

‘Download to Delicious’: Promissory Themes and Sociotechnical Imaginaries in Coverage of 3D Printed Food in Online News Sources

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Author’s accepted version of an article to be published in *Futures*.

Abstract

The fabrication of food products is one of the emergent uses of 3D printing technologies. The news media are important sources for framing the meanings of emerging technologies such as 3D food printing and introducing them to publics. In this article, I discuss the findings of an analysis of online news reporting of 3D printed food technology. A sociocultural perspective was adopted, in which the promissory themes contributing to broader sociotechnical imaginaries related to food and novel technologies were identified in the corpus of news stories examined. These imaginaries can be pivotal in framing collective ideas of where the futures of technologies lie. The analysis found that, unlike coverage of many other novel food technologies, the corpus of online news reports examined overwhelmingly framed food printing technologies in positive ways. Five major promissory themes were identified, portraying 3D printed food technologies as: futuristic; creative; healthy; efficient; and sustainable. These themes contributed to sociotechnical imaginaries that drew on a number of contemporary preoccupations related to food cultures: novelty, entertainment and leisure pursuits; convenience and time-saving; effective production and distribution; health and nutritional aspects; and environmental impacts and global food security.

Introduction

In recent years, the possibilities for the use of digital technologies in food production, preparation and consumption and in contributing to environmental sustainability have received attention (Choi, Foth, & Hearn, 2014; Davies, 2014; Spence & Piqueras-Fiszman, 2013). The fabrication of food products has been proposed as one use of digital additive manufacturing technologies – more popularly known as ‘3D printing’. Several 3D printed food devices have been developed to make a range of food products, employing computer-assisted design software working with a digital fabrication machine. The machines use cartridges filled with pliable edible matter, including food pastes, purees, powders, doughs, liquids and gels made from substances such as sugar, chocolate, cheese, flour, fruit and vegetables and animal proteins. These materials are extruded through nozzles to generate products layer-by-layer, as directed by the software.

Companies and research labs began developing prototypes of 3D printing technology to create food products over a decade ago. Since then, a number of companies and research institutes have sought to invent ways in which food printers can be used (Sun, Peng, Yan, Fuh, & Hong, 2015; Sun, Zhou, Huang, Fuh, & Hong, 2015). A small range of 3D food printing technologies are already in operation, while more are poised to come on to the market for industrial or home use. However, most of these devices remain in the development, experimental or speculative phases. A German company has introduced food printers in nursing homes to make meals for residents, while various confectionary and chocolate manufacturers are already using the technologies. The Barilla pasta company is experimenting with 3D printing, working with the Dutch research organisation TNO, which has been in the forefront of finding applications for the technologies. Several 3D food printers for domestic use are in development, but only a small number are available to consumers. These remain very expensive compared with typical domestic kitchen appliances. There are various technical difficulties and challenges that remain to be solved before the technology can be adopted across a broader range of uses, including the processing of food stuffs to ready them for printing, ensuring food safety standards, establishing supply chains for food cartridges, the slowness of the printing process, and the technologies’ cost and reliability (Houser, 2017; Pallottino et al., 2016; Tran, 2016).

As yet, little academic discussion of the social, cultural or political ramifications of 3D food printing have been published. In this article, I analyse the ways in which 3D food printing technologies have been reported in the English-language global online news media. News media portrayals of these and other novel technologies can play an important role in contributing to the configuring of publics’ understandings and acceptance. When novel technologies are emerging, the news media can be integral to what Jasanoff (2015) refers to as the ‘sociotechnical imaginaries’ that shape their meaning. She (2015, p. 4) defines sociotechnical imaginaries as ‘collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology’. Sociotechnical imaginaries can be pivotal in framing collective ideas of where the futures of

technologies lie. They build on broader sociocultural meanings that can relate to dominant ideas about how social and technological progress should be defined and develop, government and industry should operate, policy be developed and citizen/consumers respond.

Jasanoff (2015) contends that powerful voices and institutions, such as the media, government and industry, work to privilege some imaginaries over others. The news media can act as outlets for government and industry voices on new technologies, amplifying their reach and impact. To identify the sociotechnical imaginaries relating to 3D food printing as they have been constructed in the news media, I conducted an interpretive content analysis of a range of online news reports concerning the possibilities and development of 3D food printing. This analysis focuses on the ways in which the reports defined food printing technologies and their products, introducing them to audiences by articulating a set of promissory themes. Promissory themes play an integral part in contributing to broader sociotechnical imaginaries, working to specifically outline and define the potentials of new technologies (Stephens & Ruivenkamp, 2016). Following a review of previous research into the reporting of novel food technologies in the new media, I describe how the study was conducted and then discuss its findings and broader contexts.

