



# Review of Communication

ISSN: (Print) (Online) Journal homepage: <https://www.tandfonline.com/loi/rroc20>

## Introduction: optimization and its discontents

Fenwick McKelvey & Joshua Neves

To cite this article: Fenwick McKelvey & Joshua Neves (2021) Introduction: optimization and its discontents, *Review of Communication*, 21:2, 95-112, DOI: [10.1080/15358593.2021.1936143](https://doi.org/10.1080/15358593.2021.1936143)

To link to this article: <https://doi.org/10.1080/15358593.2021.1936143>



Published online: 25 Jun 2021.



Submit your article to this journal [↗](#)



Article views: 412



View related articles [↗](#)



View Crossmark data [↗](#)



## Introduction: optimization and its discontents

Fenwick McKelvey <sup>a</sup> and Joshua Neves<sup>b</sup>

<sup>a</sup>Department of Communication Studies, Concordia University, Montreal, Canada; <sup>b</sup>Mel Hoppenheim School of Cinema, Concordia University, Montreal, Canada

### ABSTRACT

Optimization is seemingly everywhere and yet elusive. Our bodies, tools, and institutions are now understood as endlessly optimizable. But what does optimization mean? Or more crucially, what does it do? Who or what is optimized or dis-optimized? This themed issue introduces optimization as a critical concept to analyze the governance and governmentality of large technological infrastructures, platforms, and self-management apps. We define optimization as a form of calculative decision-making embedded in legitimating institutions and media that seek to actualize optimal social and technical practices in real time. Our Introduction outlines the techniques, legitimations, and social practices of optimization that have spread in many forms across the globe. By questioning optimization, our Introduction considers the social practices, geopolitical networks, and forms of organization (and violence) shored up by the desire for optimum performance.

### ARTICLE HISTORY

Received 16 May 2021  
Accepted 24 May 2021

### KEYWORDS

optimization; control;  
algorithm; governance;  
theory

Optimization may be regarded as the cornerstone of many areas of applied mathematics, computer science, engineering, and a number of other scientific disciplines. Among other things, optimization plays a key role in finding feasible solutions to real-life problems, from mathematical programming to operations research, economics, management science, business, medicine, life science, and artificial intelligence, to mention only several.

Optimization entails engaging in an action to find the best solution. As a flourishing research activity, it has led to theoretical and computational advances, new technologies and new methods in developing more optimal designs of different systems, efficiency, and robustness, in minimizing the costs of operations in a process, and maximizing the profits of a company.—Preface to the Second Edition, *The Encyclopedia of Optimization*<sup>1</sup>

That optimization is taken up by mathematics and engineering, daily news cycles, and popular (non)fiction indicates the degree to which the concept has penetrated cultural consciousness. Take “Always Be Optimizing,” a widely circulated chapter from Jia Tolentino’s *Trick Mirror*, exploring the confused desires and efficiencies that delimit gender ideals and shape current rituals such as barre or boxing classes, athleisure wear, and chopped salad fast food. “[T]he worse things get,” she writes, “the more a person is compelled to optimize.”<sup>2</sup> In recent months, such familiar refrains have shifted from satire to horror as optimized platforms—including contactless delivery and new understandings

of the “essential” worker—have generated massive new wealth for tech monopolies while putting marginalized communities at risk of infection and death.<sup>3</sup> Both Tolentino’s reflections and profiles of essential workers give a human face to what are otherwise abstract optimization processes: a generalized condition of living amidst technologies that seek to intervene in and maximize our lives, including our attachments to optimization itself.

This themed issue joins a growing body of research focused on questions of computational technologies, management, and logistics. We suggest that more than shoring up large infrastructures and platforms, *optimization* constitutes a kind of *operating system* for the present.<sup>4</sup> In this way, our approach to optimization in this Introduction focuses as much on social and cultural practices (e.g., ideas about the body, aspirations, habits, lifestyle, etc.) as it does the shifting power dynamics informing platforms and the data economy. This range resonates with concerns about how tech giants have optimized social and political behavior. Facebook CEO Mark Zuckerberg countered claims about the company’s ill effect by explaining to the press, “For many years now, I’ve prohibited any of our feed teams ... from optimizing the systems to encourage the maximum amount of time to be spent. We actually optimize the system for facilitating as many meaningful interactions as possible.”<sup>5</sup> Such claims are complicated by the proliferation of track and trace technologies shaping emergent habits, cultural space, and political norms.<sup>6</sup> Put differently, meaningful interaction and what Natasha Dow Schüll terms “addiction by design” seem to be two sides of the same coin.<sup>7</sup>

