Conscious, Complacent, Fearful: Agri-Food Tech's Market-Making Public Imaginaries

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Abstract

While the tech sector has seized upon the food system as an area in which it can have a major impact, innovators within the agri-food tech domain are dogged by concerns about public acceptance of technologies that may be controversial or simply not of interest. At the same time, because they operate within an investor dependent political economy, they must demonstrate that the public will consume the products they are creating. To both secure markets and legitimate their approaches to problem-solving, entrepreneurial innovators draw on three existing imaginaries of consumers, each of which articulates with a particular tendency they have pursued in problem-solving. Reflecting a tendency of solutionism, those promoting technologies that promise minimal processing and/or short or traceable supply chains invoke a health- and eco-conscious consumer. In keeping with technofixes, those promoting technologies of mimicry invoke a complacent consumer. Reflecting the tendency toward scientism in problem solving and related projections of public knowledge deficits, those promoting potentially controversial technologies invoke a fearful consumer and embrace transparency to inform and assure such consumers. By promising future consumers who will willingly accept emerging technologies, each of these imaginaries seeks to resolve – for investors – potential problems of consumer acceptance generated by the particular approaches to problem solving innovators have adopted. While STS scholars have shown how public-facing engagement exercises and policy work are often limited by deficit-driven imaginaries of the public, in these investor-facing spaces possible objections are both imagined and overcome without any interaction with actual publics.

Keywords: Agri-food tech, imaginaries of the public, consumer acceptance, solutionism, scientism, technofix

Introduction

In the last decade or so, the tech sector has seized upon the food system as an area in which it can have a major impact. Innovators in the agri-food tech sector are imagining a future of food in which challenges facing food and agriculture have been overcome by technology, including picnics alongside the same animals that are in our sandwiches, steaks grown on mycelium 'farms,' fully automated indoor agriculture and more. What is often overlooked in the media hype, and even in the more skeptical responses in the media and in the academic literature, is that they are not only imagining the future of food, and all the ingredients, processes, platforms, and products that they imagine will save the planet, but also a public that wants, needs, and / or will hopefully eventually succumb to their vision. Critical analysis of the implications of such

innovation must, therefore, attend not only to the technologies being developed and promoted by the sector, but also the public being imagined in relation to this innovation.

Entrepreneurs and investors operating in the agri-food tech sector promise moonshots, transformative disruptions that will revolutionize the food system, and urgently so in the face of the 'grand challenges' related to climate change and population growth. As others have argued, there are many ways in which the sector appears, or aims to be, more disruptive than it actually is (Guthman and Biltekoff, 2020; Jönsson, 2020; Sexton, 2020), and is in fact characterized by what Jesse Goldstein (2018), writing about innovation in clean energy, calls 'non-disruptive disruptions,' in which the core values and politics that created the environmental challenges the sector has emerged to address are left unquestioned, intact and even in charge. Along these lines, we question whether the agri-food tech sector offers anything innovative or even disruptive when it comes to how the public is imagined.

Agri-food tech start-ups in the US operate in the context of an intensely investor-dependent, entrepreneurial-driven political economy of innovation in which the projection of a 'consumer-in-waiting' is critical to demonstrate to potential investors the value of funding such innovation (Duncan et al., 2021; Rajan, 2006). With consumer uptake of the technologies that they have devised imperative, the sector itself, along with the media and many academics attuned to the sector, are preoccupied with the question of how to achieve consumer acceptance. But rather than ask whether consumers will accept these solutions, or what needs to be done to impel their acceptance, we ask a different set of questions: we seek to understand the role that consumer acceptance plays within the sector and the political implications of this role, particularly with regards to the possibilities for the public to meaningfully affect what agri-food technologies are developed and to what ends. We ask: How do actors in the agri-food tech sector imagine the public? What role do these imaginaries play in the sector itself? What kind of agency and capacities do their imaginaries project onto the public?

While the entrepreneurial innovators we study see public acceptance as a problem originating from consumers' attitudes, beliefs, and behaviors, we find that consumer acceptance is an artifact of their own approaches to problem-solving, especially within the agri-food domain. We show how entrepreneurial innovators imagine the public as consumers and deploy particular imaginaries of consumers in order to help their solutions make sense both to themselves and to those whose support they need. More specifically, each of the three imaginaries we identify seeks to resolve – for investors – potential problems of consumer acceptance generated by the particular approaches to problem solving innovators have adopted. In so doing they promise future consumers who will willingly accept emerging technologies.

STS scholars have long noted that imaginaries of the public play an important role in the development, assessment, and regulation of cutting-edge technologies, and have shown how possibilities for public participation in the governance of new technologies is shaped by the ways in which publics are perceived and projected by institutional actors (Burri, 2015; Jasanoff, 2015). Focusing on ELSI work (ethical, legal, and social issues) in the case of synthetic biology, which happens to be one of the technologies being deployed by agri-food innovators, Marris

(2015, p.84) shows how those in the field imagined 'public attitudes' as major obstacles that needed to be surmounted in order to deliver its 'public benefit'. Public engagement activities were driven by the assumption that negative public attitudes about synthetic biology arose from lack of scientific knowledge and were thus designed to improve public understanding of potential benefits and ensure risks 'were not overblown'; there was no recognition that the definition of societal benefits or how the emerging technology would contribute to them 'might need to be opened up to deliberation' (p.85).

Also observing public engagement in the early stages of innovation, Burri (2015, p.233) compared agenda-setting policy documents on nanotechnology and found that in the German context they portrayed members of the public as informed, responsible, engaged, citizens having a 'civic duty to participate responsibly in democratic decisions and public life – including the assessment and governance of technology' (p.243). In contrast, similar documents in the US context portrayed the public as 'future consumers' and set out communication agendas designed solely to ensure that the public could fulfill their role as 'informed and willing consumers' (p.245). We build on these insights about public engagement to explore how imaginaries of the public – their role, capacities, and the aims of communication - function in a very different context. Rather than the public-facing spaces of policy or ELSI work, we analyze the role imaginaries of publics as future consumers and obstacles to be overcome play within the investor-facing spaces of Silicon Valley-based agri- food tech.

