CAN AN ALGORITHM BE AGONISTIC?
Scenes of Contest in Calculated Publics

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Abstract:

This paper explores how political theory may help us map algorithmic logics against different visions of the political. Drawing on Chantal Mouffe's theories of agonistic pluralism, this paper depicts algorithms in public life in ten distinct scenes, in order to ask the question: what kinds of politics do they instantiate? Algorithms are working within highly contested online spaces of public discourse, such as YouTube and Facebook, where incompatible perspectives coexist. Yet algorithms are designed to produce clear "winners" from information contests, often with little visibility or accountability for how those contests are designed. In isolation, many of these algorithms seem the opposite of agonistic: much of the complexity of search, ranking and recommendation algorithms is non-negotiable and kept far from view, inside an algorithmic "black box". But what if we widen our perspective? This paper suggests agonistic pluralism as both a design ideal for engineers, as well as a provocation to understand algorithms in a broader social context: rather than focusing on the calculations in isolation, we need to account for the spaces of contestation where they operate.

Keywords: algorithms, agonistic pluralism, politics, platforms

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1. Can we speak of the politics of algorithms? Certainly, we already do: there are conferences and panels about algorithmic politics, articles, special issues and books. But do we *mean* when we say that algorithms have political qualities? Tarleton Gillespie writes in "The Relevance of Algorithms" that we need to interrogate the logics of calculated publics, by paying "close attention to where and in what ways the introduction of algorithms into human knowledge practices may have political ramifications" (2014, 168). But what is the nature of this interrogation, and what is the vision of *"the political"* that is being invoked here?

Ascribing a political character to technical things is a common move, and we can trace a through-line from Plato to the nineteenth century critics of industrialism to the current computational turn. As Langdon Winner observes in *Do Artifacts Have Politics?* there are two types of argument that have become established tropes in the debate about how technical things are political. First, particular features of a device or system are said to create an effective means for establishing power and authority, but social actors are the key agents in influencing how those features will be shaped over time. The second type of argument claims that technical things are inherently political, unavoidably linked to institutionalized patterns of power and authority (1980). For example, when Engels described the machinery of cotton-spinning factories as more despotic than any capitalist, he made a case in the second category, where modern technology strongly shapes political life. Winner argues for a "both/and" position, where each mode of argumentation could be applicable depending on the context: an approach which has been critiqued as technologically determinist (Joerges 1999). But most significantly, he argues that we must study the context of technical systems and their operators along with concepts and controversies of political theory (1983, 135).

In *The Return of The Political*, Chantal Mouffe offers a critique of rationalism and liberalism which hinges on a distinction between "the political" and "politics" (2003). For her, "the political" is an antagonistic dimension, a terrain of conflict, which is always present in human societies. "Politics" is the collection of practices, discourses and institutions that establish forms of order and social organization which are always potentially conflicting, as they are always bound by "the political" (2013, 3). In this formulation, political questions involve making a choice between conflicting options - having to choose between entirely different worldviews - not by reaching a rational consensus position, but though a struggle between adversaries. This "agonistic struggle" is what she defines as the condition of a functioning democracy. By drawing on the political theory of agonism, we can begin to ask about the important differences between the political and politics, and how forms of contestation shape public discourse and civic life.

My aim here is to bring agonism to the multiple contexts where algorithms are at work in order to test the logics of calculated publics against different visions of the political. I turn to the human and algorithmic operators in spaces like Reddit, Amazon, 4chan and Facebook to generate new ways of thinking about what constitutes public discourse and the political in these terrains. Algorithms are often understood to be calculation engines, making autocratic decisions between variables to produce a single output. This view, which focuses solely on the moment of where an algorithm "acts" to produce an outcome, forecloses more complex readings of the political spaces in which algorithms function, are produced and modified. Walking through this series of scenes, we can catch glimpses of the different tensions and contests of life in calculated publics, which can otherwise be mistakenly understood as bloodless spaces of rational determination.