Novel food technologies in the news media

News media coverage of emerging technologies serves to frame issues in certain ways, working to set the agenda for how they are understood by selecting what topics to cover, which benefits and risks to identify, whose opinions to give voice to and the discursive and visual strategies employed to achieve all of this. Media organisations' and journalists' choices over how to frame news is closely associated with news values (Luokkanen, Huttunen, & Hildén, 2014; Marks, Kalaitzandonakes, Wilkins, & Zakharova, 2007). The mainstream news media are attracted towards reporting stories that include human interest elements, report unusual or surprising content, involve drama or conflict, invite emotional responses, or which present negative or positive aspects: these are some of the key news values sought by journalists and editors (Harcup & O'Neill, 2016). Novel technologies often resonate with these news values, given their newness, anticipated benefits or harms and implications for people's everyday lives. News reporting of new technologies tends to frame stories around two major themes: the benefits and promises of the technologies and their risks and hazards (Luokkanen et al., 2014; Marks et al., 2007; Metag & Marcinkowski, 2014).

If a new food technology or product is to be accepted, potential consumers must be convinced about its worth and acceptability. This is particularly the case when unfamiliar ingredients, additives or methods of cultivation or processing are employed, such as genetically modified (GM food), laboratory-cultured meat or alternative food sources such as insects (Rozin, 1999; Tenbült, de Vries, Dreezens, & Martijn, 2005). While new foods or food technologies can incite neophilia, or excitement and interest because of their very novelty, humans also tend towards neophobia, or distrust and fear of new foods (Falk, 1994; Fischler, 1980; Rozin, 1999). New or unfamiliar foods strike at the heart of people's concerns about their identity,

health and bodily integrity as well as acculturated norms and expectations about how food and the edible are defined (Caplan, 1997; Fischler, 1988; Lupton, 1996).

Research more specifically into the news media coverage of novel food technologies has shown that they often focus on controversial or contested issues and their introduction can be portrayed with wildly variable representations (Marks et al., 2007; McCluskey, Kalaitzandonakes, & Swinnen, 2016). News reports about agricultural biotechnologies consistently make associations between these technologies and other food-related risks and hazards such as mad cow disease, listeria and dioxin, highlighting the possibility of long-term health effects that remain unknown (McCluskey et al., 2016). A comparative study of American and British news coverage of agricultural biotechnologies identified two significant dangers: food safety and the effects on the environment (Marks & Kalaitzandonakes, 2002). My research into the reporting of food risks in Australian newspapers (Lupton, 2004) found that the dangers of large-scale agricultural food production received attention, particularly in relation to the use of machinery, pesticides and fertilisers, which were portrayed as 'unnatural' and harming human health and the environment.

Some novel food technologies have been held up to far more criticism than others in media coverage. Concerns about food quality and safety were raised frequently in American newspaper reports of food nanotechnologies, although discourses of risk tended to be equal in number with those portraying the benefits of these technologies (Dudo, Choi, & Scheufele, 2011). In contrast, GM food has been reported in some news media as a highly controversial biotechnology. Negative portrayals of GM foods have been particularly evident in the British news media, both reflecting and contributing to public and political opposition to this novel food technology in that country. British news reports have identified its potential to contribute significantly to alleviating world food shortages and poverty, improving food security and reducing environmental damage. A counter theme focused on the dangers and risks this food technology creates, such as human health problems and challenges to the ecosystem (Augoustinos, Crabb, & Shepherd, 2010; Murcott, 2001; Vilella-Vila & Costa-Font, 2008).

Like 3D food printing, laboratory-cultured meat is a very new high-tech approach to generating food designed for human consumption, involving tissue engineering of animal cells in laboratories. An analysis of images used in online news media reports found that they portrayed this new mode of generating meat in ways that uneasily straddled cultural boundaries. Images of cultured meat often juxtaposed classic tropes of the science experiment and laboratory (the petri dish, the scientists in white coats, test tubes) with familiar images of the meat that consumers are used to purchasing and consuming (Stephens & Ruivenkamp, 2016). Another study of American and European Union media coverage of cultured meat (Goodwin & Shoulders, 2013) found that news reports focused more on the benefits than the risks of cultured meat, with a particular emphasis on its potential to contribute to human health, environmental sustainability, animal welfare and food security.

Study details

I conducted a two-part study directed at investigating the sociocultural dimensions of 3D food printing. The first part was an analysis of the reporting of these technologies in the online global news media, while the second project involved online group discussions with Australians about their understandings of and attitudes to 3D printed food. The news media analysis project served to establish the background for the group discussions by establishing how this novel food technology has been framed in initial news reports and developing the questions asked of the participants. The findings of the media analysis are reported here (see (Lupton & Turner, 2018a, 2018b) for findings from the second part of the study).