Analytical perspectives: problem solving and consumer acceptance

The last ten years have seen a dramatic uptick in technology start-ups in the realm of agriculture and food. As an indicator of this activity, annual fundraising by agri-food tech startups has been growing rapidly from $2-3 billion per year in 2012 and 2013 to over $8 billion in 2015 and 2016 to roughly $20 billion in both 2018 and 2019 (AgFunder, 2019). The covid-19 pandemic hardly slowed this trend, with a reported $8 billion invested in agri-food tech startups in the first half of 2020 alone (Kite-Powell, 2020). Typical applications include: crop and livestock biotechnology; farm management software and big data analytics; in-field and remote farm sensors; farm robotics; vertical agriculture and other novel farming systems; food safety, traceability, and supply chain logistics; cultured meat, plant-based meat, and other alternative proteins; other synthetically fabricated foods, restaurant and grocery delivery apps; and robotic delivery (AgFunder, 2019). While many of these technologies are being designed strictly to appeal to farmers and food service providers (e.g., management software and robotics) many have a consuming public in mind, and those are of particular interest for this paper. These include both foods produced in novel conditions (e.g., vertical agriculture) and foods produced with novel ingredients and processes, the vast majority of which are meat and dairy replacements (henceforth alternative proteins).[i] Products with more amorphous audiences are also of interest to us such as technologies that promise transparency.

Nowhere is the agri-food tech ferment more vibrant than in Silicon Valley, widely considered the epicenter of such tech-centric innovation in the US. As a geographic space Silicon Valley strictly

refers to the Santa Clara Valley and its main city of San Jose, California. In fact, however, the entire San Francisco Bay area plays a role in tech culture, with many tech (and tech financing) firms scattered across surrounding cities. But, of course, Silicon Valley is much more than a geographic location. Narratives of Silicon Valley's innovation culture often attribute it to an amalgam of regional histories in, among other things, countercultural experimentation and utopian thinking, entrepreneurial fervor, and Cold War-inspired technical problem solving (Jervis, 2020; Sexton, 2020; Turner, 2006; Walker, 2018). In her history of Silicon Valley tech culture, Margaret O'Hara (2020) quips it is 'a global network, a business sensibility, a cultural shorthand, a political hack' (p.4). Yet it is also true that Silicon Valley brings together a unique blend of high tech professional and research networks with the country's greatest concentration of early-stage capital; in 2018, Bay Area startups absorbed 49 percent of the country's venture capital funding (Schubarth, 2019). Although Silicon Valley is new to food and agriculture, entrepreneurs in the agri-food space feel compelled to pitch to, if not always relocate to, Silicon Valley in order to access that capital (Sexton, 2020). At the same time, they have to make food appear technological (Sexton, 2020) and otherwise conform to the demands of venture capital for both world-changing ideas and quick profitability (Goldstein, 2018).

In this tech-saturated context, innovative entrepreneurs develop technological solutions to complex food and agriculture problems that are driven by their own visions of a better food future, or sometimes simply by what they can do based on their knowledge and skills. These approaches manifest in what we identify as three tendencies in tech-driven problem solving: solutionism, techno-fixing, and scientism. These tendencies refer of course to well-trodden concepts in STS, but we want to suggest that these tendencies take on particular valences in a profit-oriented 'ecosystem' dependent on entrepreneurial innovation and private investment and, moreover, in a sector oriented to the production of food which requires consumers to not only buy but also eat the products of invention. While these tendencies overlap in many ways, we highlight subtle differences to help elucidate the relationship each has to distinct imaginaries of consumers that we discuss further below.

Many entrepreneurs develop and promote technologies because they can, effectively engaging in what tech critic Morozov (2013) has called 'solutionism'. Morozov refers specifically to a tendency among techies, engineers and others to develop solutions in advance of investigating the problem or even knowing what the problem is. Instead, the availability of a technology precedes the problem, so that the entrepreneur goes searching for a problem to which the technology can be put to use. Commonly in the tech world, entrepreneurs take up technologies already developed in certain fields to apply them elsewhere. Such was arguably the case with cell-cultures meat, which first became conceivable from medical tissue engineering (Sexton, 2018; Wurgaft, 2019), notwithstanding that cell-cultured meat entrepreneurs, motivated by their own ideas of how to save the world, have also engaged in techno-fixing discussed below. For Morozov, the problem with solutionism is that when solutions are developed in somewhat of a vacuum of problematizations they may be mismatched to the problem they invoke, unable to deal with its complexity, or worse, can foreclose other possible problematizations and responses (see also Russell and Vinsel, 2018). An unexplored aspect of solutionism is that

solutions may also be developed in a vacuum of either citizen engagement or the public's needs or wants.

Other entrepreneurs, especially those who profess to be mission-oriented, develop technologies they believe to be optimal solutions to pressing and often complex problems. The concept of the techno-fix captures this approach to problem-solving. In the classic sense, the techno-fix refers to the forwarding of a technological solution in lieu of the messy and ultimately political work of addressing the socio-ecological conditions that give rise to such problems, such as climate change, food insecurity and so forth (Huesemann and Huesemann, 2011; Johnston, 2018). Reflecting on the term's more positive genealogy, Johnston traces the career trajectory of Alvin Weinberg, a nuclear engineer who became the head of Oak Ridge National Laboratories in Tennessee. Johnston notes how Weinberg championed the idea that engineers could replace social scientists by designing technologies that did not necessitate that the public change their habits. For Weinberg, the key technology was of course nuclear engineering and the promise of unlimited energy use. Critics of the techno-fix, such as philosopher Arne Naess, have noted that 'techno-fixes tended to prioritize the status quo, i.e., the interests of current ways of life, and particularly current socio-economic conditions and interests'. And as with solutionism (and scientism) they have 'framed problems narrowly,' underestimating both the scale and complexity of problems and the side effects (or unintended consequences) that such engineered solutions can offer (cited in Johnston, 2018, p.53). (See also Huesemann and Huesemann, 2011; Segal, 2017) and (Metcalf, 2013; Stephens et al., 2018 as it pertains to cultured meat in particular). As it applies to consumer-oriented technologies, the techno-fix reflects a sensibility that the entrepreneur knows best but the public is not ready to change their lifestyles.