2. A woman is sitting in a chair, a laptop on her knees, and she is buying some books written by authors of a conference she's about to attend, *Governing Algorithms*. When she buys Lisa Gitelman's edited collection *"Raw Data" is an Oxymoron*, she is informed that "Customers Who Bought This Item Also Bought" Finn Brunton's *Spam: A Shadow History of the Internet*, Nikolas Rose's *Neuro: The New Brain Sciences and the Management of the Mind* and Gabriella Coleman's *Coding Freedom*. She begins imagining who this group of imagined shoppers might be. Are they interested in the same topics as her? Should she buy a book about the neurobiological vision of personhood, or an ethnographic account of the Debian community? These are quite different topics, so who are these other customers and what unites them in these particular tastes? We can certainly imagine some of these answers, but we cannot know how Amazon has determined them. In fact, even senior Amazon developers may not be able to tell us exactly how this imagined public of customers has been created, and how it changed over time as millions of books are bought and profiles are updated. Algorithms do not always behave in predictable ways, and extensive randomized testing – called A/B testing – is used with search algorithms just to observe how they actually function with large datasets. Gillespie argues that algorithms "not only structure our interactions with others as members of networked

publics, they also traffic in calculated publics that they themselves produce" (Gillespie 2014, 188). Thus Amazon is both "invoking and claiming to know a public with which we are invited to feel an affinity", an imagined community that "may overlap with, be an inexact approximation of, or have nothing whatsoever to do with the publics that the user sought out" (2014, 189). The woman with the laptop types in the name of a different author: Evgeny Morozov. She is told that "Customers Who Bought This Item Also Bought", amongst other things, Eric Schmidt's *The New Digital Age* and Kevin Kelly's *What Technology Wants*. Are these books similar? No, although these are authors that Morozov has publicly critiqued. Have people, like her, bought Morozov and Gitelman's books together? Presumably, but Amazon does not tell her this story. Instead, we are shown a calculated public, but we do not know its membership, its concerns, whether or why people loved or hated these books. There is simply a consensus: these books are Frequently Purchased Together.

How are we to interpret the data we are given from Amazon? This is a representation of a book-buying public, and as such, we can turn to the history of how book-buying publics form and re-form. Publishers have long sought to manipulate book sales, through systems of publicity and marketing through to "gaming" best-seller lists through carefully timed release schedules and coordination of national networks of book buyers (Bercovici 2013). *The New York Times* bestsellers list represents a particular kind of book-buying public, but it could hardly be considered a simple reflection of public taste. Rather, it is a carefully curated list with multiple forces shaping it, from publishers to bookstore chains, to the newspaper's own criteria of where the various fiction and nonfiction categories should fall. Likewise, Amazon's ranking, recommendation and search algorithms are complex and shifting. Some – like the bestseller list – reflect timeliness signals, such as how many copies of a book have sold in the last 24 hours, so books move rapidly into and out of the ranking. Others, like the popularity list, reflect sales over a longer period, and have changed frequently to prevent gaming by publishers. Initially books given away for free "counted" as a sale, which meant publishers could arrange large book giveaways and influence popularity ranking. Now free books only count for approximately 10% of a paid sale.

Then, of course, there are the rankings of reviewers on Amazon. Strong reviews can also influence sales, so there are many attempts to game the review system. Sometimes reviewers are authors and publishers pseudonymously trying to promote their own books and attack the books of competitors (Pinch 2011, 72). Once reviewers reach the rank of an Amazon Top Reviewer they are also likely to be given free books in advance of their publication date by publishers and authors. When the ranking algorithm for reviewers was changed, producing new Top Reviewers and downgrading others, this disturbed the rankings and again produced new logics in how reviewers would seek to raise their visibility.

Of course, neither *The New York Times* nor Amazon disclose their exact methodologies for determining rankings, but they are deduced through trial and error and reverse engineering tactics. Considering both together, we can see that the representations of a book-buying public were always being manipulated, shaped, and gamed – a calculated public long before Amazon launched. But what does change are the stories we tell about this public, and the stories we are told, depending on the agents at work. As Hayles observes, the relationship between databases and narratives is a symbiotic one: as the bird picks off bugs that vex the water buffalo, so a database can create relational juxtapositions that it cannot explain, and needs narratives to make meaning (2012, 176). Those narratives matter, because they too are part of our understanding of public discourse and the political. If we broaden our scope to include the array of human and algorithmic actors developing a space – sometimes in collaboration, sometimes seeking to counter and outwit each other – we find a different narrative and a more diverse cast of political actors.