Optimizing practices are now willingly, even exuberantly, taken up by many people, “users,” aiming to enhance their own lives: in work, play, physical health, mental and emotional performance, relationships, sex, and much else. Optimization shapes expectations about the body, labor, and productivity, which, in the name of self-actualization or proficiency, consolidates new requirements for optimal performance. Always be optimizing. At the same time, optimization’s self-descriptions can be deeply misleading and are enmeshed with a wide range of contingent and inequitable norms. This is to say not only that such processes “are moving targets in a recursive system,”<sup>8</sup> but that they are shaped by social practices that may be anything but optimal. Consider essays in this themed issue that focus on optimization’s consequences for cultural production (Morris, Prey, and Nieborg), as the whiteness of computer history (Stevens, Hoffmann, and Florini), a way of simulating user experience (Uliasz), or a project that seeps into intimate realms such as deep sleep (Lyll).

Optimization is now a matter of life and death in a time of global pandemics. Health surveillance and risk modeling are among the key strategies to mitigating COVID-19, techniques Tania Murray Li might call “rendering technical” a biological problem.<sup>9</sup> Here, digital contact-tracing apps, with artificial intelligence and Bluetooth sensing, frame individual and public health as an optimization problem. These processes imagine how smart technologies embedded in everyday actions and locations might offer real-time solutions to slow viral spread. Limited in adoption and scale in much of the world, these promised health apps mostly provide, as one headline puts it, a little bit of “technology theatre” that showcases how digital networks might outsmart a biological outbreak.<sup>10</sup> Such computational technologies both predate the current pandemic and are tied to larger processes that seek to reorder human life. As Orit Halpern, Robert Mitchell, and Bernard Dionysius Geoghegan claim in “The Smartness

Mandate,” aspirations for technologies and cities to be *smart* depend on deeper beliefs in dynamic computational networks to produce “a more resilient human species—that is, a species able to absorb and survive environmental, economic, and security crises by perpetually optimizing and adapting technologies.”<sup>11</sup>

In this themed issue, we approach optimization as a keyword, an underexplored cultural and political process, and a critical concept for understanding our technologized milieu. We define optimization as *a form of calculative decision-making embedded in legitimating institutions and media that seek to actualize optimal social and technical practices in real time*. In what follows, our Introduction highlights how optimization is at once specific techniques, forms of legitimation, and subjectivities with deep historical roots in the management of bodies, capital, and empire.

### Optimization as technique

Optimization, in mathematics, “means finding the best solution among many feasible solutions that are available to us.”<sup>12</sup> Today mathematical optimization is a subfield devoted to techniques to calculate the optimal in linear and nonlinear systems. Consider that *The Encyclopedia of Optimization*, quoted in the epigraph, is over 4,500 pages long and names nearly every sector of our world. That this subfield has such a rich cultural life depends in part on the multitudes of a Cold War rationality that treated the world as a laboratory for mathematical innovations.<sup>13</sup> Networks, economics, urban planning, and business management, among many other fields,<sup>14</sup> applied a wide range of techniques “to design a system that optimizes a set of metrics subject to constraints.”<sup>15</sup> This definition reminds us that optimization is an ideal—operating on the logic of the demo or prototype<sup>16</sup>—that Louise Amoore rightly calls a “double political foreclosure” that includes “condensing multiple potentials to a single output that appears as a resolution to political duress.”<sup>17</sup> As such, it interprets and interacts with the world in ways that are not merely descriptive or calculative. Instead, techniques of optimization are world-building. They fold together multiple states and relations to create an abstract space to mathematically unify distinct functions in a reality as close to a calculated optimal as possible.