Scientism (also) describes the assumption that addressing complex social problems related to feeding a growing population on a compromised planet can and should be driven by scientific expertise. While similar in spirit to solutionism and techno-fixes, the concept of scientism highlights the ways in which science is evoked as a source of authority extending far beyond the production of scientific and technical knowledge and has been normalized as 'an ultimate source of legitimation for commercial and policy commitments it has made virtually unquestionable outside of its own terms' (Welsh and Wynne, 2013). Critics note the foreclosure of alternative questions and forms of expertise that follow from this, as well as assumptions that public concerns about new technologies have only to do with the downstream impacts rather than upstream driving purposes of science and are caused by knowledge deficits (Marris, 2015; Wynne, 2006). As Wynne (1992) has famously noted, scientistic assumptions result in 'misunderstood misunderstandings' in which public skepticism is 'misunderstood' by experts as the result of lack of understanding rather than legitimate concerns. As he puts it, a deficit model of the public understanding of science is 'almost preordained' because the culture of scientism 'has already so falsely narrowed its moral imagination to the idea that support for the policy stance is determined by scientific fact, and that no alternative is left' (Wynne, 2006, p.214). With consumer-oriented technologies, scientistic tendencies lead to a focus on transparency in lieu of substantive reflection on or engagement with the concerns of the public.

All three of these tendencies in problem solving give rise to potential friction around public uptake of these technologies. Yet in the context of innovation geared toward 'future consumers' (Burri, 2015; Rajan, 2006), these concerns translate to questions of consumer acceptance. Pre-occupations with consumer acceptance are evident in the raft of studies that have been conducted, especially involving alternative proteins, in which researchers measure likelihood of consumer uptake and sometimes discuss strategies that might enhance consumer acceptance (see review studies by Bryant and Barnett, 2020; Hartmann and Siegrist, 2017; Onwezen et al., 2021). Generally finding low levels of acceptance of cell-cultured and insect-based products and higher levels of acceptance of plant-based alternatives (Hartmann and Siegrist, 2017; Onwezen et al., 2021), such studies hint at some of the strategies we discuss below, including drawing attention to health and environmental benefits and steering away from highly technical descriptions or creating familiarity through introducing alternative proteins in existing and recognizable dishes (Bryant and Barnett, 2020; Hartmann and Siegrist, 2017; Onwezen et al., 2021). Consumer research, in other words, seeks to design effective 'end of pipe' product development and marketing, aka 'back end fixes' to problems that might arise from innovations conceived and developed without public input (Lowe et al., 2008).

Among other things, these back end fixes exist in uneasy tension with the projections we observed in which innovators claim they are responding to consumers while in fact they engage with no public input whatsoever. Indeed, a far cry from responding to consumer demand, entrepreneurs and other stakeholders enter the sector bent on addressing possible objections to new technologies. Those working in the alternative protein space, especially, engage in a great deal of discursive, regulatory, and product development practices in end of pipe attempts to shore up apparently elusive consumer acceptance (Broad, 2020a; Jönsson et al., 2019; Mouat and Prince, 2018; Sexton, 2018; Stephens et al., 2018; Stock et al., 2016). Not only is consumer acceptance important in the marketplace itself (i.e., ensuring purchasing); as many scholars have argued, demonstrating potential consumer acceptance is important for attracting capital for promissory technologies whose edibility, desirability, and ontological status remain in question (Chiles, 2013a; Jönsson, 2016; Mouat and Prince, 2018; Sexton et al., 2019). Writing specifically about animal-free food, Mouat and Prince note that 'markets, both for the products themselves and for the funding and investment required to make them, are central to its constitution' (p. 315). Yet, these scholars pretty much leave it as an issue of consumers being called upon to make markets work (e.g., Mouat and Prince, 2018; Sexton, 2018; Stock et al., 2016).

What we want to suggest is that entrepreneurial innovators' *imaginaries* of the public does crucial performative work within the agri food tech sector, akin to the role 'founder narratives' play in the high-tech start-up O'Connor observed, both justifying the existence of the company and convincing others to devote funds and other resources to it (see also Beckert, 2016). Drawing on O'Connor's observations, Fairbairn, Kish, and Guthman (in re-review) find that the Silicon Valley agri-food pitch, widely performed at sector events, serves a similar role. In their study the pitch frames the problems of agri-food so that complex and entrenched challenges appear amenable to the kind of solutions the tech-sector can provide. The pitch not only helps secure investment funds for individual startups but also helps legitimize the tech sector's overall

approach to problem solving. Their analysis does not consider, however, how the potentially huge markets that pitches routinely convey depend on projections of the public that will want what they are selling, or whose reluctance can be overcome with the right strategies.

To that concern, we build on Fairbairn et al., as well as Rajan's (2006) insights about the importance of consumers 'in waiting,' to highlight the specific role played by imaginaries of the public both in conjuring capital and making sense of their solutions (cf. Jönsson et al., 2019).[ii] We will show how solutionism impels innovators to conjure a consumer base to which they can imagine they are responding, how techno-fixing leads them to use mimicry to create what they see as responsible food products that the consuming public can adopt without 'giving anything up,' and how scientism leads them, in the name of 'transparency,' to focus on information and education. In projecting imaginaries in which their solutions appear to respond to consumer desires (e.g., for world saving products) and deficiencies (e.g., unwillingness to change their eating habits), actors in the sector superficially conjure publics who are affecting innovation. Yet the public exists solely as a figment of the imaginations of these innovator entrepreneurs; possible objections are both already overcome and untethered from any input from actual publics. Thus these projections promise future consumers to investors while exposing the pervasive fallacy of 'consumer sovereignty' - i.e., the myth that capital only serves up what consumers have demanded. (Schwarzkopf, 2011).

