1 What are algorithmic cultures?

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The current, widespread dissemination of algorithms represents a double challenge for both our society and the social sciences tasked with studying and making sense of them. Algorithms have expanded and woven their logic into the very fabric of all social processes, interactions and experiences that increasingly hinge on computation to unfold; they now populate our everyday life, from the sorting of information in search engines and news feeds, to the prediction of personal preferences and desires for online retailers, to the encryption of personal information in credit cards, and the calculation of the shortest paths in our navigational devices. In fact, the list of things they can accomplish is rapidly growing, to the point where no area of human experience is untouched by them—whether the way we conduct war through ballistic missile algorithms and drones, or the manner in which we navigate our love lives via dating apps, or the way we choose how to dress by looking at weather forecasts. Algorithms make all of this possible in a way that initially appears disarmingly simple. One way to approach algorithms is through Kowalski's now classic definition: "Algorithm = Logic + Control" (1979). Using both simple and complex sorting mechanisms at the same time, they combine high-level description, an embedded command structure, and mathematical formulae that can be written in various programming languages. A wide variety of problems can be broken down into a set of steps and then reassembled and executed or processed by different algorithms. Hence, it is their versatility that constitutes their core capability and power, which extends far beyond the mathematical and computer sciences. According to Scott Lash, for instance, "a society of ubiquitous media means a society in which power is increasingly in the algorithms" (2007, 71), an idea echoed by Galloway when he states that "the point of power today resides in networks, computers, algorithms, information and data" (2012, 92). Yet, it is imperative to remain cautious with such formulations, and their tendency to be too critical, too quickly. While it may capture important challenges that society faces with 'the rise of the algorithm,' it can also provide something of a teleological or deterministic "seductive drama," as Zietwitz has recently warned us (2016, 5). Algorithms can actually be considered less sovereign than mundane in this regard—that is, again, deeply rooted in the fabric of society. Rather than being omnipotent, they are oftentimes ambiguous and quite messy. What is crucial,

then, is to bring into question how, and especially *why*, the apparent simplicity of algorithms is in fact inseparable from their complexity, in terms of their deployment and multiple, interrelated ramifications. These are epistemological as well as ontological interrogations, confronting not only the social sciences but society at large. As both a known unknown and an unknown known, the sorting mechanism that is the algorithm still needs some sorting out.

This introduction is certainly not the first to stress the inherent difficulty of shedding light on algorithms. Seaver, for instance, observes how they "are tricky objects to know" (2014, 2), while Sandvig insists on "the complexity of representing algorithms" (2015, 1; see also Introna 2016; Barocas *et al.* 2013). Conceptually perspicacious as they are, these arguments do not, however, foreclose the need to understand the extent of such invisibility and inscrutability. On the surface, it is often the 'black box' nature of the algorithms that is first evoked, namely that they are incredibly valuable patented trade secrets for companies such as Amazon, Google, Facebook, and the like. If they were revealed to non-insiders, they would *eo ipso* be ruined. Or at least so we are told by numerous technical, economic, legal, and political experts (Pascale 2015). This is where things noticeably start to get more serious and profound. There is not one box, but multiple boxes. The opacity of algorithms is more precisely expressed in different forms of opacity, all of which, in specific ways, are contingent on the *in-betweenness* of a plethora of actors, both human and non-human. While a few commentators have remarked upon the plural character of such opacity (Burrell 2016; Morris 2015), the fact remains that each and every algorithm can only exist in rich and dense, if not tense, environments.

This is the inherently messy, vivid, and dynamic nature of algorithms, which explains why they are ultimately so challenging to study. As Kitchin puts it, "creating an algorithm unfolds in context through processes such as trial and error, play, collaboration and negotiation" (2014, 10). The latter term is of particular interest here: "negotiation" refers to the very condition of possibility/difficulty of algorithms. On the most fundamental level, they are what one can call *anthropologically entrenched* in us, their creators and users. In other words, there is a "constitutive entanglement" where "it is not only us that make them, they also make us" (Introna and Hayes 2011, 108). Indeed, the problem with such mutual imbrication is that algorithms cannot be fully 'revealed,' but only unpacked to a certain extent. What is more, they always find themselves *temporally entrenched*, so to speak. They come to life with their own rhythm, or, to use Shintaro Miyazaki's description in this volume, "they need unfolding, and thus they embody time" (p. 129). Another metaphor that proves useful in this regard is Latour's idea of the cascade (1986, 15–16): algorithms follow a non-linear course, caught in constant changes, fluctuations, and deviations both large and small. Such changes may very well be hard to follow or may even be imperceptible from time to time. The most important point to make here is how practical and mundane they are. Again, they unfold in a state of incessant negotiation and in-betweenness; for all algorithms, as Seaver has noticed, there are "hundreds of hands reaching into them, tweaking and tuning, swapping out parts and experiencing with new arrangements" (2014, 10).

The multiple ways in which algorithms unfold today thus give new meaning to the familiar description, "the most profound technologies are those that disappear" (Weiser 1991, 95). But there is more. We would like to take this opportunity to argue that such concrete unfoldings also give a new yet complex meaning to what it is that algorithms actually *do*, i.e., the kind of agency and performativity they embody. Of course, there is now a substantial tradition of academics working within this broadly defined praxiological paradigm, including Lucas Introna (this volume, 2016, 2011), Adrian Mackenzie (2005), David Beer (2013), and Solon Barocas *et al.* (2013). Somewhat aligning ourselves with them, we invoke Andrew Goffey's persuasive insight that "algorithms do things, and their syntax embodies a command structure to enable this to happen" (2008, 17)—an insight almost as persuasive as Donald MacKenzie's description of the algorithm as "an engine, not a camera" (2006). Many things could be said about such a position, and it will be important to come back to them in due time. It suffices for the moment to say that the agency of algorithms is a far cry from the category of 'action,' if we understand by the latter something purposive and straightforward. On the contrary, the type of agency involved here can be best described as 'fractal,' that is, producing numerous outputs from multiple inputs (Introna 2016, 24). What counts as 'control' in the algorithmic sense is in fact relatively limited; there is so much more implied before, during, and after the operation of algorithms. For instance, to both the anthropological and temporal entrenchment discussed above, it appears necessary to add the concept of *self-entrenchment*, whereby one algorithm is intertwined with many others in extremely intricate networks. Non-human as much as human contributions are thus key here, and could rather easily result in mismatches, unpredictable results, or even dramatic failure—as will be seen later. It is as if algorithms themselves are constituted by the very possibility of 'being lost in translation,' not only in their relations to machines, code, or even some more discursive dimensions, but in terms of the entire practicality and performativity that defines them. For an algorithm is performative by definition, and to be performative is to be heterogeneous in all circumstances (Kitchin 2014, 14–15; Seaver 2014). To be able to carefully read such messy unfoldings constitutes a pressing challenge for the social sciences in general, and for cultural sociology in particular. What does it mean, indeed, if these unfoldings themselves become a particular object of investigation? How is it that we could or should adapt in turn, with what kind of precision, changes in focus, and so forth?