Building on the concept of sociotechnical imaginaries, this study adopted an interpretative content analysis approach that sought to identify the ways in which 3D food printing technologies and resultant food products were reported in a corpus of online news media articles. I used the online tool Google News to find this material. Google News is a computer-generated news site that uses algorithms to collect and select news stories published online worldwide. It groups similar stories, so that reports published on the same topic on or around the same day are presented together. Exactly how the Google News algorithms work is not publicly explained, although Google does state that the algorithms select and rank articles based on a number of factors, such as how often and on what sites a story appears online, the freshness of the story and its location, relevance and diversity, with the objective of presenting a wide range of perspectives on a topic for the reader to choose from (Google News, 2016).

The Google News tool provides an archive of news items that can be searched by any user. As well as using specific search terms to find relevant online news stories, sources, locations and a date range can also be specified to search the database archives. Google News includes such online news publishers as industry websites and blogs as well as traditional news outlets. In October 2016, I conducted a search on Google News with the following parameters: reports using the words '3D print food' anywhere in the text, in all English-language news sources, in all geographical locations and in the range 1 January 2013 to 30 September 2016. My preliminary search of online news reports on 3D printed food found none published prior to 2013.

Once the news reports were identified, a qualitative textual analysis of the framing of 3D food printing technologies in these texts was carried out. Following the approach of Stephens and Ruivenkamp (2016), I started with the top news items identified by Google News using the search parameters I had specified, and read each one until I reached saturation for topics and themes. After reading and thematically analysing the first one hundred articles, I was finding that no new topics or themes were being reported. I read on for several pages of articles returned by Google News to confirm that saturation had been reached.

A diverse range of news outlets reported 3D food printing. These included the online sites of major general news publications (such as *The Washington Post*, *Daily Mail*,

BBC News and *CNN*), the financial press (*Wall Street Journal*, *Financial Review*, *Business Insider Australia*), newer online news sites (such as *The Huffington Post* and *Forbes*) as well as digital technology blogs like *Mashable* and *PCWorld* and specialised 3D printing, science, food industry and cooking websites.

A qualitative content analysis was undertaken of these top-ranked 100 texts, focusing on the framing of the issues that were reported. Framing analysis examines the topics and meanings portrayed in news reports (Donk, Metag, Kohring, & Marcinkowski, 2012; Luokkanen et al., 2014; Marks et al., 2007). The research questions structuring the analysis were as follows: How is 3D food printing and its products defined, described, visually represented and introduced to readers in these online news media? What news actors receive prominence in the news stories and which actors are positioned as the beneficiaries of these technologies? What novel features, uses and benefits of food printing are outlined? What drawbacks, risks or dangers of these technologies and their products are identified? And more broadly, what are the sociotechnical imaginaries developed across these news stories?

Each text identified from the Google News search was read and examined for the use of words in headlines and main texts and the content of images (including diagrams, photographs and embedded videos) used to illustrate the reports, with an emphasis on identifying recurring themes across the corpus of material. The themes and topics were iteratively generated as I read through each article and made a note of the elements outlined above in the research questions. A list of topics was generated in this way, which were then grouped together under broader topical themes that I developed as the material was examined.

News topics and promissory themes

I identified five major promissory themes, portraying 3D printed food technologies as: futuristic; creative; healthy; efficient; and sustainable. News stories often included more than one or up to all of these themes. In this section, I discuss each of themes in turn, followed by a discussion in which their broader contributions to sociotechnical imaginaries is considered.

Futuristic

The first articles on 3D food printing were published in May 2013 in response to an announcement by NASA that it was funding research to develop 3D printed food for astronauts. This news event established an initial framing of these technologies as futuristic and the stuff of science fiction. Such headlines as 'NASA Asks: Could 3D-Printed Food Fuel a Mission to Mars?' (*Washington Post*, 21 March 2013) appeared. These articles made reference to the possibility of astronauts enjoying 'pizza on Mars' using food printing technologies (*Quartz*, 20 May 2013). The well-known science-fiction cultural reference of the food replicator machine from the 'Star Trek' television series was also often used in these and later online news reports.

Some reports, even those published by 3D printing industry websites, referred to the incongruity of bringing together concepts of edible matter with 3D printing technologies. For example, an article on *3DPrint.com* (30 October 2015) led with the sentence, ‘Of all the unbelievable things that 3D printing is capable of, 3D printed food is possibly the weirdest’. As part of their attempts to introduce the new technology to readers, news accounts of 3D food printing often included diagrams of the process, photographs of the machines and descriptions of how they worked. Images and videos of 3D food printers at work displayed their high-tech features that looked significantly different from the usual form of familiar kitchen food processing appliance (see Figure 1 for an image of a 3D food printer).

Figure 1: 3D food printer



Credit: Image by Kim van Velzen, from Flickr. Attribution 2.0 Generic (CC by 2.0).