Projecting consumers for agri-food innovation

From summer 2018 to January 2021 our project team conducted participant-observation at just over 80 agri-food tech events in the broader San Francisco Bay Area a.k.a Silicon Valley. These ranged from evening pitch events to multi-day conferences, and eventually many COVID-precipitated online webinars. Nearly all of these were largely designed for attracting investor and entrepreneurial interest and generating hype for agri-food technologies and products, making these highly performative spaces (Fairbairn et al., in re-review; Goldstein, 2018). As such, we had the opportunity to observe how actors in the sector, speaking to other actors in the sector, characterize the public and strategize their responses to potential consumer concern, in both market-making and sense-making functions. During that same period, we also conducted about 50 interviews with agri-food tech sector actors, including entrepreneurs, investors, and leaders of tech incubators and accelerators, in which we asked about perceptions of the public, responses to which often mirrored the rhetoric they offered at events. We coded our event notes manually and interview transcriptions using qualitative research software, which allowed us to inductively derive the three imaginaries of consumers we flesh out here. To be clear, these categories stem from the study of what innovators say about consumers in the contexts described above, which may be completely disconnected from how consumers or customers appear in consumer research, let alone what they really think or want. Despite the likely messiness of the reality of both the consumer landscape and public opinion, the imaginaries as we encountered them in our research were largely consistent in their logics – and, in fact, no other imaginaries were salient in our data. In reporting our findings, we name some companies and their representatives when we obtained the data at a public event in which speakers would

not reasonably expect their identities to be private. We anonymized all of those we interviewed, however.

Imagining Conscious Consumers

The imaginary of the conscious consumer has been imported into the agri-food tech sector directly from the mainstream food industry, where since the early 21st century it was constructed as a response to growing public concerns about the industrial food system. Rattled by the increasingly negative perception of processed food and the food system from which it emerges, the mainstream food industry embraced the notion that the desires of consumers who were increasingly health-, eco- and label-conscious could be met not by addressing fundamental problems of the food system, but rather by providing new products, reformulated products, and marketing designed to appeal to these consumers. (Berenstein, 2018). In this way, the imaginary of the conscious consumer reframed critiques of the industrial food system as demands for 'real,' 'natural, 'clean' and organic industrial foods.

Instantiating a variation on solutionism, in which an innovation requires a consumer base to which it can be positioned as a response, this very same imaginary is strategically invoked by proponents of consumer-facing agricultural technologies such as controlled environment agriculture and supply chain traceability technologies (Broad, 2020b). Innovators in this space regularly describe consumers as wanting food that is healthier and fresher, and wanting to 'to know everything now…' An Investor at a 2020 event explained that we know from history that massive changes in consumer preferences in combination with a technology shift can 'massively' change an industry for decades, and that something of this scale is happening now; thus consumer preference for clean food and 'knowing where their food comes from' is driving many of their investments.

Actors in the agri-food tech sector import the pre-existing imaginary of the conscious consumer to claim that there is a demand for controlled environment agriculture because it can provide fresh, healthy, local food. An interviewee who serves as global lead of post-harvest research and development for a major agricultural company told us that what is 'really pushing' indoor farming is that companies are realizing that 'there is a boom of preference for local or close to home...if we can grow year-round even though is expensive, consumers are willing to pay more for local fruit'. Another investor explained that demand for indoor agriculture is going to continue to be driven by the steady growth of a middle class that is trying to eat fresher, healthier and cleaner while knowing where their food comes from at the same time that they turn farmland into the urban areas where they want to live. Along these same lines, at an event we attended a representative of a major player in the indoor production of high-end lettuces explained that their strategy is to respond to consumer demand; 'it's not about building as a land grab and the customers will come, but about consumer demand and therefore we grow'.

Producers and proponents of technologies of traceability such as but not limited to blockchain also invoke conscious consumers, linking their desire for safe and healthy food to the kind of information that these technologies can provide. An investor focused on ag-tech startups

explained that traceability technologies have been around for a while, but they could not previously interest big food companies in them ‘because 10 years ago consumers really did not care that much about where their food comes from’. He went on to explain that all of this has changed, since consumers are now so much more aware, asserting that consumer desire to know their food is fresh, ethical and safe ‘has driven a lot of technologies around traceability’. Strikingly, he went on to immediately describe the ‘happy coincidence’ that the technology ‘can satisfy that need’ that already existed. While we risk of parsing too closely the words of a single interviewee, his comments nicely illustrate how the imaginary of the conscious consumer makes sense of technologies of traceability whose consumer audience is unclear.

Invoking this imaginary of the conscious consumer also plays a key role in promoting alternative proteins that are comparatively less processed. The imagined desires of conscious consumers for short ingredient lists containing only words that are easy to pronounce serves as a point of differentiation for those who can position their animal-free proteins as clean label or natural. As one investor we talked to explained, in one version of the sector’s history the ‘alternative meat revolution’ started because people wanted to lessen their footprint. The ‘irony of it,’ he continued, is that the alternative meats’ ‘claim to fame is that they are healthier versions of traditional meat’ and yet they do not meet the conscious consumer’s understanding of healthier. These consumers are ‘looking for fewer ingredients in their food, not more, but you look at something like the Impossible burger or whatever...I think one of them has 22 ingredients in it’.

Thus, the imaginary of the conscious consumer is taken up by alternative protein companies seeking to gain competitive advantage through simple labels and free-from claims. For example, Beyond Meat, the maker of widely available plant-based beef substitutes and other like products, has built its brand identity in part through non-GMO verification, in contrast to Impossible meat (also a widely available plant-based substitute) which, for example, cannot sit next to it on the shelves in Whole Foods because of their strict non-GMO requirements (Broad, 2020a). Nowadays, a company making a pea protein-based chicken nugget alternative, proudly claims on its website that its ‘made with just 7 ingredients even kids can pronounce’ and provides a comparison chart with other nugget brands that includes a row noting the number of ingredients in each product (the plant-based competitor Nuggs apparently has 26).