Here we want to make two points about the relationship between optimization and understandings of (human) development. First, optimization relies on longstanding colonial and scientific knowledges that apprehend self and social determination through the lens of development, progress, innovation, perfectionism, and so on. As Denise Ferreira da Silva puts it in her analysis of scientific notions of race, “development carries [at least two] significations: as an *end*, or something that expresses the higher, superior values of a particular collective, and as a *necessity*, which is a natural outcome of the operations of the laws of nature.”<sup>18</sup> That such teleologies are legitimated by appeals to dominant values and natural law is a reminder of the persistent dangers associated with optimal thinking. Second, and crucially, the ends and necessity of contemporary optimization projects have also been recast by computational networks, machine learning, data capitalism, and mass digitization.<sup>19</sup> No longer tied to clear endgames—cybernetic rationality, modernization paradigms, equilibrium, etc.—optimization is increasingly plastic, a cluster of real-time computational protocols that “deploys ideas of resilience and practices management without ideals of futurity or clear measures of

‘success’ or ‘failure.’”<sup>20</sup> What this shift means for ideas about race, policing, and governance, among many other issues of social and political concern, is thus critical for understanding the work of optimization in the present.<sup>21</sup>

Optimization techniques operate in at least three ways: quantification, de-situation, and formulation. Optimization, firstly, presumes there is data, or should be data, to solve a new problem. Here, we draw on historian Alan Desrosières’s history of statistical reasoning, in which he demonstrates that quantification and statistics are at once socially constructed and simultaneously *hold* to reality. Desrosières offers the useful term “adunation” to describe how “the national territory” becomes “a single space of equivalence,” at least quantitatively.<sup>22</sup> Through adunation of past and present, optimization can solve social and political problems mathematically.

Next, de-situation removes data from its context—a move that both turns specific data into information and abstracts actual practices into generic aggregates. Experiments are an important decontextualizing technique, perhaps clearest in the tendency for computer science to re-state situations as well-known problems in the field (e.g., the dining philosophers, the two generals, the traveling salesman, the diaper transport problem, the towers of Hanoi).<sup>23</sup> Consider the way that self-driving cars approach vehicular homicide through the Trolley Car Problem. MIT’s Moral Machine even made a crowd-sourced game out of the problem, asking visitors whether a runaway autonomous vehicle should kill three dogs and a cat or two men, one woman, and a baby. On such dilemmas, Amore observes that “the madness of the trolley decision is that it must necessarily be made in the darkness of non-knowledge, that is categorically not subject to pre-programming to optimize any outcome.”<sup>24</sup> Following Amore, thought experiments not only de-situate and produce non-knowledge, but also invite known solutions to be *formulated* so as to allow for the calculation of an optimal state in a new context. Here, we can look to studies of specific optimization formulas such as Theodora Dryer’s histories of confidence intervals<sup>25</sup> or William Cook’s history of the Traveling Salesman Problem (a classic problem in computer science described as finding the best route for a salesman selling their wares across the United States). The Traveling Salesman Problem has been formulated in many ways, including transportation, social networking and even manufacturing. Mathematical optimization, indeed, the computing industry, strives for more efficient, more effective solutions to these classical problems.<sup>26</sup> That 100-year-old problems are still being solved with “better” algorithms and advanced computing suggests the deeply contingent nature of such processes.<sup>27</sup>

Calculated optimums make judgements in the name of pure mathematics or natural law. Even when the optimal state might be emergent, there is a relationship formed between calculation and existence—an ideal calling to be actualized in the world. Optimization, in other words, creates suboptimality. Finding optimal moves in game theory concurrently found suboptimal moves in human behavior. As Paul Erikson et al. write in their history of Cold War rationality, “[b]y emphasizing the divergence between actual human reasoning and standards of formal rationality such as logic and Bayesian statistics, [behavioral psychology] implicitly reinforced the normative authority of the latter.”<sup>28</sup> After escaping Cold War laboratories, optimization now shadows every human move. These literal “technologies of the self” shape new expectations about bodily performance, such as creativity and concentration in our jobs, proliferating forms of “cosmetic neurology,” and much else besides, often evacuating any

countercultural sense of self-experimentation in the name of economic imperatives.<sup>29</sup> But what happens to our bodies, vulnerable communities, and understandings of society under conditions of perpetual adaptation and improvement?

Scholars in the humanities and social sciences can contribute to a critique of the many transitions and consequences briefly suggested above—developmentalism, racism, habituation, datafication, abstraction, etc.—by locating calculative decisions and imperatives in actual social worlds. What matters here is less the validity of a given set of calculations and more the recognition of the simple fact that techniques of optimization seek to reorder the world by implementing new demos or prototypes.