3. So what can political theory offer the debates about algorithms? McKenzie Wark argues that technology and the political are not separate things: "one is simply looking at the same systems through different lenses when one speaks of the political or the technical" (2013). Likewise, Alex Galloway notes that we should not focus so much on devices, or platforms or apparatuses as such and more on the systems of power that they mobilize (2012, 18). Some algorithms, like Google's EdgeRank search algorithm, are described as autocratic – making decisions without our knowledge, invisible to us, presenting a singular worldview. Barbara Cassin has described how other algorithms, like Google PageRank, appear to have a more deliberative democratic ethos, "using graph theory to valorize pure heterogeneity, showing how quality is an emergent property of quantity" as part of an imagined consensus (Galloway 2013, p. 137). But for Lucas Introna, the PageRank algorithm is plutocratic, supporting the prominence of things that are already powerful and visible.

> Instead of treating all links equally, this heuristic gives prominence to back links from other 'important' pages – pages with high backlink counts…In the analogy to academic papers, a metric like this would imply that a particular paper is even more important if referred to by others whom

are already seen as important – by other canons. More simply, you are important if others who are already seen as important indicate that you are important" (2006, 19).

While this is a convincing argument, one could observe that this is how much of academia already works, and has done so for a long time. Introna concludes that "search engines, through their undisclosed algorithms, constitute the conditions that make some websites/pages attractive or visible and others not" (2006, 19). Again, this is a powerful argument, yet it doesn't acknowledge the ways in which individuals, institutions and industries have emerged to attempt to "game" search algorithms. From paid Search Engine Optimization (SEO) services to the tricks that people try to make their name appear first in Google searches, the spaces of intersection between humans and algorithms can be competitive and rivalrous, rather than being purely dictated by algorithms that are divorced from their human creators.

In *Adversarial Design*, DiSalvo brings notions of agonism and agonistic pluralism to design. He argues for *adversarial design*, which can make plain this "forever looping confrontation" and provide resources for more people to participate in that dissensus (DiSalvo 2013, 5). Where Mouffe uses the term adversaries to describe the relations between actors in an agonistic democracy, DiSalvo uses the term to describe the character of designed systems and their operations. By labeling an object as adversarial, argues DiSalvo, it shifts the grounds for critique, prompting us to look at its designed qualities and what they bring to the fore (2013, 6). What might happen if we brought a model of agonism to understanding algorithms? We would have to begin with the premise of ongoing struggle between different groups and structures – recognizing that complex, shifting negotiations are occurring between people, algorithms and institutions, always acting in relation to each other. We would go further than simply analyzing the design of the algorithm, and pay close attention to shifts in power, from programmers to the algorithms themselves to the wider network of social and material relations.

4. Chantal Mouffe is being interviewed for a political magazine. She is asked, "How do you define democracy, if not as a consensus?"

CM: "I use the concept of agonistic pluralism to present a new way to think about democracy which is different from the traditional liberal conception of democracy as a negotiation among interests and is also different to the model which is currently being developed by people like Jurgen Habermas and John Rawls. While they have many differences, Rawls and Habermas have in common the idea that the aim of the democratic society is the creation of a consensus, and that consensus is possible if people are only able to leave aside their particular interests and think as rational beings. However, while we desire an end to conflict, if we want people to be free we must always allow for the possibility that conflict may appear and to provide an arena where differences can be confronted" (Castle,1998).

5. It's Spring of 2013, and Boston is warming up. I remember the day of April 15 as clear and bright, so when the plume of grey smoke rose over the city, it was stark. My office window is on the 12th floor, overlooking the Charles River, in line with Back Bay. I check Twitter. It was the photographs I noticed first: runners headed into an explosion, a collapsed body on Beacon Street. Then, images of people bleeding. Two bombs had exploded on the finish line of the Boston Marathon. That was when I looked up and saw the bridges: streams of people were running away from the city and into Cambridge.

In the hours afterward, with suspects at large, a subreddit called /r/findbostonbombers began to crowdsource information. At its peak, over 272,000 people were reading Reddit, with 85,000 following the bombings subreddit (Martin 2013). Images from security cameras were scrutinized and marked with arrows and circles around suspicious-seeming individuals with backpacks. While the subreddit was charged with the mission of "finding the bombers", it was also a source of breaking news. I would flip between Reddit and Twitter, watching as theories emerged and people pored over each new twist. The discussion of news quickly became a powerful kind of collective narrative-making as well as basic fact-checking. It also had an affective power. People were expressing their shock and anger at the same time as they were trying to make sense of the events as they accelerated: from the bombing, to the shooting of an MIT security guard, to a manhunt and city-wide lockdown.

