16 December 2010, *The New York Times*)*

This excerpt, from an article about recommendations proposed by the President’s Bioethics Commission, follows quotes from environmental groups calling for a moratorium and calling self-regulation, as suggested by the commission’s report as useless. The argument is similar to the chairwoman of the commission’s take:

*“Here’s something significant in science, but there’s no cause for fear and dread about what is going to happen immediately next,” Amy Gutmann, the chairwoman of the commission. . . .” (underline added) (17 December 2010, *The New York Times*)*

This assertion that synthetic biology warrants no immediate concern is congruent with our findings in other aspects of SB news. That is, while articles brought up potential risks to SB, they rarely identified them as ethical concerns; the debates regarding SB’s relations to genetic engineering and nature also drew ambiguous conclusions that neither opposed SB nor guaranteed its innocence. These findings altogether represented SB news’ tendency to perpetuate the status quo and discourage active resistance to the development of synthetic biology.

The lengths of the articles about SB were surprisingly longer than expected. That is, when the topic was discussed it was never a “short” story (< 300 words). This may indicate that the discussion of synthetic biology was geared towards a more educated and already science interested public. Gschmeidler and Seiringer [2011] found similarly that medium and long articles dominated. They argued that the topic was quite complex and required more description. However, they did find an increase in short articles after 2008. We suggest that future research look at the type of media that covered short stories. That is, we suspect that shorter stories increased in more mass consumed media. The lengthiness of SB news articles geared toward a more scientifically minded audience instead of the average reader will also explain its low frequency.

Our finding, that there were only a few articles each year except for 2009 when there were none and 2010 when there were ten, makes sense with public survey data that has shown that most people have never heard about synthetic biology or have heard very little [Pauwels, 2009; Gaskell et al., 2010]. The spike in 2010 can be attributed to Craig Venter’s announcement that his research team had created the first synthetic life in a bacterial cell controlled by a synthetically produced genome [Gibson et al., 2010]. Ancillotti et al. [2016], in a review of media studies of synthetic biology news coverage across Europe and the U.S., argued that we cannot clearly say whether there is low news coverage of the field, because the studies used different criteria for inclusion of news articles. In their studies, they included terms such as ‘bacterium’, ‘DNA’ and ‘bioengineer’ among many other search terms. They then read articles and ranked them as having a weak to strong connection to SB. They argued that those articles that discuss the science without the exact naming of SB should be included for purposes of understanding the media framing. We disagree in that we purposely included studies only if they directly used the term “synthetic biology” and significantly discussed the science — that is, it could not be a side mention or on a list of several new fields. Some of the terms used by Ancillotti et al. [2016], would fall into genomic sciences more broadly or genetic engineering.

Due to the fact that the field is not well known in the public, we argue it is not possible for it to be evoked in the media without being named. We did however explore the debate over synthetic biology’s likeness to genetic engineering, and the larger question of what this comparison means and does.

Potential issues

Overall, the mention of potential issues is present but vague and when more detail is given, the answer seems to be that scientists are already aware of dangers and that self-regulation will be key to keeping everyone safe. But this position is dubious. The article “Lab Fight Raises U.S. Security Issues”, which was about Paul Rabinow’s resignation from the synthetic biology lab, raised questions about regulations, so did several articles about the forming of the President’s Bioethics Committee, and the committee’s report [Gollan, 2011]. These articles would make it seem as though there is a fight for control between the private and public sectors, creating a tension between “self-regulation” and “government regulation.” This tension, upon closer examination, is however misleading.

Paul Rabinow's resignation that was suggested by federal funders led to Drew Endy, a lead scientist on the project, taking over the ethics thrust; essentially creating a self-regulated project. Meanwhile, the Committee's report handed the control to the scientists to self-regulate. The news reports and related discourses' insistence on the self/private-government dichotomy seems curious considering the way in which self-regulation was disproportionately gaining grounds, with no sign of government regulation pushing back. This may be due to the media's tendency to look for and heighten tension and conflict, although we argue that this has the effect of actually diverting attention from real public engagement. Nevertheless, the exact areas of regulation and issues in question were only broadly and vaguely discussed. No news articles had been found with concrete conclusions or suggestions about regulatory actions regarding any of the issues mentioned, and no specific SB applications had been reported facing legal restrictions. By maintaining the illusion of an ongoing debate, the articles underplayed the fact that a status quo existed in the development of SB, which leaned towards self-regulation.

Likeness to genetic engineering

We were interested in how the likeness to genetic engineering may impact ethics debates. Our assumption was that if were more like genetic engineering, it would be more likely to come under similar ethical scrutiny to genetic engineering that has a relatively public profile in the public. However, we found that the more different it was to genetic engineering seemed to cause more concerns about the need for new regulations. For example, one article argued that "the rise of SB only intensifies ethical and environmental concerns" (14 February 2010, *The New York Times*) portrayed SB as a rising new technology distinct from the already established genetic engineering, thus cannot be adequately regulated by existing laws.