Now is an appropriate moment to assess the state of research on algorithms in the so-called 'soft sciences,' and to reflect on both its virtues and shortcomings. The fact is that the field of algorithmic research has arrived at a certain degree of maturity, even if it was not until very recently that it started to migrate to the humanities, social sciences, and cultural studies. Currently, there are several promising cross-currents that more or less co-exist, but that do not yet properly engage with one another. First, there are those authors developing almost stand-alone concepts: "the algorithmic turn" (Uricchio 2011), "algorithmic ideology" (Mager 2012), "algorithmic identity" (Cheney-Lippold 2011), "algorithmic life"

(Amoore and Piotukh 2016), and the like. There are also significant attempts toward a 'sociology of algorithms' that have emerged in the field of Science and Technologies Studies (STS) and the Social Studies of Finance (MacKenzie 2015; Wansleben 2012), as well as embryonic efforts to develop Critical Algorithm Studies (The Social Media Collective 2015). In addition, there have been several important conferences over the last three to five years in North America and Europe, including 'Governing Algorithms' (Barocas *et al.* 2013) and the one that gave rise to this book project (Ruhe 2014). Together, these different perspectives have raised crucial epistemological questions as to what would constitute the most appropriate scope for studying algorithms. For instance, what would be too narrow or too broad? And what constitutes the ideal distance to study algorithmic culture, allowing for a critical reflexivity without being too detached or removed from the actual practice and operation of algorithms? To this can be added the problems often associated with so-called 'hot topics,' that is, the pursuit of the 'new' for its own sake, and how to avoid falling into the "trap of newness" (Beer 2013, 6–7; Savage 2009).

Conceptual innovation, in light of such questions and problems, might very well mean returning to, and relying and building on older but more solid foundations, which do in fact exist. What we propose in this introduction is thus to revisit and modify Alexander R. Galloway's classic intervention, which construes ours as an age of algorithmic culture (2006). This idea of culture as marked by the algorithmic resonates strongly with the encompassing yet established discipline of cultural sociology and its efforts 'to take meaning seriously,' i.e., to understand 'meaning' not as a series of intangible or untethered significations, but as something deeply rooted in reality, agency, and performativity. Indeed, a cultural sociology of the algorithm is possible only insofar as algorithms are considered as both meaningful *and* perfomative, that is to say, performative *for the very reason* that they are meaningful, and vice versa. It is our contention here that while the aforementioned perspectives are all significant contributions, they generate rather than obviate the need for thicker, deeper, and more complex analyses of the kind of culture that algorithms are currently shaping. As the title of this volume suggests, we want to engage with this possibility of an algorithmic culture by supplementing or contaminating it with observations on pluralization.

The plurality of cultures in algorithmic cultures

Despite its theoretical potency, Galloway's innovation was never fully developed, and appears more inspirational than analytical. Of late, it is mostly Ted Striphas who has led what he calls "historico-definitional" efforts in determining what could more fully constitute such an algorithmic culture (2015, 2009; Hallinan and Striphas 2014; see also Roberge and Melançon forthcoming; and to a lesser extent, Kushner 2013). And the way he puts things in perspective has a rather humanistic tone: "What does *culture* mean, and what might it be coming to mean, given the growing presence of algorithmic [recommendation] systems [...]?" (Hallinan and Striphas 2014, 119). His attempt, in other words, is geared towards finding essential, if not ontological, categories under the terms "work of culture" or "world's cultural heritage," and their fundamental transformation through automation. For Striphas, it is all of the circulation, sorting, and classifying processes that are now dictated by "a court of algorithmic appeal." This too is a powerful notion; Striphas's argument is worth mentioning as it is epistemologically sound and captures the important stakes in this debate. On the one hand, he never fails to acknowledge the dual nature of algorithmic culture, or the way its semantic dimensions are inseparable from its more technical ones. On the other hand, he fully appreciates how the very 'publicness' of culture is currently being black-boxed through processes of privatization, to which we return below. The problem, small as it is, is elsewhere. If Striphas's arguments can be criticized at all, then it will be for their tendency to be relatively abstract and broad. To say that we are witnessing a shift towards algorithmic culture does not necessarily have to be an all-encompassing theoretical move. His idea of algorithmic culture remains *one* concept of *one* culture. In the end, as much as it is meaningful and consistent, it struggles to recognize the variety of algorithms today, and the ways they are fractal and heteronomous by definition. So how do we proceed from here? How can we develop an understanding of algorithmic culture that takes meaning seriously by being especially attentive to its inherent performativity and messiness? One possible way is to go even further back in time, to another seminal author who preceded Striphas and Galloway. In the 1970s Michel de Certeau wrote *La culture au pluriel*, in which he insists that any definition of culture would have to conceive of it as *un multiple* (1974; translated by Conley as *Culture in the Plural*, 1998). While he could not have been aware of the significance algorithms would later gain, his idea is nonetheless vital, and inspirational in this context. Indeed we are currently living in the age of algorithmic *cultures*.

Although difficult to represent in simple logical terms, one thing can be many, and multiple disparate things can be very commensurable. Such is an archipelago—for instance, the Bahamas and the Philippines—to give a metaphorical example. In the case of algorithmic cultures, it is necessary to make sense of how a certain enclosure is nonetheless part of a larger whole. There are of course many ways to explain such an enclosure; one that has become almost mainstream in cultural sociology comes from the Yale School, which insists on giving cultural realities a 'relative autonomy' in the way their terms are often dependent on one another (see Alexander 2004, 1990; Alexander and Smith 2002, 1998; see also Sanz and Stančík 2013). As for algorithms themselves, they develop a routinized 'inside,' an internal or auto-referential logic that is all interrelated meanings. They are a textual reality even before they are mathematical calculations; they crystallize imaginaries, hopes, expectations, etc. As Valentin Rauer puts it later in this volume, "Algorithms are part of a broader array of performativities that includes, for example, rituals, narratives, and symbolic experiences" (p. 142). As contingent normalizers and stabilizers, they have a symbolic life of their own which, like texts, only makes sense in a particular context. Cultural

sociology rests here on what may constitute an original, yet very solid theoretical ground. Jeffrey Alexander's notion of "relative autonomy" resonates with Lorraine Daston's more recent narratological perspective, for instance, which inquires into the specific "history and mythology [...] of the algorithm" (2004, 362). To give a concrete example of how an algorithm, or a set of algorithms—a network or a specific family, so to speak—develops *by, of,* and *for* its own, our contributor Lucas Introna has shown elsewhere how algorithms used to detect plagiarism also alter the long established definition of what it means to produce an 'original' text. As algorithms can identify matching copies by fastening upon suspicious chains of words, writers have adapted their style of writing. Plagiarism algorithms are thus only able to detect "the difference between skillful copiers and unskillful copiers," and thereby performatively and somehow paradoxically produce the skillful copier as an 'original' author, resulting in an entire culture surrounding the sale of 'original' essays and ghost-writing services (Introna 2016, 36). Hence, instead of treating algorithms as mere utilitarian devices, the study of algorithmic cultures rather identifies the *meaningfully performative* effects that accompany algorithmic access to the world: What is it that they *do*, culturally speaking? How do they *make sense* of their surroundings and the different categories people use to interpret them?