## Optimization as legitimation

Techniques of optimization are inert without being adopted and applied to the world. The embrace of optimization requires attention to changing institutional forms that, first, allow mathematical decisions to be taken seriously as answers to social and other problems and, second, work to actualize optimal states in their organizations, management strategies, and product cycles. Our focus on optimization in this themed issue complements larger theoretical generalizations of power such as algorithmic governance, algocracy, data capitalism, and surveillance capitalism.<sup>30</sup>

Here optimization fits into a larger critique of reasoning, management, logistics, and capitalism that provide what Sheila Jasanoff calls “legitimizing devices.”<sup>31</sup> If, as we suggest above, contingent models of progress and perfection inform optimization techniques (e.g., through the language of best practices, mathematics, scientific ideas about race or gender, etc.), then legitimation operates by institutionalizing standards (e.g., in the form of law, policy, protocol, infrastructure, habit, etc.). This is what, in different contexts, Keller Easterling has termed “extrastatecraft,” David Graeber calls “the utopia of rules,” and Ruha Benjamin describes as “the New Jim Code.”<sup>32</sup> Importantly, norms, among other legitimating units, matter as much when they are followed as when they are disrupted: in each case they shape the conditions of possibility for entering or acting within a given system.

Consider the International Standards Organization (ISO), a non-governmental organization with bodies in 165 countries that “share knowledge and develop voluntary, consensus-based, market relevant” standards for global industries—from quality control, environmental waste, and workplace accidents to food safety, energy management, and IT security. The ISO sums up standards with a familiar refrain: “Think of them as a formula that describes the best way of doing something.” And: “When things don’t work as they should it often means that standards are absent.”<sup>33</sup> The ISO is just one of many institutions that transform optimal models into community and industry benchmarks. At the same time, the ISO is itself an industry, selling access to international standards documents such as ISO/IEC 27001, “Information Security Management,” for 166 Swiss Francs.<sup>34</sup> Such best practices are, of course, crucial to the global production and circulation of goods and services. Many such standards (e.g., ensuring the safety of food supply chains or managing the removal of dangerous waste) are infrastructural to the world system. But standardization also establishes specification, thresholds, and normative values, which is to say that such processes can be divisive and extractive. The harmonizing of intellectual property regimes through the Trade-Related Aspects of

Intellectual Property Rights agreement or what scholars have termed “platform imperialism” are just two such examples.<sup>35</sup>

In this way, diverse political and economic institutions consolidate both the aspirational horizons guiding optimization techniques and ground them in individual and social practices. Whether maximizing worker utility, minimizing surplus, standardizing trade, or, more recently, regulating dopamine, what matters here is the way that institutions grant legitimacy to certain optimization techniques—even when those techniques may be lacking. In an early example, the Project for the Scientific Computation of Optimum Programs (or Project SCOOP) sought to resolve the post-World War II conundrum of supplying Berlin by air. Herbert Simon and George B. Dantzig devised a model to optimize the Berlin Airlift, but “the air force lacked the computing capacity to deal with ... Project SCOOP’s original optimizing Berlin Airlift model” and for years “had to rely on nonoptimizing models” that achieved comparable results with much less computer capacity.<sup>36</sup> Here, an unreasonable faith in optimization allows for the substitution of a much less complex solution, without acknowledging its own limitations.

From this view, optimization’s legitimacy is deeply conjunctural—begging the question, “optimal for whom, where, and when?” This is also to ask how statistical optimization models translate in the boardroom, from management to employees, or inform structures of feeling or local practices? As Marina Welker observes in *Enacting the Corporation*, “how we construct corporations as actors has crucial entailments for how we assign responsibilities to them, and vice versa.”<sup>37</sup> Further, works such as Marc Steinberg’s *The Platform Economy*, which traces the rise of the platform concept in Japanese management theory, or Deborah Cowen’s *The Deadly Life of Logistics*, which examines the comingling of martial and industrial practices in shaping logistical space, offer useful illustrations of both optimization’s geographical specificity and universalizing thrust.<sup>38</sup> Cowen, for example, observes that the supply chain is the “paradigmatic space of logistics” and tells us much about contemporary structures of power. She continues:

It is no accident that the supply chain of contemporary capitalism resonates so clearly with the supply line of the colonial frontier. It is not only striking but diagnostic that old enemies of empire—“indians” and “pirates”—are among the groups that pose the biggest threats to the “security of supply” today. It is also incredibly revealing that these groups frame their struggle in explicitly anti-imperial terms.<sup>39</sup>