This is consistent with Gschmeidler and Seiringer's [2011] suggestion that the proximity to already established genetic technologies was part of the reason for lack of public interest and controversy. People shared a sense of familiarity and comfortableness with respect to genetic engineering, that it has been debated and regulated. On the other hand, distance from established genetic technologies called for new and targeted regulations. With this in mind, our finding that the *NY Times* reports offered no definitive conclusion as to whether SB was more like genetic engineering or different from it indicates an ambiguity that again haunted the discussion around SB. This "non-result" echoed the vagueness we found in potential issues of SB. We suspect that this general ambiguity contributed to the lukewarm interest in ethical debates and government legislation.

Relationship to "Nature"

Although the fear of "playing god" has come up often in academic treatment of the field, it appeared that religion and god were not explicitly discussed in most articles. Our analysis of *The NY Times* articles found that controlling nature was mentioned directly or alluded to, which seemed to signal the same concern, thereby collapsing nature and god together to represent a power greater than scientists.

We found both an assurance that we could control nature and also have the proper respect for nature, and that we could never be “god” or totally understand “nature.” As mentioned earlier in the results, Dr. Baltimore’s ‘qualification’ of Venter’s synthetic cells as *imitation* not *creation* is an apt example of this assurance. Statements such as this are reminders that the scientists were merely mortal and no match for nature/god, at the same time as their powerful manipulations were announced. In effect, these reassurances blunted the force SB’s major developments could have had on public impression, as well as overlaying a veil of vagaries over SB’s relationship to “nature.” We suggest that by focusing on the natural/unnatural debate as one of greatest concern, it confines debate. For example, we see that when activist concerns are brought up they are summarily qualified as having concern about the development of “unnatural” organisms/products.

We find it important to note that the framing of the debate as nature/god vs. culture/scientists falls into a common binary of nature vs. culture debates. These debates have been critiqued for missing the more complicated relationship between nature and culture [Haraway, 2003], and has even been folded into scientific fields with a more simplified environment-gene interaction science that arguably still misses the interrelated and unquantifiable nature of the contribution of each. Through this binarization of the argument, there is an anthropomorphizing of all of what we think of as “nature” (as if we can separate out and understand it) as an entity with which the scientists compete for the power of creation. We therefore found ambivalence between celebrating the power of scientists vs. the power of nature.

Temporality

In terms of ethical discourse, some news articles more than others prompt immediate actions. This sense of urgency is labeled as “temporality” in our study, which denotes a “present-ness” of SB and whether or not there is advocacy for immediate action for or against it. We found that whether or not synthetic biology was happening now, had happened, was about to happen or was more likely to be empty promises/sci-fi fantasy, was not easy to determine. In the 32 articles we looked at, the temporality remained ambiguous. As demonstrated in our results, statements contradicted about SB’s speed of development, as well as its likelihood to realize its “sci-fi-esque” promises. On one hand, this ambiguity ultimately left readers unsure about whether or not this science was even possible, and on the other, suggested that this kind of technical manipulation of organisms is commonplace — that science such as SB has always been happening, and will continue to happen. In both cases, it leaves the audience with nothing to act on *in the moment*; no sense of urgency. Further, the ambiguity keeps it important enough to report on but not something to do anything about, fostering a passive instead of active attitude towards the field. This ambiguity permeated the reporting of SB, which we argue is connected to the overall lukewarm interest on SB observed in previous studies.

Conclusion

Our analysis suggests ambiguity itself as a prominent characteristic in SB news reporting. While we do not argue this is an intentional move — we raise the suggestion that this may have the effect of minimizing public involvement and therefore public accountability for the scientists.

Previous studies concluded that synthetic biology was not at the forefront of the public consciousness, and the popular opinion regarding the emerging technology was ambivalent [Gschmeidler and Seiringer, 2011]. These researchers proposed that more time was needed for concrete and unambiguous attitudes towards synthetic biology to be formed and observed. Gschmeidler and Seiringer's [2011] study of German language media between 2005–2009 concluded that there was not yet a set frame for synthetic biology in German media. The researchers at the time theorized that synthetic biology was still in development and had yet to enter public consciousness as its own category (as opposed to as a subset of genetic science). Our study looking into the past decade up to 2015 came to similar conclusion about the ambiguity of synthetic biology news.

However, we argue that the ambiguity is less due to the field being in development but rather related to the very characteristic of the field and how it presents itself. As others have read media reporting through metaphors as ethical pronouncements [Balmer and Herreman, 2009; Hellsten and Nerlich, 2011], we similarly read in to how the field is described as having ethical impacts. Our study contributes to the understanding of synthetic biology and science communication in that it proposes the possibility of the ambiguity itself as an established attitude toward synthetic biology, enabled by experts and media representations. We suggest that the vagueness of synthetic biology — in its definition, public attitude, self-presentation and media portrayal — potentially exempt the scientists from ethical responsibilities and regulations. This study calls for further investigation and follow-up on public opinions about synthetic biology in order to better understand and have conversations about the potential implications and impacts of synthetic biology as a growing new field in biotechnology.

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