As it turns out, one of the most salient points to be made in this introduction revolves around algorithmic cultures as being *un multiple*. Nick Seaver offers a similar argument when he notes that "rather than thinking of algorithms-in-the-wild as singular objects, [...] perhaps we should start thinking of them as a population to be sampled" (2014, 6). Algorithms are dynamic entities that mesh with specific sets of knowledge and experience in textured and complex ways. Thus, another appealing way to make sense of their relative autonomy and enclosure is to borrow from the language of cybernetics (Totaro and Ninno 2014; Becker 2009). Feedback loops, decision-making by classification, continual adaption, and the exchange of information are all characteristics of recursive quasi-circular routines that typify the non-linear unfolding of algorithms, as seen above. Göran Bolin and Jonas Andersson Schwartz have recently given this idea a practical spin, noting that

> (a.) in their daily operation, professionals have to anticipate what the end-user will think and feel; [... and that] (b.) many everyday users try to anticipate what the [...] media design will do to them, [...] which involves a recourse back to (a.)
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> (2015, 8)

Google could serve as a prime example here. Complex and multivalent, there exists, as our collaborator Dominique Cardon calls it, something like a unique "PageRank spirit" (2013; see also in this volume), in which symbolic as well as performative aspects are constantly interacting. Such a spirit is easy to spot in the cyclical anticipation of needs, the satisfaction of experience, and the personalization of navigation, all typical of the contemporary search engine. It is also

evident in the implementation of sophisticated algorithms over the years—such as Panda, Penguin, Hummingbird, and Pigeon—and how they have helped in the on-going struggle against the polluting power of search engine optimization (see Röhle 2009). Lastly, this particular spirit is present in how Google has tried to find a balance between its sense of natural, meritocratic indexing and its own commercial needs, which then serve to subsidize its more futuristic technological endeavors. Not only are these three examples recursive in themselves, but they also end up swirling together and influencing one another to create a distinctive, powerful, and meaningful algorithmic culture. This is precisely Google's own "culture of search" (Hillis *et al.* 2013) or, to put it more bluntly, the "Googleplex" (Levy 2011). Is this to say that the company has no sense of what is going on outside? Certainly not. Rather, this particular culture can co-operate with others, and may even coincide with others in many respects, but it does not mean our analysis should conflate them all. A finer understanding of algorithmic cultures, in other words, should be able to zoom in and zoom out, to see the particularities of each algorithmic culture, as much as what they also have in common.

Examples of this abound: individuality *and* reaching, particularity *and* sharing, distinctiveness *and* commensurability, small *and* big picture. For algorithmic cultures can of course cut across various social, economic, and political spheres; for instance, when a particular usage of predictive algorithms in the stock market borrows its probabilistic methods from games of chance, transporting them into another field, and thereby transforming them for its own practical needs. Or when developments in artificial intelligence are derived from computer algorithms in the game of chess, thereby shaping the very future of artificial intelligence for years to come (Ensmenger 2012). Thus, algorithmic cultures are not based on a fixed and unmoving ground, but are rather more like mobile methods that are adapted, transformed and made to measure for each particular use. In fact, this entire volume serves as proof for this argument. Each chapter develops a unique take on what it means for algorithms to be culturally entrenched and performative; each of them explores the density extending from a particular assemblage or ecology by proposing a specific interpretation. The exact description of the chapters' contents will come in a moment, but suffice now to say that it also falls on the reader to navigate between them, to ask the questions s/he judges appropriate, and to wrestle with the different intellectual possibilities that are opened up.

To argue that algorithmic cultures are *un multiple* still opens, rather than forecloses, the need to find a plausible solution to the problem of what could constitute their variable yet common nature. There must be something; indeed, algorithms revolve around a question or an issue that is each and every time particular but nonetheless always similar. We want to suggest here, as others have, that such important stakes constantly bring about and thus recycle "the power to enable and assign meaningfulness" (Langlois quoted in this volume in Gillespie 2014; see also Roberge and Melançon forthcoming). This is a question as old as the idea of culture itself, and the social sciences have been aware of it for their

entire existence too, from the moment of their founding until today (Johnson *et al.* 2006). Culture needs legitimacy, just as algorithms and algorithmic cultures need legitimacy. It is about authority and trust; it is about the constant intertwining of symbolic representation and more prosaic performance, the production as well as the reception of discursive work. In our current day and age, we are witnessing the elaboration of a kind of 'new normal' in which algorithms have come to make sense in the broader imaginary; they are 'accepted' not because they refer to something transcendent in the classical sense, but because they have developed such acceptability in a newer, more immanent way. Scott Lash's insight regarding algorithms' principle of "legitimation through performance" is fundamental in this regard (2007, 67). In their actual real-time unfolding, algorithms implicitly or explicitly claim not only that they are cost-effective, but moreover *objective*, in both an epistemological and a moral sense. Again, this occurs in a very mundane way; their justification works, as much as it is rooted in an enclosed routine that says very little in fact: *algorithms work straightforwardly, they provide solutions, etc.* Neutrality and impartiality are whispered and tacitly assumed. Tarleton Gillespie notes something similar when he underscores that "more than mere tools, algorithms are also stabilizers of trust, practical and symbolical assurances that their evaluations are fair and accurate, free from subjectivity, error, or attempts at influence" (Gillespie 2014, 179; see also Mager 2012). That is the magic of something non-magical. Objectivity as an information process, a result, and a belief is the equivalent of legitimacy as the result of a form of belief. The strength of algorithms is their ability to project such objectivity to the outside world (to what is in their rankings, for instance), while accumulating it 'inside' the algorithms themselves as well. This is because any provider of value *ought to be* constructed in a way that is itself valued. Gillespie is astute on this point, noting that "the legitimacy of these functioning mechanisms must be performed alongside the provision of information itself" (2014, 179). Here legitimacy acquires an ontological dimension.