But the turning point for Reddit came when an opinion emerged that one of the suspected bombers looked a lot like missing Brown University student Sunil Tripathi. Suddenly, this idea was upvoted by hundreds of people, and it became the leading theory, even though there was much disagreement and contention over the resemblance. Within an hour, Tripathi was being named as a suspect in the mainstream media, and Redditors were being hailed for their successful identification. But they were wrong. Sunil had nothing to do with the bombings, and his body was discovered in the Providence River a

week later. While most of the posts citing Sunil were deleted by Reddit and by users after the scale of the misidentification became clear, there remains (for now at least) a subreddit where parts of the Sunil Tripathi discussion can be read. It is a complex, partial exchange of both praise and critique, dotted with "deleted post" notifications:

> *"But I'm sorry, the photos look a lot like him so far. I'm sorry if that objective observation upsets you."*

> *"The unreasonable people on this thread are outnumbering reasonable ones. He's a minority with resemblance! Must be him! You guys can pretend to be detectives on a witch-hunt but it's all just pretend nonetheless."*

> *"Dude...this thread is going to go down in history!"*

> *"As one of the biggest witch hunts in reddit history! As an embarrassment that lead to the harassment of the family of an innocent man!"*

There are also messages expressing concern for Tripathi's family and what they might be experiencing as pictures of their missing son appeared on multiple news networks, named as a potential terrorist. Several years prior, Reddit has created a policy not to allow personal information on the site, such as links to Facebook profiles or full names. Such information could be removed or downvoted. But this is not what happened during the bombings discussions. As Reddit explained in a published apology:

> We hoped that the crowdsourced search for new information would not spark exactly this type of witch hunt. We were wrong…One of the greatest strengths of decentralized, self-organizing groups is the ability to quickly incorporate feedback and adapt. Reddit was born in the Boston area (Medford, MA to be precise). After this week, which showed the best and worst of Reddit's potential, we hope that Boston will also be where Reddit learns to be sensitive of its own power (Martin 2013).

How does a community experience shame? Tomkins, in his studies of affect, notes how shame "operates only after interest or enjoyment has been activated…hence any barrier to further exploration with partially reduces interest…will activate the lowering of the head and eyes in shame and reduce further exploration or self-exposure." (2008, 354). Thus shame, as Sedgwick and Frank observe, is at one end of the affect polarity *shame-interest*, with shame "is the incomplete reduction of interest" (2004, 97). The spike of interest in the possible culpability of Tripathi is cut short with the realization of a serious error, and followed by an official apology. But the user deletions within the subreddit itself can also be read as visible traces of shame – wanting to *unsay* something.

For Reddit, it was a strange and difficult time. In Mouffe's words "a collective identity, a 'we', is the result of a passionate affective investment that creates a strong identification," but it is also bounded by aggression and other negative affects (2013, 46-47). It had been a time of coming together as a community during a period of crisis, but also a period of mistrust, fear and shame. While a simple reading of the results of the upvoting algorithm would suggest that "everyone" on Reddit agreed with the Tripathi theory, the remaining traces of the discussion point to something far more complex: a peak of interest laced with disagreement and anger, and certainly not a consensus. The combination of the upvoting algorithm, a high volume of retweets directing to the subreddit, and the avid attention of outside forces, resulted in a misidentification that became highly visible, even as it was being contested within the Reddit community itself. What remains are the traces of debate, the disagreements, claims and insults, the shame deletes, the affective attachments, and the presentiments about a campaign that would not end well. The power of Reddit, through the unbearable cacophony of that week, was something deeply contested and keenly felt, a nexus of interest and shame.

6. Can an algorithm be agonistic? Algorithms may be rule-based mechanisms that fulfill requests, but they are also governing agents that are choosing between competing, and sometimes conflicting, data objects. If algorithms present us with a new knowledge logic, then it is important to consider the contours of that logic, and by which histories and philosophies it is most strongly shaped. Certainly, it would be difficult to describe many public relevance algorithms as agonistic; so much of the messy business of choosing is kept out of sight: the order of search results, which books are sold together, which post is popular, or which news stories are deemed most relevant. What we see is a single result, or a neatly curated selection that matches our preferences and previous data behaviors. Much of the algorithmic work of determining the winners of information contests is invisible to us. The criteria by which algorithms determine evaluation are obscured while they are enacting political choices about appropriate and legitimate knowledge. Yet these deliberations are crucial; this is the stuff of governance, which is to say the lower case "g" governance

that Lazzarato describes as "the ensemble of techniques and procedures put into place to direct the conduct of men and to take account of the probabilities of their action and their relations" (2009, 114). But those algorithmic processes of governance will be differently aligned: why would there be a single knowledge logic of algorithms? With so many types of algorithms, working within platforms with different aims, they too can be antagonistic agents, at odds with each other.