The institutionalization of standards thus draws our attention to processes of territorialization and deterritorialization that are the heart of globalization. Supply chains quantify and standardize global space and time as part of a “logistics revolution” that relies on “lean manufacturing, flexibility, just-in-time inventory systems, [and] ‘pull’ production,” among other calculative systems.<sup>40</sup> However, supply chains have specific limits demarcated by institutional influence and capacity, such as protecting global shipping lanes from maritime piracy, and are not fully integrated or reliable. While information has the capacity to flow at gigabit speeds, and is thus distinct from oceanic transport, it too relies on complex material infrastructures, including undersea cables, data centers, and orbiting satellites.<sup>41</sup> But supply chains, like signal traffic, also instantiate important geopolitical vectors. In this context, it is crucial to reiterate that neoliberal globalization has, in the name of economic optimums and equivalencies, generated massive

inequality.<sup>42</sup> Further, the space–time of contemporary inequity does not map neatly onto quaint models of the first and third world, core and periphery, but is amoeboid or fractal: the richest and poorest may now live as neighbors, worlds apart. In practical terms, it is difficult to reconcile the techno–economic justifications informing optimization techniques and institutions with the growing violence, injustice, and poverty that these systems both rely upon and generate.

So far, we have suggested that institutions actualize techniques of optimization by producing standards and connecting distinct spatial and temporal zones. This is to draw attention to the ways that logistics, organization, and related systems shape the distribution and localization of optimization—including its many frictions. One resonant example here is the shipping container. The result of a decades-long process of standardization, the shipping container has designed and redesigned ports, trucks, and ships, enabled by and enabling mathematical optimization to ensure the smooth flow of raw materials, manufacturing and assembly, and finished goods en route to global markets.<sup>43</sup> In tandem with logistics, concepts such as Fordism, Post-Fordism, Toyotism, and McDonaldisation help to elucidate the centrality of the transnational corporation for optimization strategies. Sociologist George Ritzer, in his study of hamburger giant McDonald's, emphasizes how the firm functions as a paradigmatic organization model focused on efficiency or, “finding and using the optimum method for getting from one point to another”; calculability that “emphasizes the quantitative aspects of products sold (portion size, price) and services offered (the time it takes to get the product)”; predictability: “the assurance that products and services will be much the same over time and in all locales”; and control over customers and franchises to modify behavior.<sup>44</sup> Never again can we think of an Egg McMuffin without thinking about its optimized ratios of egg, meat, cheese, and bun.

Institutions and standards *mediate* between top-down optimization techniques and more bottom-up social practices, considered below. In this context, the global uptake of smartphones, the Internet of Things, and related networks, are exemplary. Smartphones shape our everyday experiences of optimization, allowing for targeted, personalized nudges and feedback, that both track behaviors and offer data to users for their own personal interventions.<sup>45</sup> Google's “Selfish Ledger”—an internal video-thought-experiment made by the head of design at Google X—offers a vision of such processes by speculating about the ways our data, the “constantly evolving representation of who we are,” might be given volitional purpose. The video suggests that nudges and auto-recommendations could steer individuals and, in doing so, populations, toward goals such as environmental sustainability, better health, and even altruism. The provocation can be read as Google asking itself what to do with its power—how to optimize what and for whom? Here Google's optimization protocols trade in probabilities, seeking to maximize or minimize the likelihood of certain events or behaviors, like reducing hateful comments by tweaking its filtering algorithm.<sup>46</sup> In this context, smartphones and computational networks not only provide the built infrastructure and institutional legitimacies for optimization projects like that imagined by the Selfish Ledger, but can be understood to be too optimistic regarding their abilities to track users, shape behaviors, and delimit the future. We develop this idea by turning to social and cultural practices in the next section.