This is not to say that the quest for legitimacy is an easy endeavor—quite the contrary. Performance and justification exist only insofar as they can find an audience, to the point in fact where the 'reception' part of the equation is just as important. The problem, of course, is that such reception is inherently cultural and constituted by interpretation, expectation, affect, speculation, and the like (Galloway 2013; Seyfert 2012; Kinsley 2010). Reception, in other words, is unstable and uneven by its very definition. What Lash calls "legitimation through performance" is for this reason nothing less than a steady negotiation—in terms close to those discussed above. Performance and reception interweave in such a way as to constitute specific routines and cultures in which the trust afforded to algorithms cannot foreclose the possibility of contestation. The hopes and desires of some could very well be the fears and dislikes of others. And while justification is performative, so too is criticism. The controversy that erupted around Google Glass is a case in point. Research into their Glass Explorer program initiated by one of us has indicated how much style and design has been figured into the corporate planning for wearable computing (Roberge and Melançon

forthcoming). For example, to give Google Glass a broader appeal, the company hired a Swedish designer to help design the device, including its color palette and minimalistic contours (Miller 2013; Wasik 2013). Regardless, the critical response was negative, noting that Glass is "so goddam weird-looking," "ugly and awkward," and makes interaction "screamingly uncomfortable" (Honan 2013; Pogue 2013). Social and cultural discomfort with this new form of interaction helps explain the algorithmic device's critical reception. In the end, it was the pejorative term "glasshole," symptomatically blending aesthetic and normative-moral judgments, that proved one of the most influential factors that forced Google to withdraw. What this example thus shows is how ambiguous various meanings and interpretive conflicts, as well as the algorithmic cultures they shape, end up being. Messiness is not an option; it is an ongoing and transformative characteristic.

Algorithmic traffic: calculative recommendation, visibility and circulation

The key idea behind this volume on algorithmic cultures is that such cultures are plural, commensurable, and meaningfully performative. The purpose here is to offer a "thick description" *à la* Geertz (1973), i.e., an analysis of different routinized unfoldings that revolve around rich and complex stakes and issues. Legitimacy is certainly one of these. Everyday life is full of occasions where this question is not raised, but here the stakes are tremendous, as they encroach on some sort of cultural core. Algorithms are sorters; they are now key players in the gatekeeping mechanisms of our time (Hargittai 2000). To be sure, gatekeeping has been around for a long time, from the arts patrons of the classical age to modern-day newspaper critics. But this only strengthens the argument: the role played today by algorithms still adheres to a prescriptive selection of ascribing value, for a particular audience, with all of the attendant moral and political valences. Gatekeeping is about making editorial choices that others will have to deal with. It is about taste and preference-making, which explains, at least in part, why many recommendation algorithms are so influential today, from Amazon to Netflix, YouTube, and the like. Beer synthetizes this point nicely:

> It is about the visibility of culture, and of *particular forms of culture that algorithmically finds its audience.* These systems shape cultural encounters and cultural landscapes. They also often act and make taste visible. The question this creates is about the power of algorithms in culture and, more specifically, the power of algorithms in the formation of tastes and preferences.
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> (Beer 2013, 97, emphasis added)

Two recent articles in particular have captured this trend and how it has evolved in specific settings, one in terms of film (Hallinan and Striphas 2014), and the other in music (Morris 2015). Netflix, and specifically the Netflix Prize, is

emblematic in many regards; launched in 2006, the contest offered US$1 million to whoever could first boost the accuracy of their recommendation algorithm over the benchmark of 10 percent. As the challenge was a huge success among computer scientists in the U.S. and abroad, it represents for Blake Hallinan and Striphas a prime example of how "questions of cultural authority are being displaced significantly into the realm of technique and engineering" (2014, 122). Yet this is only one half of the equation. The other half deals with the logic or the economic purpose enabling such a quest for personalized recommendation, something the authors call a "closed commercial loop," in which "the production of sophisticated recommendation produces greater customer satisfaction which produces more customer data which in turn produce more sophisticated recommendations, and so on" (122). Where information processing becomes key, the meaning of culture drifts toward simpler views on data, data-mining, and the value it produces. This is what Jeremy Wade Morris finds as well in his study of Echo Nest, the "taste profiling" platform acquired by the music streaming service Spotify in 2014. The management of massive databases and new behavioral tracking techniques, by those that Morris calls "infomediaries," now relies "on the efficacy of the algorithms [...] to know what is essential about you and your tastes" (2015, 456). This is the case because it essentially opens the door to "highly segmented and targeted advertising opportunities" (455). This logic or trend is indeed very strong, though it is not the only one at play. Morris's argument is subtle enough to recognize the pervasiveness of human-maintained playlists as a mode of alternative curation that most of today's platforms are unable to let go of. These human-to-human taste dialogues, so to speak, still exist in most music streaming services as a way to cope with the abundance of content. Both automated and so-called 'manual' gatekeeping mechanisms thus co-exist more or less side by side in a sort of complex, if tacit and very delicate, tension.

The data-intensive economy and culture that is currently taking shape is also of interest to Lucas Introna in his contribution to our volume. By tracing the genealogy of online advertising, he analyzes recent forms of what he calls "algorithmic choreography." While traditional online advertisements indiscriminately place ads on sites that all users will encounter—a banner on the top of a webpage, for instance—more innovative brokers such as Dstillery adapt to what they perceive as the needs of the individual. Data-mining, behavioral targeting, contextual advertising, machine-learning algorithms, and the like are thus all part of the same arsenal. The aim here is finding a "market of one," where particular subjects are addressed through personalized advertisements. Time and again, it is about addressing "the right person at the right time with the right creative content" (p. 41). Such a choreography requires and enacts particular forms of subjectivity, which Introna calls "impressionable subjects," i.e., subjects that are willing to be impressed by the information the algorithm has prepared for it at any given moment. In one way of reaching customers in an online advertisement called "prospecting," data are collected from user activities on the spot (through clicks, queries, etc.). From such data, correlations can be derived and users can be "branded": whoever visits a particular page, for example, might be interested

in the same products as another user who visited similar sites. On the one hand, in algorithmic cultures the subject is treated as a mere statistical entity, a branded subject. On the other, subjects are not entirely passive, but rather are actively engaged in the selection of information they see and how they are shaped by it; they partially curate what they are going to see (and perhaps buy) through their own behavior. Thus, user behavior and online advertising become deeply cultural and social affairs because they either enact subjects or fail to connect with them. Introna shows how in their own way algorithmic cultures are *un multiple*, that is, very generic but at the same time very personal. Placing an advertisement correctly enacts or confirms the subject in a highly personalized way: who I am becoming depends on where I am surfing. In turn, incorrectly placing an advertisement is not only a missed opportunity, but can also question and insult the subject ('Why am I seeing this?').