7. If the politics of the most well-known public relevance algorithms is commonly located on a spectrum between autocracy and deliberative democracy, we can discuss the limitations of those models. In Mouffe's words, "when we accept that every consensus exists as a temporary result of a provisional hegemony, as a stabilization of power and that always entails some form of exclusion, we can begin to envisage the nature of a democratic public sphere in a different way" (1999, 755). And so we reach her strongest argument for why agonism is important:

> This is why a pluralist democracy needs to make room for dissent and for the institutions through which it can be manifested. Its survival depends on collective identities forming around clearly differentiated positions, as well as on the possibility of *choosing between real alternatives* (1999, 756). (emphasis added)

And this is why it matters whether algorithms can be agonistic, given their roles in deliberation and governance. When the logic of algorithms is understood as autocratic, this poses serious problems when we wish to intervene in their process of governance. If algorithms adopt deliberative democratic paradigms, it assumes an internet of equal agents, rational debate, and emerging consensus positions. This is not the internet that many of us would recognize. We may feel more familiar with trolls, bots, Markov chains, subtweeting and hatelinking. Does a logic of agonistic pluralism help us understand these entities and practices? Such a logic emphasizes that algorithmic decision-making is always a contest, one that is choosing from often counterposed perspectives, within a wider socio-technical field where irrationality, passion and emotion are expected. As an ethos, it would assume perpetual conflict, recognize contestation and, in William Connolly's words, promote "multiple constituencies honoring different moral sources" (1999, 51). But it would at least offer the ability to choose between "real alternatives".

We could think about this from a design perspective too: how can we show the complexity of human-algorithmic contests? One way might be to adopt the Wikipedia "view history" and "talk" page mode, where the changes and backstage debates about the value of content are visible, even after that content has been deleted. This could be adopted in spaces where disagreements emerge between competing forces as to whether content should remain, such as YouTube and Facebook (Crawford and Gillespie, 2014). A publicly viewable backstage discussion page has the benefit of revealing the contested nature of knowledge: instead of content just disappearing from view, it leaves a set of traces that indicate why this article, video or image was deemed inappropriate or offensive. Such an approach offers a different path than the disappointingly limited calls for algorithmic "transparency", which seem doomed to fail. First, companies like Facebook and Twitter won't reveal a proprietary algorithm's workings for fear of losing their competitive edge, and of users "gaming the system". Second, as Helen Nissenbaum has argued, there is a *transparency paradox*: revealing how an algorithm works, even if it were possible to predict consistently (which it often is not), would mean "revealing information handling practices in ways that are relevant and meaningful to the choices individuals must make" (2011, 36). And even if one did so, describing "every flow, condition, qualification and exception, we know that it is unlikely to be understood, let alone read" (Nissenbaum 2011, 36).

Instead, to recognize the value of different perspectives and opposing interests involves both an acceptance of what Howarth calls "the common rules of the game"[1], and an expectation that conflict and "gaming" of systems is an "infinite process" (2008, 187) and that algorithms are participants in wider institutional and capitalist logics. By drawing on agonistic pluralism in this socio-technical approach, we can see the many ways that algorithms work in contested spaces.

8. Late April 2009. It's the big public announcement of the *Time 100*: Time.com's public poll where millions of votes are cast on the 100 most influential people in the world. But this one came as quite a surprise: the winner was moot, aka Christopher Poole, the then-21-year old founder of the online community 4chan. A close observer could notice a message embedded in the top 21 contenders: the first letter of each name spelled out "MARBLECAKE ALSO THE GAME". Indeed, this was a clever hack by members of 4chan and Anonymous, with marblecake being the name of the IRC chatroom where Project Chanology was planned, the Anonymous campaign against Scientology (Lamere 2009a). Initially, a simple

"autovoter" was created that would automatically vote for moot as well as rank the other contenders. Initially, this ballot stuffing worked well – Time.com had no complex validation of the votes, although there were barriers:

> "Another challenge faced by the autovoters was that if you voted for the same person more often than once every 13 seconds, your IP would be banned from voting. However, it was noticed that you could cycle through votes for other candidates during those 13 seconds. The autovoters quickly adapted to take advantage of this loophole interleaving up-votes for moot with down-votes for the competition ensuring that no candidate received a vote more frequently than once every 13 seconds, while maximizing the voting leverage" (Lamere 2009a).