At an event focused on mycelium the founder of AtLast teamed up with Stonyfield Farm’s Gary Hirshberg, a recent investor, to promote the clean label advantage of their mushroom-based product by explicitly and enthusiastically evoking the demands of the conscious consumer. Hirshberg repeatedly pronounced clean label alternative proteins a ‘mega trend,’ explaining that today’s millennial consumers, especially moms, are ‘more clear than ever “we are what we eat”’. He explained that they want to feel they can trust a product and ‘the first signal of trust is how many ingredients are in the label’. AtLast, he explained, fits into this trend because ‘it’s incredibly simple. Words people can pronounce’. Referring to the indoor farming process that produces their industrialized mycelium slabs in just ten days he continued, ‘And it’s a farm. The corollary of the simple ingredients is farms people can see. We are going to bring influencers in’.

Across these examples, actors strategically leverage the imaginary of the conscious consumer to gain essential support for particular technologies and the visions for the future of food that they represent. While not speaking directly of this imaginary, an exchange we observed at a major industry event in San Francisco in 2019, captures the role that imaginaries of consumers in general, and this one in particular, serve. Responding to an audience question about how large companies navigate entrenched risk in the business while bringing in external innovation, a representative from a large snack food company explained, 'You get this beautiful shield called "it's all about the consumer." Once you're addressing consumers' needs and honestly in the service of what they want and what problems you are solving… when you have that conviction it's actually quite powerful. It's hard to deny that higher purpose of really wanting to serve consumers'. The comment is suggestive of the role the imaginary of the conscious consumer plays as a 'shield' for agri-food tech innovators, where it serves to both bolster and obscure the sector's solutionism. Its central conceit is that consumers are shaping innovation and product development through their conscious demands for healthy and sustainable foods, and yet the imaginary is often invoked within the sector to promise consumer acceptance of technologies that were not designed to meet consumer needs.

In short, in the context of the mainstream food industry the imaginary of the conscious consumer works as a sleight of hand through which critiques of the food system are translated into clean label trends that can be met with little to no change to the values, power structure, or aims of the food system that has given rise to those concerns. Importing this imaginary, actors in the agri-food tech space enact similar foreclosures under the guise of meeting the desires of conscious consumers, notwithstanding that many innovators are truly driven by the conviction that they are meeting consumer wants. While conscious consumers are understood as tech-averse and desiring solutions from nature rather than the lab, which is in many ways at odds with the agri-food tech sector's values and aspirations, some in the agri-food tech space have taken up the imaginary as evidence of consumer desire for their products. In a feat of solutionism, those promoting consumer facing agricultural technologies such as controlled environment agriculture, supply chain traceability technologies, and even particular versions of alternative protein, claim that their technologies not only answer to these presumed desires but have emerged in response to them.

Imagining Complacent Consumers

While some alternative protein companies embrace the imaginary of the conscious consumer, a very different imaginary dominates the discourse around alternative proteins as well as other technologies of mimicry, such as a variety of products aiming to offer sweetness without or with less sugar (SupLant Stem Sugar, Better Juice). Here, rather than projecting health- and sustainability-conscious consumers (presumed to be upper middle class) agri-food tech actors conjure a mass of 'regular' consumers who are dangerously complacent. Reflecting an approach to problem-solving encapsulated in the techno-fix, innovators in the alternative protein space tend to be highly mission driven (Broad, 2020a; Wurgaft, 2019) but they believe that 'people on the street' don't care enough about the challenges facing the food system to change

their eating habits, instead wanting food that is tasty, cheap, convenient and, mainly, familiar. Thus, innovators position themselves as responding not just to the grand challenges, but the combination of those grand challenges and the unwillingness or inability of 'average' consumers to change their eating habits, invoking the imaginary of the complacent consumer to make sense of and markets for technologies designed to mimic familiar eating experiences with radically transformed production practices (Jönsson et al., 2019; Mouat and Prince, 2018; Sexton, 2018; Sexton et al., 2019). 'It's easier to change the world than it is to change consumer habits,' asserted a speaker at one event. 'We don't want consumers to have to change their behavior, consumers are very bad at changing their behavior,' said another.

Some alternative protein proponents attribute the problem of consumer complacency to a powerful biological need for meat. For example, one subject explained that people know about the problems with meat, but they just keep eating more and more of it anyhow, 'something about human physiology, we like meat, we want to eat meat… So rather than continuing to beat our head against this wall of like, trying to educate people out of what they're just going to do, let's change the meat'. Many also express the belief that consumers are just not interested in giving up the foods they love for the sake of the environment. Explaining why his product would be marketed on health and flavor rather than on environmental benefits, the founder of one company lamented the apathy of average consumers: 'I wish people would do the right thing for the right reasons. Sadly, that is a rare thing to happen…. It's not going to be marketed on environmental reasons, I regret to say'.

Along similar lines one interviewee told us he was driven in part by realizing 'it was going to be very difficult to get people to compromise and, say, eat the sustainable thing instead of the delicious or convenient thing'. At a conference, a representative of Impossible explained that despite the catastrophic threats we face due to the use of animals in the food system, 'no way are you going to get people to change their diets and stop wanting to consume these foods'. Some contested the notion that consumers who appear not to care about health and sustainability are irresponsible or callous, acknowledging that they may face challenging economic or other circumstances and must balance other demands on their time, energy and money. One alternative protein CEO described consumers as 'victims of a broken system' in which 'it takes a herculean effort to eat healthy,' and described his approach as 'choice architecture,' changing behaviors by changing the environments in which decisions are made.

For vegan and vegetarian founders who have not only managed to change their own eating habits but also committed their lives to finding ways to save the world, technological solutions are a practical and compassionate response to the limits of average complacent consumers who cannot or will not do the same. In an interview, one founder described how he and his co-founder had both become vegetarians to 'reduce our impact on the planet as well as the animal welfare concerns of industrial farms'. Things got much harder when they later decided to go vegan, and they realized that 'if this is going to be so hard to us and we're crazy mission driven, we love the planet, we love animals…. then it's going to be next to impossible for this movement to scale and for regular people to accept it. Those that don't care about animals or the planet'. Another founder, a long-time vegan and animal rights advocate, described spending most of his

life trying to ‘give animals a voice’ and persuade people to change their eating habits before giving up on expecting other people to have a ‘moral awakening’. As the CEO of a company that makes a blended meat product designed to win over those who are not so morally driven, he has never actually swallowed his own products instead, ‘I put them in my mouth and chew it up and spit it out just to see if I can tell the difference’.