Several news stories expressed ideas about future living in which 3D food printing devices featured as a prominent part of home kitchens. For example, *The Telegraph's* feature on ‘back to the future’ (22 October 2015) employed a range of experts to predict how they envisaged the world of 2045. One part of the article focused on how food preparation would take place: ‘By 2045 many kitchens will feature a 3D Printer ... a fun kitchen gadget to sit alongside the Soda stream and waffle maker.’ News reports were frequently inspired by events such as launches of new 3D printing devices and initiatives using these machines, including the major CES trade show held each year in Las Vegas, where a huge range of new digital devices are displayed: including, in 2015,

the XYZPrinting 3D food printer covered by news outlets like *Mashable* (6 January 2015).

Many news accounts throughout the period examined continued to represent 3D printed food in speculative terms as 'the food of the future'. Their headlines sometimes made this direct statement, as in 'The Future of Food: Print and Eat?' (*Baking.business.com*, 14 July 2014). Articles on current 3D printed food experiments emphasised their novelty, frequently employing words such as 'innovation', 'fun', 'endless possibilities', 'new experiences' and 'ground-breaking' and making reference to scientific terms such as 'labs' and 'experiments'.

In summary, these news reports represented the possibilities offered by these technologies as rapidly developing, but located as somewhere in the near future rather than the present. The novelty, high-tech and unfamiliar nature of these technologies were represented as intriguing and exciting, conforming to popular understandings based on cultural products like 'Star Trek', rather than as frightening or potentially harmful. They were framed as offering future benefits both to specialised groups (such as astronauts) and general consumers such as domestic cooks or those interested in novel, experimental food products.

Creative

Many news reports were illustrated with images of existing 3D printed food products. Images included such foods as sugar-based or chocolate decorative items for special foods such as wedding cakes and candy and chocolates that could be personalised using such features as people's names, special messages and even their portraits. These images showed foods that looked familiar, attractive and decorative, albeit in some cases more intricate in their shapes than many other sweets or cake decorations (examples of such foods can be seen in Figures 2 and 3). In one example, reports covered the initiative of Dylan's Candy Bar chain in the USA to introduce 3D printing technologies which enabled customers to customised their sweets and watch as they were fabricated.

The possible impact of 3D printing technologies on the world of haute cuisine also received attention in many news reports. Here again, references to 'innovation', 'novelty' and 'revolutionary' developments were made to explain how the art of high-end restaurant cooking could be enhanced with the use of food printing technology. For example, an article published on the *BBC* website (1 March 2016), headlined 'How 3D Printing Is Shaking Up High End Dining', reported the use of 3D food printer technologies by Spanish chef Paco Perez. The author emphasised Perez's fine-dining cuisine credentials with reference to the fact that he had won several Michelin stars. The report provided the fine detail of how Perez creates a dish he entitles 'Sea Coral', beginning with a 3D-printed 'coral' shape made of seafood puree. A video embedded in the report showed how Perez and his co-workers constructed this dish in one of his restaurants. In addition to the formulaic portrayal of chefs and their assistants showing them at work using conventional devices such as knives and saucepans, the video depicted them looking at a computer screen and filling stainless steel canisters with food purees, then using the touchscreen on a Foodini food printer and watching

as the machine fabricates an intricately designed edible object directly onto a white dinner plate, ready for Perez to add his finishing touches.

Figure 2: 3D printed chocolate



Credit: Image by Maurizio Pesce, from Flickr. Attribution 2.0 Generic (CC by 2.0).

Figure 3: 3D printed sugar confections



Credit: Image by Maurizio Pesce, from Flickr. Attribution 2.0 Generic (CC by 2.0).

In mid-2016, several news outlets covered the launch in London of the pop-up restaurant Food Ink. Diners at Food Ink were served a nine-course meal in which all the food was fabricated using 3D printing technology. This initiative was typically reported in news articles as an extension of novelty restaurants and cuisine such as ice bars, dining in the dark and molecular gastronomy. The *Daily Mail* (12 July 2016), for example, categorised Food Ink as one of London's range of 'hipster' and 'quirky' eateries. Several news outlets covered the launch of the 3DS Culinary Lab in Los Angeles in late 2015, which brings together 3D food printing technology developers with chefs and food industry representatives. The Project Nourished initiative, invented by members of a virtual reality start-up also based in Los Angeles, incorporated a number of digital technologies. As well as using 3D printed food made from algae and yeast, this project involved technologies such as virtual reality, aromatic diffusers emitting food aromas and a wearable transducer to mimic the sounds and vibrations of chewing and swallowing to create new multi-sensory eating experiences. *The Mirror's* (14 July 2016) report on the project was headlined, 'Is This the Coolest Dining Experience Ever? Futuristic Restaurant 3D Prints Your Food'.