In his contribution, Tarleton Gillespie investigates the complexity and heterogeneity of automated gatekeeping by addressing the rich yet understudied subcategory of trending algorithms. Indeed, these are everywhere today, from Buzzfeed to Facebook and Twitter; they are an icon of a new genre that is oftentimes the icon of themselves, since "trending is itself trending." Gillespie's fine-grained analysis thus starts by asking not what algorithms do to cultural artifacts, but instead "what happens when algorithms get taken up as culture, when their kinds of claims become legible, meaningful and contested" (p. 69). Such algorithms appear as a measurement ritual, but of exactly what is less clear. Is it a glimpse into the popularity of different content, as was *American Top 40* or *Billboard*? Is it a small window into 'us,' with the attendant problem of defining exactly who this 'us' is—a public, a nation, etc.? Or is it simply about capturing some sort of pulse, velocity and movement in between undisclosed and thus incalculable points? Surprisingly, all these difficulties are fueling, rather than extinguishing, the urge to measure and position measurement as a meaningful accomplishment. In other words, trending algorithms are popular because they are inherently ambiguous. In addition, real and practical biases are numerous, as if they were inscribed in the very DNA of these algorithms. According to Gillespie, this has to do with the black box character of most social media platforms. More important, however, is the fact that biases are above all interpretations of biases, in the way that they depend on the expectations, hopes, and desires of those who care enough. Validity is a cultural question in this regard. For instance, many have criticized Twitter and Facebook for the triviality of their trends, while at the same time often underscoring that their own favorite 'hot topic' was not appearing. Controversies related to trending algorithms are simply not about to vanish. They emerge from time to time, depending on different places, people and issues, as a symptom of something deeper—indicating a fundamental conflict over legitimacy.

Gatekeeping, as has become clear, represents an issue with both representational and performative ramifications. As it deals with the visibility and circulation of pretty much everything cultural, it has been fundamentally transformed by the dissemination of algorithms. The challenge to the authority-thrust nexus

of all gatekeeping mechanisms is thus as significant as those mechanisms are constant. For the social sciences, too, this represents a substantial challenge, one that forces us to develop new holistic understandings as well as new and more empirical analyses (Kitchin 2014; see also Ruppert *et al.* 2013). In their contribution to this volume, Jean-Samuel Beuscart and Kevin Mellet offer an excellent example of the latter. They study *LaFourchette.fr* and other consumer rating and review sites as a now more-or-less standardized, if not ubiquitous, tool on the Web. What their findings show, however, is that the massive presence of such platforms is not antithetical to a sense of agency among users, and that the latter has given rise to a rich and interesting negotiation among actors, both human and non-human alike. Frequent writers of reviews, for instance, are indeed moved by a non-negligible dose of reflexivity. According to Beuscart and Mellet, "at least part of the effectiveness of this phenomenon is the ability of users to build a coherent pattern of use that regulates their evaluation behavior to work towards a collective aim" (p. 90). Self-esteem thus derives from a sense that somehow there exists a form of readership that also forms a rational and socialized judgment. This might create a distant image of what constitutes a collective intelligence, and such an image is active enough to be considered performative.

Not to be forgotten is the question of whether the actual fragmented nature of recommendation algorithms constitutes *un multiple*. Different calculation routines clearly produce different outcomes, and from there it becomes important to assess what this could mean, both ontologically and epistemologically. Putting things in such a perspective is the task Dominique Cardon sets for himself in his contribution to our volume. He proposes, in essence, a classification of classificatory principles, focusing on the ways that they are not simply and straightforwardly dependent on economic forces, but also on one another, by way of relation, opposition, comparison, etc.—a conceptual move closely linked with Alexander's "relative autonomy of culture," as seen above. Cardon discusses four types of calculation and the ways they inform the "competition over the best way to rank information": *beside the Web*, as a calculation of views and audience measurement; *above the Web*, as a meritocratic evaluation of links; *within the Web*, as a measure of likes and popularity; and finally, *below the Web*, as the recording of behavioral traces that allows for more tailored advertising. These four types reveal very different metrics, principles, and populations to be sampled, and yet they are commensurable in that together they inform a "systemic shift" in how society represents itself. "Digital algorithms," writes Cardon, "prefer to capture events (clicks, purchases, interactions, etc.), which they record on the fly to compare to other events, without having to make broad categorizations" (p. 106). Statistics as we used to know them, such as those relying on large variables like sex and race, are being replaced with more precise and individualized measurements. In turn, society appears as an increasingly heterogeneous ex-post reality, the best explanation of which might be that there is no real, fundamental, or comprehensive explanation—with all the consequences that this entails for the social sciences.

From algorithmic performances to algorithmic failures

Instability, fragility and messiness all gesture at the praxiological character of algorithmic cultures. In contrast to the dominant paradigm of computer science, which describes algorithms as procedural and abstract methods, we conceptualize algorithms as practical unfoldings (Reckwitz 2002). Galloway, in his seminal essay, already points to the *pragmatic aspect* of algorithmic cultures: "to live today is to know how to use menus" (Galloway 2006, 17). As users, when we operate in algorithmic cultures, we operate algorithms. For instance, the handling of software menus is a practice (interactions and operations with others, human and non-human alike) in which we manage algorithmic devices: we schedule meetings on our online calendar, set up notifications on emails, program our navigational devices to lead us home, etc. We activate and deactivate algorithms to govern our daily life. Thus, algorithms are not so much codes as they are *realizations of social relations* between various actors and actants.

As practices, algorithms are distinguished by recursive and very entrenched *routines*. Algorithms are supposed to help in the performance of repetitious tasks; they implement activities for reduced cognitive and affective investment, and thereby make it possible to focus on more important and perhaps more interesting tasks. The analysis of algorithms as routines (or routine practices) accounts for deviations from the mathematical and technical scripts, deviations that emerge from various sources, such as a failure in design, incomplete implementation, and the messiness of operations or interactive effects between different algorithmic and non-algorithmic actants. This is something computer science can barely do, as it is in its DNA, so to speak, to define algorithms through *precision* and *correctness*. Computer scientists accept deviations only in human routines, and thus foreclose the possibility that not every repetition is identical; rather, each iteration of the routine introduces little deviations in each step (Deleuze 1994). We would even go so far as to say the discourse of the discipline of computer science conceptually excludes algorithmic practices, and hence the possibility of their deviations from the script. For cultural sociology, the assignation of deviations exclusively to humans seems problematic. The notion of an algorithmic precision and correctness seems to be rather part of the tale of an *algorithmic objectivity* discussed above, a quest for a higher rationality, where algorithms act autonomously and supercede human routines. In this tale, algorithms promise an identical repetition that allows for easy modeling and precise predictions. However, such *imaginaries* of algorithmic cultures, their promises and dreams, have to be distinguished from algorithms in practice.