But once the hacking was observed, Time.com shifted to an authentication model using a CAPTCHA, which asks voters to enter words seen in distorted text images. This shut down the autovoters, but then Anonymous came up with various workarounds (Lamere 2009b).

This was one of many contests in what ended up as a complex exchange, but eventually the hackers realized they had the upper hand: why not add their name to the World's Most Influential list? But without already being explicitly named on the nomination list, they would have to spell it out.
Time Inc., with few options open other than declaring a failed poll, published the results and duly declared moot The World's Most Influential Person, with MARBLECAKE spelled out for all to see. They noted that Time.com's technical team did "detect and extinguish several attempts to hack the vote" but they did not comment on the fact that the entire top 20 was clearly an elaborate joke.[2] In the contest between Time.com and 4chan plus Anonymous, there was a clear winner.

If this wasn't enough, the victory was repeated in 2012, when 4chan arranged for North Korean leader Kim Jong Un to take the number one spot. This time, Time.com acknowledged the vote tampering: "However, some of the highest vote tallies got a boost from members of Internet forums like 4Chan, which launched a campaign to manipulate the results, pushing North Korea's leader to the top of the list."[3] They did not record the fact that this time the top results spelled out "KJU GAS CHAMBERS."

9. How else might agonism be useful to us when thinking about algorithms? Rather than fetishizing the algorithm itself, theories of agonism allow us to widen the perspective to include the contested spaces where algorithms are designed. They are always made by and in relation to people: they are in flux and embedded in hybrid spaces. Thus, we can look to the companies and offices where algorithms are created as fruitful sites of research.[4] These workplaces are themselves spaces of everyday conflict and dissent, where algorithmic design decisions are made after debate, disagreement, tests and failures. And we can look to the spaces where algorithms and people are interacting in quite public ways: for example, Reddit makes part of its algorithmic ranking process public. Users like having more awareness of the rules of the system, and some enjoy the possibility of gaming it, collectively or individually. While transparency is no guarantee of legitimacy, it is does mean that more opaque, autocratic systems (such as Facebook) generate more suspicion.

10. An algorithm itself is a narrow process of calculation, one that follows a set of instructions to produce an output. But we cannot understand their broad effects by solely focusing on the mechanistic process. As Gillespie argues, "a sociological analysis must not conceive of algorithms as abstract, technical achievements, but must unpack the warm human and institutional choices lie behind these cold mechanisms" (2014, 169). We should also consider the political theories we bring to our analyses, and how power is being shaped and reshaped in these processes. By looking beyond algorithms as fetishized objects, we can account for a wider range of actors: be it developers in cubicle farms, Twitter bots, Amazon book buyers, 4channers and Redditors. And we can also look to the ways people reverse engineer algorithms, acting in direct contestation, where the troll, the artist and the hacker become key players in an agonistic system. Theories of agonism prompt us to consider in greater depth the many spaces of dispute where humans and algorithms engage.

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[1] Another promising approach for thinking about algorithms and agonism can be found in the work of James Tully. For Tully, there is a clear link between the agonal and dialogic games of mutual cultural recognition—which he thinks are constitutive of social relations—and the notion of human freedom (Tully 1999, 162–169). For Tully, "politics is the type of game in which the framework—the rules of the game—can come up for deliberation and amendment in the course of the game" (Wenman 2003, 177).

[2] See "The World's Most Influential Person Is…" *Time*, April 27, 2009.
http://content.time.com/time/arts/article/0,8599,1894028,00.html

[3] See "And The Winner of TIME"s Person of The Year Reader Poll Is…" *Time*, December 13, 2012.
http://newsfeed.time.com/2012/12/13/and-the-winner-of-times-person-of-the-year-reader-poll-is/#ixzz2EwqcOsHC

[4] For example, see Nick Seaver's ongoing research into music algorithms, for example: Seaver, Nick. "Hearing Taste: Computer Audition and Automatic Recommendation." Paper presented at the Society for Social Studies of Science Annual Meeting, Copenhagen, Denmark, October 2012.