In keeping with underpinnings of the techno-fix, innovators deploy the imaginary of the complacent consumer as a mandate for tech driven solutions to the grand challenges that bypass consumers altogether, saving the world without asking consumers to give anything up, or even be able to sense that their food has been radically transformed. Their aim is to create technologies of mimicry with such fidelity that consumers get to, as Clara’s website promises, ‘have their cake and eat it too’. As another interview explained of cell-cultured meat, ‘Let’s use science to fix one of the worst things… in our planet, which is factory farming. Let’s use science to just end that and give people exactly what they want to eat, what they love eating’.

Innovators thus regularly invoke the imaginary of complacency to suggest a need, if not a demand, for products that that achieve indistinguishability. They present technologies of mimicry as both an alternative to and as a substitute for education or other means of cajoling people into making responsible choices. Pondering the challenge of educating consumers to be more environmentally conscious when they tend to think it’s ‘someone else's problem’ one interviewee clearly described the technology as a form of education: ‘So that education piece, I think... to get there we have to make products that directly mimic animal meat’. Alternative protein makers boast of tricking tasters or consumers with their products. One interviewee proudly noted that 60% of focus group participants could tell no difference between their products and regular chicken nuggets. Danone boasted at a conference that many people who buy their So Delicious products don’t even realize it is dairy free. At another conference speakers celebrated Beyond and Impossible as ‘having shown you can have products that taste exactly like meat’. During a panel discussion at the 2019 Future Food Tech conference, a panelist described Impossible’s CEO (also on the panel) as having, ‘made something exactly the same out of something not exactly the same,’ invoking important ontological questions (Jönsson et al., 2019; Sexton, 2016; Stephens and Ruivenkamp, 2016).

Figure 1: Impossible Burgers, changing the world instead of changing eating habits to meet the needs of consumers imagined as complacent

Ontological questions aside, such assertions highlight the way in which imagined complacent consumers and their supposedly unchangeable eating habits make sense of technological innovation that seamlessly solves problems while leaving the behaviors and experiences of consumers intact. This, despite the fact that it *is* undeniably behavior change to choose a plant-based burger rather than a beef burger, even if it does happen at a fast-food drive through among ‘regular people’ presumed to not care. This, especially because, despite the hype and hyperbole, these products do not taste, smell and handle exactly the same as their animal counterparts, and innovators themselves will sometimes confess this even as the sector celebrates having achieved indistinguishability.

At the same time, some raise salient concerns about technofixing. Reflecting on the approach of using plant-based proteins to try to shift consumer preferences, one person we interviewed warned, it is 'a lot safer' to be a technology that meets a need. Raising the specter of GMOs, he drew a parallel to Monsanto's attempt to lead with technology in the case of Golden Rice; 'the world quickly found that technology like genetic modification did not shift consumer preferences,' and instead created backlash. He continued with words of caution: 'So, technology as a tool to change consumer preference, there's still potential there, but the history has been a failure. Not that we're doomed to continue to repeat that history. Hopefully we'll learn from history and get better at it, but historical precedent has been abject failure'. Meanwhile, at one event we attended a high-profile CEO of a major alternative protein company unsettled the audience with an obvious if controversial truth about the sector's approach, suggesting that technologies of mimicry offer expensive, complex solutions to health and environmental challenges that could, alternatively, be solved by eating whole foods:

> We also recognize that trying to figure out a way to get more people whole foods like apples, pears, kale, collard greens…these are things that don't necessarily require billions of dollars of venture investment, they do require farmers and a market, consumers that are willing to consume them. … I do think sometimes in the discussion about technology and its role in food that very basic straightforward answer can be missed, and I'd be remiss if I didn't at least put it out there.

Complacency, in other words, does not mandate or even justify technologies of mimicry, despite so many assertions otherwise. Thus, while promoters of alternative proteins project and embrace complacency to make sense of and make markets for techno-fixes, they sometimes also recognize that such thinking forecloses the many other directions, some decidedly less high tech, which may offer sustainable paths forward.

Seemingly in contrast to the imaginary of the conscious consumer, the imaginary of the complacent consumer portrays 'regular people' not as driving innovation through their demands for healthy and sustainable food, but as not caring enough about health and the environment to change their eating habits. These consumers are projected as being led into the future by technology designed to educate or make change so easy it is seamless or undetectable. However, a similar sleight of hand is at work as the innovators position themselves as driven toward techno-fixes, as if inevitably, by the combination of grand challenges and complacency; the imaginary obscures their own role in driving the techno-fixes. Meanwhile, the projection of the complacent consumer reinforces an imaginary in which the role of the public is solely to accept and consume new technologies. But here consumer acceptance of novel technologies is the modest aim, while bypassing public awareness altogether- and with it any possibility of their participation in assessment of the technologies - appears to be the moonshot.

Imagining Fearful Consumers

As described above, some food tech companies are well positioned to align with the imaginary of the conscious consumer for competitive advantage. While these companies take public concern about GMOs and other technologies at face value, even amplifying them by advertising their simple labels or compliance with non-GMO standards, those promoting solutions that rely on the use of biotechnology or other technologies considered potentially controversial (such as cell culturing) instead invoke a familiar artifact of scientism; the imaginary of a fearful public whose irrational concerns are based in knowledge deficits and must be overcome through education. In so doing, they reframe the concerns of the empowered consumers as based in irrational fears, and – as Marris (2015) finds in the case of synthetic biology – see public attitudes as a problem that needs to be overcome in order to deliver their public benefit.

In response to the scientistic presumption that public concerns about technologies must be the result of fear-based anti-science sentiment, some companies whose production processes depend on biotechnology or intense processing positively position their brands as proudly tech forward and 'pro-science'. Impossible, whose signature ingredient, heme, is produced through genetic engineering, is known for 'unapologetically using GMOs' and describes itself as uninterested in natural positioning (i.e. appealing to conscious consumers) because 'We need science to feed the world'. At an event, Brian Crowley CEO of Soylent, the famed meal replacement beverage company, began his presentation with a giant photo of himself in a PRO GMO Soylent T-shirt, talked passionately about how the company is so excited about the potential of GMOs that they put up billboards about it, and plainly asserted 'the non-GMO debate feeds of fear and disregards science'.