In algorithmic cultures, we witness changes of social relations, for instance the emergence of highly customized relations. In Joseph Klett's contribution to this volume, he gives an example of the transition from digital stereo to "immersive audio" that exemplifies such a change. Stereo sound (the sound we get from traditional stereo speaker systems) operates with generic relations: each audio speaker establishes a fixed relation to a 'user,' which really is an invariant sensory apparatus located in a fixed point in space (the so-called 'sweet-spot').

In contrast, relations in algorithmically realized soundscapes are highly personalized. Klett shows how audio engineering, as with many other technological apparatuses, is moving from the use of algorithms as general mediators to the use of algorithms as highly specific mediators between technological devices and singular individuals. Such personalization allows for a much richer audio experience, because we do not have to find the optimal spot of sound exposure; instead, the sound is continuously adapting to our individual perspective. Inevitably, the transition from generic relations to dynamical adaptive relations through algorithms has consequences for social life. By adapting to individual bodies and subjects, personalization algorithms also change the very nature of social relations, disentangling and cutting off some relations and creating new ones. Personalization algorithms in noise-cancelling headphones are an example of such disconnections; they deprive social relations of acoustic communication. Thus, personalization algorithms create enclosures around the subjects where "the body becomes a part of the audio system" (p. 116). Together, body and device create a closed algorithmic culture.

In this day and age, algorithmic relations are not only enacted by and with humans, but also by and with algorithms themselves. There are indeed endless chains of algorithms governing one other. Understanding such relations will cast doubt upon the purported antagonism between humans and computer algorithms, between humans and algorithmic routines—antagonisms endemic to the proposals of computer science, approaches that generate notions like algorithmic objectivity and pure rationality. The crafted imaginary that reiterates and relies on the classic myth of a struggle between man and machine (as exemplified in mythical events such as Kasparov vs. Deep Blue) ignores human immersion in algorithms (such as the programmers' immersion in Deep Blue—their tweaking of the programming between matches to adjust to Kasparov's play). It bears repeating that the definition of algorithms as formal procedures focuses only on precise and identically repeatable processes, while the examination of practices and performances takes into account deviations and divergences. Unstable negotiations, slippage, fragility, and a proneness to failure are in fact important features of algorithmic cultures. In 'real life,' algorithms very often fail, their interactions and operations are messy. This is particularly true when they tumble in a sort of in-betweenness among other actors (algorithmic or not), where they tend to deviate from their initial aim as much as any other actant.

The emergence of failures has to do with the complexity of interactions. Interactions that are not only face-to-face or face-to-screen, but that also take place within complex assemblages, contribute to the production of errors and bugs. Countless examples of such failures can be found, from the (mis)pricing of "Amazon's $23,698,655.93 book about flies" (Eisen 2011), to the demise of *Knight Capital*, an algorithmic trading company that lost about US$400 million in a matter of 45 minutes due to a malfunctioning trading algorithm (SEC 2013, 6). Consequently, the everyday use of algorithms results in a mixture of surprise and disappointment. The astonishment often expressed when Amazon's recommendation algorithms correctly predict (or produce) our taste, and directly result in a purchase, goes hand in hand with complaints of how wildly off the mark they are. We have come to expect failing algorithmic systems and we have indeed become accustomed to dealing with them. Making fun of such failures has become a genre in itself: "@Amazon's algorithms are so advanced, I've been offered over 10,000 #PrimeDay deals and am not interested in any of them" (Davis 2015).

In his contribution to our volume, Shintaro Miyazaki explains the avalanching effect of "micro-failures" in algorithmic cultures. He shows how something that might seem miniscule, irrelevant, a small divergence in code, an almost indiscernible misalignment, can be leveraged to catastrophic results in algorithmic feedback processes. Miyazaki's historical case study of the AT&T Crash from 1990 shows that such failures have been part of algorithmic cultures from very early on. In this case, a software update in AT&T's telephone network created a feedback loop in which the entire system created an unstable condition from which it was not able to recover. While separate subsystems contained emergency routines that enabled each to automatically recover from cases of malfunction, the algorithmic feedback loops across subsystems caused interacting algorithms to turn one another off. This resulted in an algorithmic network with unproductive operations, which stem from what Miyazaki calls "distributed dysfunctionalities" (p. 130).

If we were to take seriously the fact that failure is an inevitable part of algorithmic life, then Miyazaki's analysis of "distributed dysfunctionality" has a further implication—namely, that distributed dysfunctionality may in fact be a process where a network of algorithms inadvertently creates a higher form of an *ultimate machine*. The prototypical ultimate machine was created by Claude E. Shannon. It has one, and only one, particular purpose—to turn itself off:

> Nothing could look simpler. It is merely a small wooden casket the size and shape of a cigar-box, with a single switch on one face. When you throw the switch, there is an angry, purposeful buzzing. The lid slowly rises, and from beneath it emerges a hand. The hand reaches down, turns the switch off, and retreats into the box. With the finality of a closing coffin, the lid snaps shut, the buzzing ceases, and peace reigns once more.
>
> (Clarke 1959, 159)

Because of its particular functionality, the ultimate machine was also named the *useless machine* or *leave me alone box*. The case described by Miyazaki may be understood as a more complex version of such a machine. In fact, it was not a single machine that turned itself off, but rather a chain of machines performing algorithmic interactions, so that each machine turned its neighbor off, right at the moment when the neighbor's recovery operation had been completed. While a simple ultimate machine still requires humans to flip the switch, algorithmically distributed dysfunctionality incorporates this function, creating a stable instability that requires non-algorithmic actors to end those dysfunctional and the nonproductive routines. This is a case of an algorithmic practice where algorithms start to act and interact according to a pattern that had not been inscribed into

them, making them essentially unproductive. One might describe such a machine as an algorithmic Bartleby, where the demand to initiate routines is countered by the algorithmic expression *I would prefer not to*. Such a description has perplexing explanatory value, especially if we contrast it with our earlier definitions of algorithms as routinized unfolding. As much as Bartleby's refusal affects the daily routines at work, algorithmic dysfunctionality also addresses those routines, undermining them and making them *unproductive*.