In online news accounts of these initiatives, emphasis was placed on the technology's capacity to expand consumers' imaginations and expectations around food and eating experiences. One of the embedded videos in the *Daily Mail's* report on the Food Ink pop-up restaurant was that of the company's own promotional video. It featured stunning images of colourful food fabricated on their machine served in an attractive restaurant setting. Terms used in the video such as 'pixels to printer to plate', 'hacking fine-dining' and 'download to delicious' brought together computer jargon with gastronomic experiences, seeking to position the food as simultaneously gratifying consumers' desire for new food experiences that combined cutting-edge technology with flavour and visual impact.

The news reports categorised in the creative theme again emphasised the novelty of the food printing technologies, but combined this attribute with presenting the decorative, creative and entertainment potential of these technologies. The tenor of reporting tended to focus on the present rather than the futuristic possibilities of these foods, as many of the food products these news stories covered were already beginning to be offered to consumers. Gourmet chefs looking to expand their repertoire, and members of the food-consuming public, including those seeking novelty and decorative food items as well as those looking for innovative high-end dining experiences, were positioned as the beneficiaries in this promissory theme.

Efficient

Another dominant promissory theme in online news media concerned the contributions 3D printing technology could make to processing food efficiently for people in restrictive or emergency conditions, as well as for the home cook. The opportunities for food manufacturing systems to be improved – and indeed, even revolutionised – were also canvassed.

News reports claimed that 3D printing technologies could be employed in present conditions to meet food provision requirements in difficult situations. For example, in an article on the latest technologies that could help in emergencies, *The Guardian* (22 December 2015) noted that drones could be combined with 3D printed food technologies to deliver food to emergency-affected areas. Tech blog *NPR* (4 November 2014) published an article on the American Army's experiments in using 3D printing technologies to make food for soldiers in the field. Other articles described the possibilities of food printing for airline travellers and people in refugee camps.

Food printing was also presented as an opportunity for home cooks to prepare meals and snacks quickly and easily. As a report in *PCWorld* (7 November 2014) argued, 'After a long day at the office, the last thing you want to do is tie on an apron and cook a meal. How about just printing one?'. This idea captured the attention of news outlets like *The Huffington Post* (1 August 2016), which published a story reporting the research of Hod Lipson and colleagues at Columbia University in developing 'a 3D printer for the home that could revolutionize how we eat'. In a *Wall Street Journal* article entitled 'What Are You Printing for Dinner?' (9 June 2016), Lipson was also cited, remarking that kitchens are "the most primitive thing in our house," but soon "we'll be able to download and print dinner".

3D printing and food industry blogs suggested that such features as being able to customise food products using the technology would have a major impact on food processing and manufacturing with the next two decades. One example is a report published on *3Ders.com*, a 3D printing industry news blog. Headlined 'Experts Predict 3D Printed Customised Food Items to Rule the Industry in The Next 20 Years' (15 July 2015), the author also employed terms such as 'revolutionise' and 'radically change' to present the potential of 3D food printing technologies for these purposes. It was asserted in the news reports that using this technology could result in more efficient storage, transportation and preparation of food and the de-centralisation of food preparation. For example, Anjan Contractor, whose company received the grant from NASA in 2013 described earlier to create a prototype of a 3D food printer, was quoted in several news stories as envisaging a future when food waste as part of food preparation could be eliminated by the domestic use of such a machine. He claimed that people could store food cartridges for long periods of time and use them to create foodstuffs tailored to the requirements of the machine's software.

Here again, photographs and videos used to illustrate news stories typically brought together images of high-tech food printing devices and computer geeks clustered around computer screens with those showing kitchen workers and chefs preparing the ingredients to use in printing equipment. Many news accounts used references to familiar kitchen appliances like ovens, soda stream drink makers and waffle makers in the attempt help make 3D food printers appear appropriate to domestic conditions. They worked to position these novel digital technologies as offering new helpful ways to achieve mundane food preparation for busy people who had little time to cook meals at home.

These news reports involved discussion of a very near future in the use of food printing across a range of contexts. While again the possibilities and benefits of these technologies and products were brought to the fore, these reports used frames that emphasised their utilitarian and functional attributes. The beneficiaries of food printing receiving attention in this promissory theme included the home cook looking for convenience and saving time and those in situations where adequate meals can be difficult to provide, as well as industry stakeholders in the food manufacturing system.

Healthy

Several news reports drew attention to the health and nutritional benefits offered by 3D printing food technologies. Potential consumers and purchasers of home food printers were positioned not only as being able to alleviate their time-poor lives by acquiring such a device, but also to ensure that the food they prepared was as healthy as possible. It was claimed that 3D food printing could encourage children to eat foods such as vegetables by fabricating them in attractive shapes (one example provided was dinosaur or butterfly shapes made from spinach quiche).