Figure 2: Soylent's Pro GMO stance responds to consumers imagined as fearful

Simulate, a company making Nuggs, aka 'the most advanced chicken nugget on the planet,' also embraces a tech forward approach, adopting much of the same software-style marketing as Soylent once did. This includes calling the nutrition panel 'tech specs' and including 'release notes' for each 'version,' explaining that 'Simulate developers are constantly updating the codebase of our products'. At an event described as being about the 'bleeding edge' of plant-based products, the CTO of Simulate asserted 'we believe technology is the solution'. He described clean labelling as a defensive move in the face of growing distrust of the food industry and assert that his company 'is not going to be ashamed of using technology and processing and transformation to make the best possible products for our consumers'.

In contrast to the brazenly tech forward approach of the 'pro-science' crowd, many others in the sector urge a more careful approach to how technologies are introduced and marketed, but they share the assumption that public concerns are based in emotions, specifically fear, that can and must be overcome through communication. At one event, a pioneer in cell-cultured meat explained that the differences between medical and food applications for the technology include scale, economy, safety and emotion: 'I discovered you are dealing with a lot more emotions. I was naive about this. You need to think and address these early on or else people won't eat it'. At another event a representative of Impossible explained, 'People tend to be a little scared if they don't understand'. At yet another, a representative from Memphis Meats, a company

focused on cell-culture technology, said, ‘from a personal standpoint, I think genetic modification is the bee’s knees, I think it’s great. From an industry standpoint, the public is scared and needs to be educated about how it’s not dangerous’.

As these remarks make clear, fear of the public’s fears – similar to what Marris (2015) refers to as synbiophobia-phobia – along with assumptions about its basis in lack of understanding, has generated a widespread commitment to sharing information with the public as a means of mitigating their concerns. Many are explicit about the importance of approaching communication skillfully so as not to repeat the GMO debacle, assumed to be the result primarily of poor communication on the part of those who first introduced the technology. A speaker explained that objections to GMOs are based on a ‘misunderstanding of what they are,’ including the misperception that they are not natural. He went on to explain, ‘Fear of GMOs can be addressed with information and fighting with facts’. One interviewee explained, ‘there were big, big mistakes’ made in the past that led to a lot of distrust, ‘we’re dealing with this mess now and need to really…bring that technology out there in a very different way’. Also reflecting on past mistakes, another described the ‘early days’ of GMOs from the consumer perspective: ‘this is GMO, but I'm not getting the benefit. I don't think we should do this, this is new, this is scary, but you're slipping this into my food. You're not being overt with it, there must be something wrong,’ going on to assert, ‘I don't think it was handled extremely well’. From his perspective, the ‘winning ticket’ is to ‘really message it correctly and... really highlight a lot of the benefits to the consumer’. One founder described the way ‘food technologies like genetic modification...were introduced to the public’ as ‘quite poor, and people were really skeptical of them because of that,’ going on to explain, ‘you don’t get a second chance to make a first impression. You really need a good first impression’. While his products do not use genetic engineering, many of those who do celebrate ‘transparency’ as a chance to make a good second impression.

Transparency is widely embraced as a strategy for proactively communicating with the public about novel technologies, providing information designed to assuage fears and avoid repeating the mistakes of the past. A representative of Impossible, for example, hailed transparency as ‘the magic ingredient to winning the confidence of the public’. One interviewee described the importance of being ‘radically transparent’ with consumers: ‘We're not trying to hide anything, you go to our website and how do we make it page, you'll find a whole lot of information…if you go to the how we work page and then go down and click on the even more details, there's a whole 20, 25 page long thesis on why we decided to do it, how we do it’.

Like so many others, Perfect Day’s website prominently features a 4-step depiction of its technological process, using simple graphics and minimal text to tell the story of how their animal-free milk protein is made. It goes on to provide layer upon layer of more detailed information about the technology, all of which is designed to depict the process as simple and relatable. For example, at one point the text explains, ‘to create an animal-free version of milk protein, we simply had to introduce animal (cow) genes to an organism that wasn’t an animal’. Drawing on familiar agricultural metaphors (Broad, 2020a), the narrative goes on to describe how micro flora then basically become just like grazing cows: ‘We gave our microflora the genetic blueprint corresponding to whey protein, enabling it to produce real milk protein —

identical to what cows produce. Now, as our flora graze on simple plant-based inputs, they naturally produce milk protein'.

In another part of the website, fermentation is described as 'the new alchemy' and readers are reassured that it is a 'natural process you probably already know something about…. Think pickles, kimchi, sauerkraut, tempeh, miso, kombucha, beer, and wine to name just a few…' While 'precision fermentation' may be less familiar, readers are assured it has long been used to make 'life-saving insulin and antibiotics'. There is an article called 'meet the flora' - about the michroflora used in the process, that continues the agricultural metaphors, 'You could think of microflora as the agricultural animals of tomorrow. Except they're not animals at all! If *Trichoderma* is "the new cow" for making dairy, then it's a really, really small cow, with no body, mind, or nervous system'. The website, with its layers of information, may be more exhaustive than most but is in many ways illustrative of the sector's approach to transparency, which emphasizes explaining how technical processes work using language and graphics designed to make them feel simple, familiar, natural and safe (Broad, 2020a; Guthman and Biltekoff, 2020).