Cases of unstable algorithms are not unusual. In algorithmic trading, it is not uncommon for traders to have to force algorithms out of unstable conditions. For instance, software bugs or feedback loops might cause an algorithm to flicker around thresholds, where it continuously places and cancels orders, etc. (Seyfert forthcoming). Even though the phenomenon is very difficult to trace, some scholars have also argued that many unusual market events can be explained by such non-productive routines (Johnson *et al.* 2012; Cliff *et al.* 2011; Cliff and Nothrop 2011). To give an example, an initial analysis of the Flash Crash of 2010 suggested that such non-productive algorithmic interactions might have been the culprit. The Flash Crash describes a very rapid fall and consecutive recovery in security prices. The Joint Report by the Commodity Futures Trading Commission and the Security Exchange Commission in the United States described it in the following way:

> At about 2:40 in the afternoon of May 6, prices for both the E-Mini S&P 500 futures contract, and the SPY S&P 500 exchange traded fund, suddenly plunged 5% in just 5 minutes. More so, during the next 10 minutes they recovered from these losses. And it was during this recovery period that the prices of hundreds of individual equities and exchange traded funds plummeted to ridiculous levels of a penny or less before they too rebounded. By the end of the day everything was back to 'normal,' and thus the event was dubbed the May 6 Flash Crash.
>
> (CFTC and SEC 2010a, 3)

According to this Joint Report, high-frequency traders (relying on algorithms)

> began to quickly buy and then resell contracts to each other—generating a 'hot potato' volume effect as the same positions were rapidly passed back and forth. [...] HFTs traded over 27,000 contracts, which accounted for about 49 percent of the total trading volume, while buying only about 200 additional contracts net.
>
> (CFTC and SEC 2010a, 3)

This *hot potato effect* is another iteration of distributed dysfunctionality, an unproductive routine that inadvertently subverts the productivity paradigm of the financial markets.

One reason for the emergence of failures in algorithmic practices has to do with the fact that interactions with and among algorithms often tend to be misunderstood. In his contribution, Valentin Rauer shows in two case studies the

problems in assessing algorithmic agency. In algorithmic cultures, traditional interactions through deictic gestures have been replaced by what Rauer calls "mobilizing algorithms." While face-to-face interactions allow for deictic gestures such as *this* or *you*, interactions over distance require intermediaries. Mobilizing algorithms have become such intermediaries, operating to a certain extent autonomously. Examples are automated emergency calls that serve as functional equivalents to deictic gestures (Mayday! Mayday!). Rauer shows that the introduction of such algorithmic intermediaries leads to varying scales and ranges in capacities to act. Such scaling processes make the notion of a purely algorithmic or human agency problematic. Self-sufficiency and complete independence are thresholds, or rather each constitutes a limit that is never fully reached in either humans or algorithms. But in public discourse, such scales of agency are ignored and obfuscated by strong imaginaries. The problems with these imaginaries become especially visible at the moment of algorithmic breakdowns. Rauer illustrates this with the case of a "missing algorithm" that ultimately led to the failure of the Euro Hawk drone project. In this particular circumstance, a missing algorithm caused the drone to fly on its first flight "unguided and completely blind, posing a real threat to anything in its vicinity" (p. 146). That particular algorithm was 'missing,' not as a result of an unintentional error, but rather, because the drone was supposed to be guided—that is, governed—by an acting human. Thus, the prototype of Euro Hawk operated with a strong notion of human agency—an agency that always masters its creations—while the agency of the drone was underestimated. The *missing algorithm* shows that failures and messiness are crucial to algorithmic practices.

Paradoxical as it seems, a missing algorithm is part of the messiness in algorithmic practices, a messiness that is also the reason for the promises and dreams inherent in algorithmic cultures. That is to say, the fulfillment of this dream is *always one step away* from its completion. There is always only one more algorithm yet to be implemented. In other words, it is only such constant algorithmic misalignments that explain the existence of promises and hopes of a smooth algorithmic functionality. If everything were functioning smoothly, these promises would be superfluous and would simply disappear. Strictly speaking, the dream of algorithmic objectivity, of smooth operations and efficiencies, of autonomy and the hope of a higher rationality, makes sense especially in contrast to constant failures.

Furthermore, misalignments and failures in algorithmic cultures are not only due to missing algorithms and bugs, but may precisely be attributable to the mismatch between the expectations of algorithmic rationality, agency, and objectivity inscribed in the codes on the one hand, and actual algorithmic practices on the other. When algorithms enter into socio-technical assemblages they become more than just "Logic + Control." Thus, a cultural analysis of algorithms cannot just include the technical niceties of codes and technical devices, i.e., their technical functionalities; it will also need to focus on the complex of material cultures, technological devices and practices. Hence, it is problematic when contemporary studies of algorithms primarily focus on the creepiness and

suspicious nature of algorithms, which are hinted at in conference titles such as "The Tyranny of Algorithms" (Washington, December 2015). Such perspectives not only ignore the very mundane nature of the disappointments caused by algorithms but also the logical dynamics between promise and disappointment operating in algorithmic cultures. These studies tend to conflate the industries' imaginaries of rationality, autonomy, and objectivity with actual practices. They (mis)take the promises of those who construct and, most importantly, sell these systems for the realities of algorithmic cultures. Where they should be analyzing the 'legitimation through performance' of algorithmic cultures, they end up criticizing imaginaries and their effects, irrespective of the praxiological processes of actualization (or non-realization) of these imaginaries. In their preferred mode of criticism they fall prey to what Mark Nunes has called "a cybernetic ideology driven by dreams of an error-free world of 100 percent efficiency, accuracy, and predictability" (2011, 3). Consequently, by overestimating the effectiveness and by ignoring the messiness and dysfunctionality of algorithmic practices, these cultural and social analyses take on the character of conspiracy theories in which "secret algorithms control money and information" (Pasquale 2015).

The rather conspiratorial attitudes towards algorithms might also be explained by the sheer magnitude of the ambiguity that is involved in algorithmic cultures. Algorithmic practices, where we use and where we are being used by algorithms, involve tacit knowledge. Most of us use algorithms every day, we govern them every day, and we are governed by them every day. Yet most of us do not know much about the algorithmic codes of which these algorithmic assemblages are made. This non-knowledge makes us suspect something uncanny behind the screen, something that is fundamentally different from the intentions of our human companions. It is the lack of information that leads some human actors to ascribe intentions to all algorithmic activities, a general attitude of suspicion that Nathalie Heinich has called the "intentionalist hypothesis," that is, a "systematic reduction of all actions to a conscious (but preferably hidden and thus mean) intention" (Heinich 2009, 35). It is this ambiguity that makes the analysis of algorithmic cultures in social and cultural studies particularly germane. The production, usage, and failure of algorithmic systems are stabilized by cultural narratives that resort to powerful imaginary expectations. Thus, in order to see this tension between practices and imaginaries, to grasp algorithmic cultures in their constitutive tension, it is not enough to focus on the cultural narratives of those who explain and promote algorithmic systems and on those who express conspiratorial fears: focus on the algorithmic practices themselves is also required, for it is here where failures are most visible.