The potential health benefits of 3D printed food for all age groups were outlined as well, focusing on the opportunities to personalise the content of food using the technologies and to make meals and snacks quickly that are fresher and contain fewer preservatives, salt and saturated fats compared with the usual convenience foods to which people may resort. News reports cited food printing technology developers and researchers contending that they would promote healthy eating by requiring the use of fresh ingredients. Furthermore, using the machine at home offered the opportunity to meet personal dietary requirements removing allergens or other elements that people wish to avoid consuming (such as animal products if they are vegetarian or vegan).

News articles also covered the use of 3D printing to prepare more appealing meals for people with dysphagia (chewing and swallowing difficulties) or other eating difficulties. A 3D printing industry website (*3DPrint.com*, 28 October 2015) reported on this development, detailing the device currently being tested by the German IT company Sanalogic. Other reports made mention of another German company, Bizoon, which by mid-2014 was already testing its range of printed 'Smoothfood' in nursing homes in its home country. Indeed, according to *Gizmondo's* rather irreverent headline reporting this development, 'The First Cheap 3D Printed Food is Delicious Nursing Home Mush' (30 May 2014). Images of this food portrayed plates with gelatinous shapes made from such substances as chicken and vegetable purees that looked visually attractive.

In these reports included in the promissory theme of health, 3D food printing technologies were portrayed as either already in operation (as in the printed foods provided in nursing homes) or envisaged to take place in the near future. Claims to novelty rested on the attractive incorporation of healthy ingredients or soft-textured food products offered by the shaping capacities of the technologies. People with

dysphagia, and more broadly, consumers looking to provide nutritious foods for themselves or their family members were represented as the main beneficiaries.

Sustainable

The final promissory theme drew on claims relating to more environmentally-friendly and sustainable food production. The idea that food production, storage and delivery systems could be more efficient if 3D printing technologies were introduced was also linked to possibilities to reduce their impact on the environment, while the opportunity to reduce food waste, use alternative food sources and maximise the nutritional components of food was positioned as offering solutions to food shortages.

Here again, Arjan Contractor was a major news actor, contending that in time, world hunger problems could be alleviated by the use of 3D printing technologies. Indeed, this was the topic of the headline of an article published in *Quartz* (20 May 2013) on Contractor's project: 'The Audacious Plan to End World Hunger With 3D-printed Food.' The *Quartz* article went on to refer to the possibility of making 3D printed food from ingredients such as insects, algae, duckweed, lupine seeds, beet leaves and grass. It was also contended in this and other articles that experiments in culturing meat could be brought together with 3D printing technologies. Meat grown in this way could be used in the printer to generate appealing shapes for consumption. *Gizmodo* asked readers, 'Would You Try 3-D Printed Meat?' (29 June 2016), discussing various research initiatives into developing the technology to do just this.

These reports went beyond the benefits for individuals of these technologies to representing them as solutions to global problems such as climate change and reliance on livestock for food production. None of the proposed 3D food printing technologies has yet come on to the market. The promissory narratives of these stories make grand claims, but remain mostly in the speculative futures mode.

Dissenting voices

As I have shown, discussion of 3D food fabrication in the corpus of news accounts examined, particularly by developers and entrepreneurs seeking to attract attention to their wares, often tended to boosterism and wild and optimistic claims for the future. Few critics of 3D food printing have thus far received attention in the news coverage. Although there are manifold legal issues that could complicate the introduction of food printing technologies, including those concerning food labelling, potential problems with food contamination and storage causing food poisoning, and food adulteration (Tran, 2016), these were hardly canvassed. Little discussion was provided in the news reports concerning details of how easy it may be to use 3D food printing technologies, how tasty the food generated from it might be, or whether the food they made may pose any risks to those consuming it. The possible economic repercussions for the food industry were not raised in the reports.

At most, dissenting opinions were provided at the end of long articles that had gone into some detail in outlining the benefits of food printing. Thus, for example, *The*

Washington Post (21 May 2013) quoted Gawain Kripke, the policy director for food security and hunger at Oxfam America, as suggesting the 3D food printing was not going to be able to solve world hunger problems in the near-term. Simpler technology such as access to tractors and seeds, he said, would be more effective. In one of the few cautionary reports to appear in the corpus of texts examined, a food industry news website, *Foodmanufacture.co.uk* (16 September 2015) published an article in which the possible safety risks of consumers using the devices at home were raised. In the lead sentence, it was claimed that '3D food printing presents one of the top four food safety challenges of tomorrow', but no further detail was offered.