## Optimization as social practice

In *The Mythos of the Electronic Revolution*, James W. Carey and John J. Quirk note that “toward the end of the 19th century, Americans who had witnessed the destructive effects of industrialization were subject to a naïve yearning for a rebirth of native optimism and a resuscitation of the bright promises of science and technology.”<sup>47</sup> This native optimism appears perennial in North America and is increasingly constitutive of global imaginaries. Alongside the excitement surrounding the electronic revolution, Carey and Quirk continue, emerged a “rhetoric of the electrical sublime” that “invested electricity with the aura of divine force and utopian gift and characterized it as the progenitor of a new era of social life, which somehow reverses the laws and lessons of past history.”<sup>48</sup> This claim, among other works—David E. Nye’s *American Technological Sublime* and Rudolf Mrázek’s *Engineers of Happy Land*,<sup>49</sup> to name just two—underscores a basic connection between optimism and new technology within diverse projects to remake or optimize the world and drives understandings of the self and self-actualization. In this context, mythos refers to the deeper cultural context that makes the values of optimization appealing to people.

From engineers and political scientists to science fiction and countercultures, techno-optimism has been central to the emergence of the internet as a real and imagined space/object/practice. Consider the delirious disembodiment of John Perry Barlow’s “Declaration of Independence of Cyberspace,” released in 1996 at the site of the World Economic Forum, which begins: “Governments of the Industrial World, you weary giants of flesh and steel, I come from Cyberspace, the new home of Mind.”<sup>50</sup> In subsequent years, invocations of cyberspace and the technological sublime became an enabling force for early internet investment and adoption, including the dot-com bubble of the late 1990s, by imagining the internet as a technology of freedom. As Wendy Hui Kyong Chun argues in *Control and Freedom*, this faith in the baptismal power of technology relied on an understanding of the internet “as a medium of freedom,” but where “one is only free when one is in control.”<sup>51</sup>

The coupling of techno-optimism and control-freedom signals yet another key aspect for defining optimization as a critical concept. If above we propose that optimization idealizes and legitimates, then our aim in this section is to consider how such processes ground, and are in turn grounded by, social practices and desires. Two framing points are useful here. First, we understand the optimization of social practices and subjectivities to emerge in the space between aspiration and desire—where the former names the official structures shaping self and social actualization (Google, neoliberal economic policies, racism, cisheteropatriarchy, etc.), and the latter names the enacted and affective forms that trouble or exceed those expectations. In this way, desire and aspiration are at once mutually constitutive and conceptually distinct.<sup>52</sup> Second, as gestured to above, optimizing techniques and institutions increasingly enfold people, so-called users, into recursive systems that operate on the logic of the demo or prototype. As Fred Turner puts it, prototypes “belong to a way of looking at the world in which individuals constantly remake themselves, in which they test themselves against the world and, if they find themselves wanting, improve themselves.”<sup>53</sup> Put simply, the ends of optimization are without end. Just as abstracted optimization techniques imagine plastic and resilient subjects capable of constantly testing bodily and social limits, so too do actual people and communities enact their own optimizing projects, reshaping the present and future.

Optimization, in other words, produces its share of discontents. In this context, it is tempting to think of various responses to, or ways of inhabiting, optimization projects as forms of counteroptimization. This line of thinking no doubt has potential—not the least of which is to underscore concrete acts of resistance to dominant ideologies and technologies. But more than resistance, such everyday actions, habits of living, and forms of organization must be understood to be ordinary and constitutive. This is also to underscore a key impetus for this themed issue’s focus on the cultural, mediating, and communicative aspects of optimization. What technical and scientific understandings of optimization neglect or fail to observe are not, in this sense, absent or even unusual (e.g., counter to or outside of optimization). Rather, these gaps in understanding are epistemological and produced by the commitments of specific fields of research and development (e.g., computer programming, management, the life sciences) whose orientation brings certain aspects into focus while obscuring others.

In contrast to artists’ hacks or debates in media theory, recent efforts by Black and Indigenous scholars, activists, and abolitionists to defund police departments, ban facial recognition, and “reimagine the default settings of technology and society”<sup>54</sup> offer a different response to knowing and acting upon control technologies. These responses simultaneously resist hegemonic optimums and seek to instantiate new ideals, legitimacies, and ways of living in their place. Many such projects, including the Abolition Collective’s *Making Abolitionist Worlds* or Tiffany Lethabo King’s *The Black Shoals* work to take apart and create social and political worlds in the name of equality and reparative justice, and against white supremacy and structural violence.<sup>55</sup> Safiya Umoja Noble’s analysis of Google’s search results as “technological redlining” and “algorithmic oppression,” is also exemplary here. Against such formulations, Noble insists that we return the “missing social and human context” to algorithmic decision-making, and attend to the constitutive ways that anti-Blackness, sexism, and social inequality are baked into technological innovation.<sup>56</sup> Thinking with Jason Edward Lewis, Noelani Arista, Archer Pechawis, and Suzanne Kite, optimization is a colonial desire to control *with* and *through* technology. Indigenous epistemologies offer ways to think against optimization and reimagine our relations between and amongst machines.<sup>57</sup>