Cultivating algorithmic ambiguity

Because algorithmic circuits are interactions between very different human and non-human actors, they are ambiguous, and it becomes particularly difficult to locate agency and responsibility. Consequently, algorithmic circuits and interactions present a challenge, not only to the scholars in social sciences and cultural

studies. Interpretations vary widely, and the distribution of agency and the attribution of responsibility shifts, depending on the epistemic formations of the interpreters of particular events. While some authors like Miyazaki focus on pure algorithmic interactions (Miyazaki [in this volume]; MacKenzie 2015; Knorr Cetina 2013), others conceive of them as distributed functionality between humans and algorithms, as "blended automation" (Beunza and Millo 2015), while some even go so far as to see in algorithms nothing but instruments of human agency (Reichertz 2013). Political systems especially tend to resort to the last view, in particular when things go wrong and accountable actors need to be named. Here, the Flash Crash of 2010 and its interpretation by the Security Exchange Commission in the United States is a particularly apt example. The rapidity of the fall in stock market prices and their subsequent recovery led to fingers being pointed at the interactions of trading algorithms of high-frequency traders. Early interpretations especially took this event as a new phenomenon, an event resulting from the interaction of complex technological systems ('hot potato effects'). However, as time went by, human rather than algorithmic agency was increasingly deemed accountable. A comparison between the first report of the Flash Crash by the CFTC and SEC from May 18 (CFTC and SEC 2010a) and the second report from September 30 (CFTC and SEC 2010b) shows an increasing focus on the inclusion of individual actors and their intentions. While the first report also includes the possibility of inter-algorithmic feedback loops (the aforementioned 'hot potato effects'), the most recent report from 2015 does not mention algorithmic interactions or any type of complex feedback loops. Instead, it points to a human trader, London-based Navinder Singh Sarao, who was the single individual actor named as being connected to the event (CFTC 2015a and b). Such reductionist explanations are highly contested within the field. For some, it seems highly improbable that a single trader can intentionally create such an impact on a trillion-dollar market (Pirrong 2015). If his activities did indeed contribute to the Flash Crash, then, it has been argued, it was rather as an unintentional butterfly effect, as conceptualized in complexity theory (Foresight 2012, 71–72).

However, as this example of the slow transition from blaming algorithmic interactions to blaming human intentions shows, the interpretation of algorithmic failures greatly depends on the epistemic paradigm used by the interpreter. That is to say, each interpretation stems from a particular way of sense-making, which includes the devices used to access an event. While information science, media studies, and STS have no problems ascribing agency, responsibility, and accountability to emergent phenomena stemming from inter-algorithmic events, the same is not true for political systems (or market authorities for that matter) that (still) tie responsibility to human actors. It is safe to say that the political system itself created the pressure on the SEC and CFTC to present an accountable actor with which traditional juridical systems can operate. Algorithms are certainly not (yet) among those. As we have seen, the emergence of algorithmic cultures is also accompanied by the blurring of clearly defined flows, creating an atmosphere of uncertainty about the identity of interactional partners.

Thus, one of the most important questions within algorithmic cultures is always "who we are speaking to" (Gillespie 2014, 192). In all types of social media platforms, the user needs to trust that s/he is interacting with an 'actual' user. That is especially important for economic interests, which rely on an unambiguous identification of senders and receivers of financial transmissions. Economic operations rest upon clear definitions of the party to whom (or which) we are speaking, for it is only then that we know the identities of those from whom we are buying or to whom we are selling.

In his contribution to this volume, Oliver Leistert shows that social media platforms solve this problem by operating with purification practices, which seek to ensure that our crucial communications are with 'real' users and real users alone. In turn, users need to believe that their counterparts are real, ergo, they need to *trust* the social media platform they are using. Thus, the "algorithmic production of trust" (p. 159) is one of the most important mechanisms of social media platforms. This is what such platforms actually *do*: rely heavily on trust to solve the problem of uncertainty. Leistert further describes the doubling mechanisms in conditions of uncertainty, where certain social bots are designed to *exploit the trust* that social media platforms painstakingly try to establish. He sees such social bots as machines that parasitically feed on our desires to be followed, to be ranked, and to be trending. As 'algorithmic pirates' they feed in various ways on 'pure' interactions. These desires can be exploited, for instance by the offer to 'automatically' feed it with fake followers, with bots that pretend to be 'real' followers. In addition, it is not uncommon for some—often commercial—users to buy followers on social media platforms. Another example is *harvesters* that attempt to friend as many users possible in order to extract user data. Not only do they feed on the desire of a particular user to enhance his/her popularity (through the increase in the numbers of followers), they also feed on the data flows that constitute the core business of social media platforms. Leistert hence describes real performative effects in algorithmic cultures. Not only is the general uncertainty regarding whom we are addressing exploited, the exploitation in fact increases uncertainty, even for bots. For instance, when 'social bots' mimic human users they increase uncertainty to the extent that they themselves become unsure whether or not they are still dealing with 'normal' users. Thus, bots themselves have to identify fake counterparts. On the one hand, algorithmic parasites pollute the pure interactions between 'normal' users that social media platforms try so hard to establish. But on the other hand, they too need to purify the pollutions their own actions have caused. In turn, what Leistert shows is how purification practices and parasitic bots performatively intensify and escalate the process of producing and reducing uncertainty.

The interpretations of algorithmic cultures are not just epistemic problems, questions of who is right or wrong. Where computer science defines algorithms as procedures or recipes for solving problems, approaches such as cultural sociology emphasize their performative effects, their recursive functions by which algorithmic practices not only create new problems, but also create the problems for which they are ultimately the answer. The performativity of algorithms is also (recursively) related to reflections in social and cultural studies itself.

Barocas and Nissenbaum (2014) have shown that the use of new technologies can initiate a reflexive process that helps us clarify already existing ideas. For instance, algorithmic practices do not simply, as is often suggested, challenge traditional notions of privacy, for instance in the context of Edward Snowden's revelations. Algorithmic practices such as Big Data do not simply threaten classic notions of individual privacy and anonymity, since they do not operate with classical features such as name, address, and birth place. Rather, they change the very definitions of what it means to be private and anonymous. By assembling algorithmic portfolios of the users they are tracing, they operate with entirely different features of their users, and thereby create new identities. Consequently, Facebook's shadow profile and what Google has rather cynically called our "anonymous identifier" (AdID) are effectively mechanisms in identity politics (Barocas and Nissenbaum 2014, 52–53). "Anonymous identifier" clearly differs from a classical identifier, in which identity corresponds clearly to names, addresses, social security numbers, and so on. The clarification of such conflicting definitions of basic terms is important because it might help us circumvent foreseeable misunderstandings in future political regulations.

For the understanding of algorithmic cultures, it is important to understand the multiplicity and entanglement of these imaginaries, epistemic views, practical usages, and performative consequences. For this reason, scholars in social sciences, cultural studies, and in particular, cultural sociology, should take heed and not mix up or conflate promises, imaginaries, and practical effects. This is not to say that we are reducing imaginaries to mere fantasies. Imaginaries are also real; they have real effects in algorithmic cultures, and thus need to be taken into account. However, the performative effects of imaginaries, and the performative effects of practices, do differ. It is important to be able to distinguish the two, and not only for cultural sociology.

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