The cost of home food printing machines was also raised as a potential barrier to consumer interest in some reports, as was the problem that these devices were still in development, so that people who may be interested in purchasing them would have to wait until they came onto the market. The expensive nature of the gourmet printed food featured in restaurants also received attention, as in the following headline used in an article about the FoodInk pop-up restaurant: 'Is This the Future of Fine Dining? Restaurant Where All the Food and Even the Table Is 3D Printed - But It Will Cost You £250 a Head' (*Mail Online*, 15 July 2016). Some reports also quoted experts in the food industry as voicing some reservations about whether 3D printed food would be widely accepted by consumers. This was usually in response to the more speculative uses of the technology, as in the Project Nourished initiative described earlier, or the use of cultured meat.

Discussion

The five major promissory themes I identified in the corpus of news reports on 3D food printing – futuristic, creative, healthy, efficient and sustainable – are indicative of broader sociotechnical imaginaries related to food processing and food consumption. Table 1 provides an overview of the major topics included under each theme. The themes have resonances with sociotechnical imaginaries relating to new digital technologies, scientific experimentation, the food production industry, haute cuisine, home cooking, creativity, healthy diets and initiatives directed at environmental sustainability, ethical consumption and green politics.

The sociotechnical imaginaries of 3D food printing are still in development. Like laboratory-cultured meat (Stephens & Ruivenkamp, 2016), the ontology of 3D printed food currently inhabits an ambiguous space between cultural categories. The widespread adoption of the term '3D printing' to describe the digital additive manufacturing process serves to position this technology as a familiar domestic device, albeit one not usually employed to generate edible products. Digital printers, while they are common as devices in the workplace and home office for printing words on paper, are not generally associated with the production of edible materials or the location of the haute cuisine restaurant or home kitchen. As food processing machines, they currently largely inhabit the status of the futuristic machine of science fiction or fantasy (as in the 'Star Trek' food replicator).

Table 1: Promissory themes and topics identified in online news reports of 3D food printing

Promissory Theme	Topics
Futuristic	Food for astronauts Science fiction technologies High-tech food processing Kitchen of the future Innovative and revolutionary food science developments
Creative	Novelty food products Food as decoration Food as entertainment Customised foods Haute cuisine Digitally augmented dining experiences
Healthy	Food for people with dysphagia and the elderly Nutritious food preparation Customised food for special groups
Efficient	Food for armed forces, refugee camps and emergency situations Food for plane travellers Easy to prepare food for the home cook More efficient storage and transport of food
Sustainable	Better food production, storage and distribution systems lessening environmental impact Use of alternative edible substances in food products

A tension was evident across news reporting between attempts to emphasise the futuristic and novel affordances of 3D food printing and those that sought to render them familiar and therefore more acceptable to potential consumers. Related to this tension was the contrasting of the banal and the mundane with the sci-fi possibilities of food printing in the news reports. Some reported applications of 3D printing portrayed these technologies as little more than handy new kitchen gadgets, gimmicky machines for manipulating and presenting foodstuffs, or a more appealing way of processing and presenting everyday nutritious or easy-to-eat foods. Other reports took a far more speculative and futuristic approach in attempting to positively portray the possibilities and promises of food printing.

For the most part, scientific innovation was portrayed as a positive force in news reports of 3D food printing. The unconventional association in the news articles of digital printing technologies with such endeavours as gourmet and home cooking and efforts towards improving human health, world hunger and environmental sustainability only served to support its possibilities. The vast majority of online news reports represented food printing as ameliorative, progressive, entertaining and creative: a fine example of the marvels of modern science and digital technological developments with both entertainment and more serious purposes. Narratives on printed food drew on the conventions of science fiction and futuristic discourses to emphasise the novelty, scientific nature and potential of the technology.

Molecular gastronomy is perhaps the closest form of cuisine to that using 3D food printing technologies. As in news reports of food printing, portrayals of molecular gastronomy in popular culture have emphasised the marrying of science with cuisine as a means of emphasising its distinctive progress-oriented, creative and ground-breaking features. Whereas new food technologies tend to be associated with industrial-level, large-scale enterprises, both molecular gastronomy and 3D food printing technologies incorporate scientific devices and procedures into chefs' kitchens and fine dining (de Solier, 2010; Domene, 2013). While discourses of molecular gastronomy emphasise new knowledges and techniques derived from physics and chemistry into the kitchen (de Solier, 2010; Domene, 2013), a focus on computing devices and software is incorporated into news accounts of food printing.

Unlike molecular gastronomy, however, in which the major emphasis is on presenting style and taste of the food prepared in new haute cuisine ways that require high levels of knowledge of expertise and technical skill, food printing in news accounts is represented as achieving more diverse ends. Narratives on printed food technology claimed that not only can it contribute to the preparation of novel dishes, it can make the preparation of food easier, more convenient, healthier and more sustainable for the home cook and gourmet chef alike. 3D food printing technologies also inspired accounts that focused on the possibilities for their contribution to fun, customised and decorative foods. The technologies were represented as yet another new and exciting way in which digital devices and software could be incorporated into everyday life and leisure cultures.