Despite the overall disruptive intent of the sector, food tech transparency strategies reflect many of the same assumptions that Marris (2001) identified as myths about public views on GMOs in 2001; views that seem so evident they seem to require no substantiation despite their divergence from the findings of many years of social science research. Approaches to transparency are clearly shaped by the myth that the public is 'irrational and unscientific,' and the assumption that if only they understood the science better they would accept GMOs (p. 546). As the above example exemplifies, transparency strategies seek to reassure through analogies to natural processes, reflecting the myth that 'people are obsessed with the idea that GMOs are "unnatural"' (p. 546). Frequent references to insulin and antibiotics stem from the myth that people are concerned about the use of GMOs in agriculture but not in pharmaceuticals because they are motivated only by direct personal benefits to accept new technologies, a belief that also motivates messaging that, as noted above, 'highlights a lot of the benefits to consumers' (p. 546-7). Thus, while aiming not to repeat the mistakes of the past, food tech promotors have developed communication strategies that are based on the same imaginaries of the public that have animated science communication around GMOs for decades. As Marris notes, tensions arising around these technologies are likely due not to 'a lack of public understanding of the science but rather policies that continue to be based largely on erroneous beliefs about "the public"' (p.548).

Fundamentally, the imaginary of the fearful consumer and the transparency strategies that emerge from it are effects of scientism and center around the discredited but ever-resilient, and often shape-shifting, deficit model of the public understanding of science, in which public skepticism can only be seen as the result of a lack of understanding and trust in science (Wynne, 1992; Wynne, 2006). The public is imagined as emotional, irrational and dependent on experts to correct their misperceptions. The public is furthermore imagined as concerned solely about impacts on their own 'health or wealth' rather than with the aims, purposes, and social impacts of technological innovation (Marris, 2015, p.90). This projection positions transparency as an imperative driven by consumer concerns yet denies there is any legitimate basis for those

concerns. Like the imaginary of the complacent consumer, and in conjunction with it, this projection imagines a public lacking the agency and the capacity to participate in meaningful assessment of these technologies, their application or the values driving their development and use.

Conclusions: Consumer imaginaries in an investor-facing economy of innovation

Silicon Valley's entry into agriculture and food brings all the trappings of Silicon Valley's political economy of innovation: highly hyped, investor-dependent, entrepreneur-driven and thus necessarily profit-oriented. Moreover, entrepreneurs in this space often approach problem solving apart from any form of public engagement or input, setting the groundwork for problems of public acceptance. In this context, a commercialized view of publics as eventual consumers prevails and is especially fraught because the solutions involve, or are, food. Critical, then, for this political economy to function, are projections of consumers whose desires can be played upon or whose reluctance can be overcome so that innovators can deliver their public benefit.

In this paper we have thus identified three pervasive imaginaries of consumers, each of which articulate with a particular tendency in problem-solving within this political economy of agri-food innovation. Reflecting a tendency of solutionism, innovator entrepreneurs promoting consumer-facing agricultural technologies, as well as those invested in alternative proteins that can also claim to be 'clean,' invoke an imaginary of a conscious consumer desiring food that is healthy, safe, and environmentally benign. In keeping with the logic of the technofix, those seeking to mimic animal protein through technologically advanced processes that do not conform to clean label constraints invoke a complacent consumer, imagined as lacking the will to change eating habits in the interest of planetary survival. Finally, innovators promoting potentially controversial technologies, including those reliant on genetic engineering, imagine fearful consumers, uninformed and apprehensive of novel technologies they do not understand. Potentially misreading the nature of consumer skepticism, while at the same time trumping consumer concerns with appeals to the authority of science (i.e., scientism), this imaginary underpins a widespread embrace of transparency to inform and assure consumers.

Together these imaginaries promise consumer acceptance of potentially controversial technologies, and in so doing help the solutions make sense both to the innovator entrepreneurs themselves and to those whose support they need, i.e., investors. Thus, the public is imagined instrumentally, conveniently, and strategically as part of the promise – made to investors and others who matter – that these solutions will be taken up if not eagerly then at least eventually by the public acting in their capacity as consumers. Indeed, following Duncan et al. (2021) and Wynne (2005), it appears that agri-food tech's imaginaries of the public most serve the innovators themselves as they seek to attract investment in an economic ecosystem in which solving the world's problems may not even be the point.

Whether agri-food tech sector actors imagine the public as conscious in relation to consumer-facing agricultural technologies, complacent in relation to technologies of mimicry, or fearful in

relation to potentially controversial technologies, they conceive the role of the public to be along a continuum of acceptance or rejection of preordained solutions. But these imaginaries not only promise future consumers. They also depict innovations – developed in a vacuum of public input – as having already been influenced by consumer demands, desires or deficiencies. The imaginary of the conscious consumer looks like a response to consumer concerns, but we have shown that it defangs critique and obscures solutionism as an approach to problem solving that precludes public participation. There may be some empathy involved in the imaginary of the complacent consumer, in which innovators appear to respond as if inevitably to the public's inability to change their eating habits, but it primarily projects passivity and justifies efforts to bypass, not engage with publics. The imaginary of the fearful consumer positions transparency as a response to consumer demands for more and better information, but projects a public lacking the knowledge, understanding and rationality required for meaningful engagement and, thus, underscores the mandate for actors in the sector to act on behalf of reticent consumers, rather than in consultation with informed citizens.

Thus, not only has the potential for public response to these technologies been reduced to the acceptance or rejection that can be exercised by consumers, but the influence of imagined publics appears to have already been accounted for, their concerns addressed and overcome. While STS scholars have shown how public facing engagement exercises and ELSI work are often limited by deficit-driven imaginaries of the public, we observed no interest in facing the public at all; in these investor-facing spaces the public's objections have been both imagined and dispensed with. There appears to be no need, therefore, to meet actual publics outside of the confines of the market, in the public sphere, where debate and disagreement about the role and direction of innovation for the future of food might take place. Even the imperfect possibilities of public engagement, shaped as they are likely to be by the 'misunderstood misunderstandings' well established by critics, have been vanquished – at least in sector imaginaries – before having even the potential to emerge.

Notes

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[i] We make this cut notwithstanding that certain technologies that are farmer-facing may be subject to public criticism, as has been the case with GMOs.

[ii] At first glance our approach bears some similarities to Chiles's (2013b) discussion, in the context of in vitro meat, of the relationship between stakeholder 'ideologies' of technology and their assumptions about consumers. Chiles, however, explores assumptions about consumers stemming from a range of ideologies of technology, while we hone in on assumptions about consumers as they relate to specific problems in market-making.