If molecular gastronomy represents intersections between food, science, art and late capitalism (Domene, 2013), then 3D food printing bring all these together and adds the elements of digital technologies, health, convenience and environmental sustainability and food security. With their focus on health and personalised nutrition, news narratives on the affordances of food printing echo some of the ideals expressed in other food trends: those of healthy eating (Caplan, 1997; Lupton, 1996) and functional foods (Crawford, Brown, Nerlich, & Koteyko, 2010), in which food's value is positioned principally in terms of the nutrition and good health it may offer. They further draw on the types of discourses espoused in green politics and food activism for sustainable consumption (Evans, Campbell, & Murcott, 2012; Lang & Heasman, 2015; Siniscalchi & Counihan, 2013), in highlighting the technology's potential to reduce food waste and energy required for transportation and distribution of foods, use alternative sources of protein and enhance global food security. Here the reporting of 3D printed food shared some similarities with news stories on cultured meat (Goodwin & Shoulders, 2013; Stephens & Ruivenkamp, 2016).

News actors receiving most attention as authoritative voices in the news reports included the developers of 3D printing technologies seeking to draw attention to their inventions, university-based researchers and designers experimenting with and developing the technologies and high-profile chefs. It was these news actors whose opinions and ideas about what food printing could achieve who had the major influence on the framing of the news reports. Key news actors identified in the online

news reports and images and videos illustrating them combined a hitherto unconventional and incongruous set of actors and settings. The dominant actors and images used in these news reports combined signifiers of the scientific laboratory (white coats, test tubes, sterile benches) with symbols of computer technologies (IT experts in t-shirts fiddling with computer screens or tangles of wires and motherboards), high-end cuisine (chefs and assistants in aprons and chef's hats preparing and plating food in restaurant kitchens and intricate and decorative food items).

The views of current or potential consumers concerning what they thought of printed food received little voice in the news media. As most of the technologies described in the news reports were not yet in use, few images portrayed people actually eating printed food products. Yet there was extensive discussion of consumers as potential beneficiaries of these technologies across the five promissory themes. 3D printed food was portrayed as offering home cooks convenience, saving them time and providing them with the opportunity to make and serve more nutritious food. People in special circumstances such as astronauts, refugees, those in emergency situations and air travellers, as well as those with chewing and swallowing difficulties, were also singled out as potential beneficiaries. Consumers who enjoyed new foods and styles of eating were another group targeted in news stories.

As I have shown, thus far, few negative accounts have emerged to counter these techno-utopian representations. This is an intriguing finding in itself, given that in the past novel food processing technologies involving unfamiliar technological manipulation have often provoked at the least uncertainty, and at the most extreme, representations of such food as non-edible, dangerous or threatening, or even as grotesque 'Frankenfoods' (Hellsten, 2003; Messer, 2007; Stephens & Ruivenkamp, 2016). Few rhetorical strategies were employed that referred to any possible shortcomings or risks of introducing this technology. Instead the focus in online news reports was on its value for digital technology entrepreneurs, restaurateurs, the food industry, consumers and the environment.

The often-ambitious claims that were made for 3D printed food by the major news actors were rarely contested in the news accounts. This may be due to several factors, such as: this technology is still relatively new and in the development and speculative stage rather than in widespread use, and thus its possibilities and consequences have yet to be fully reported; the diversity of claims made for printed food and their positive associations provide a strong rhetorical argument to support their introduction; unlike such novel food technologies as GM food, as yet the stakeholders involved in developing and promoting printed food are small-scale entrepreneurs, designers and restaurateurs – the profit interests and motives of Big Agri-food or politicians are not associated with food printing; and while some of the ingredients used for some of the proposed printed food products may be novel or unconventional (such as cultured meat, algae and insects), the technology itself is relatively uncontroversial. Its novelty lies principally in the way foods are prepared and shaped rather than in such confronting manipulations as genetic modification.

Conclusion

In this article, I have identified the promissory themes contributing to broader sociotechnical imaginaries about 3D printing in online news media accounts. Sociotechnical imaginaries draw on and enact moral, social and political meanings. They work rhetorically to privilege some uses of novel technologies over others as desirable and attainable. They extend these meanings into the future by identifying visions for how and in what way new technologies might (and should) be applied. Online news stories provide one context in which these imaginaries can be articulated and distributed. In the case of the online news accounts examined, a diverse range of potential uses and benefits were offered for using 3D printing technologies to generate food products. These news accounts make grand claims that invite consumers to imagine a future in which 3D food printing is part of their food preparation and dining experiences. However, there are still many unknowables about what 3D food printing can offer and how they might be enacted. The question remains as to whether these imaginaries will come to fruition, what forms of alternative or contesting visions might challenge them, and to what extent consumers accept these imaginaries and incorporate food printing technologies and their edible products into their everyday lives.

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