Beyond technologized aspirations—such as those observed by Jonathan Crary in *24/7*, including anti-sleep pills for soldiers—social practices must also be understood to include informal infrastructures, radical forms of self-care, mutual aid, and local cosmologies not centered by dominant optimalities.<sup>58</sup> This is to call attention to a gap between optimization’s idealized user and use, and the ways that actual people and practices fail to inhabit articulated norms—and in so doing create new social worlds.<sup>59</sup> Put simply: optimization need not be limited to official modalities and life-worlds (as is generally the case in studies of optimization). Instead, what Alessandra Renzi (echoing many other such works) terms “counter-modelling” to describe the forms of life carved out by *kampung*s or informal settlements in Jakarta, Indonesia, is redolent here. In neighborhoods targeted by urban reforms, Renzi observes, “counter-modelling brings together a variety of alliances, strategies and tools in the hope to change the material and discursive function of the kampung in the city.” Such alliances create unofficial institutions able to both dispute city planners’ optimal designs and legitimate the local expertise and traditions.<sup>60</sup>

While Jakarta may be far afield for a largely North American communication studies readership, the point is not to locate such inhabitations elsewhere, but rather to understand locally valid social practices *as best/just practices for otherwise worlds*.<sup>61</sup> This is both to reject the technological determinism informing optimization discourse, and to underscore the many ways optimization fails to meet the needs of most people—how it abandons, exhausts, and eliminates. Techniques of optimization are simultaneously hegemonic (i.e., tied to speculative finance, neo-imperial logistics, Euro-American norms, whiteness, etc.) and necessarily partial, biased, and decontextualized. In other words, optimization’s demo or beta logic approaches everyday life as a testbed or clinical trial, where untested solutions circulate in the name of the coming fix. Against this thrust, shifting attention away from optimization’s ideals and institutions, and toward locally grounded practices and legitimacies, has the potential to animate new understandings of optimization as a critical concept—in media, cultural, and communication studies and beyond.

## Toward critical histories of optimization

There can be no complete history of optimization. But there are tendencies and moments that bring into relief its organizational power—that is, the ways optimizing processes arrange and have arranged human and nonhuman worlds. The techniques, legitimations, and practices discussed above have circulated across different situations and territories, both near and far, borrowed and stolen. We can understand today’s enthusiasm for optimization as a culmination of more than a century’s investment in communication, control, and calculation. Here we briefly identify four frames integral to the history of optimization and its impact in and on the present: empire, war, neoliberalism, and platforms.

### Empire

One such tendency can be found in the infamous abolitionist diagram of the slave ship *Brookes*,<sup>62</sup> examined by Simone Browne in *Dark Matters*,<sup>63</sup> among other scholars. The diagram orients our own focus in this Introduction toward optimization as an operation of power, a quantification of human suffering, and a technique of empire. The abolitionist image details the inhuman spaces of confinement whereby kidnapped enslaved people were stolen across the Middle Passage. It depicts over 400 Black bodies “stowed” in spaces with a height measuring two feet seven inches—men, women and children separated into different parts of the ship to maximize human cargo. Designed to draw attention to the horror of slavery, the diagram also shows how calculative reasoning and speculative finance inform every inch of the ship’s design, and indeed the global economy in the age of so-called Enlightenment. The ship’s dimensions are calculated to maximize the transports of enslaved people while minimizing the risk of death, disease, and mutiny—an act compounded by the underwriting of losses by insurance companies and financial ventures. Even in such conditions of horror and “social death,” many people rebelled, escaped, or chose to jump ship and die at sea.<sup>64</sup>

The slave ship *Brookes* example captures the role of optimization as a technique of “racial capitalism,” Cedric J. Robinson’s term for how capitalism’s “development,

organization, and expansion ... pursued essentially racial directions, [and] so too did social ideology.”<sup>65</sup> So too did optimization. European empires—Germany, France, and Britain—developed statistics to help manage territories, trade, extraction, and colonized peoples on a global scale. These techniques were rooted in the state social sciences that Michel Foucault described in his lectures on apparatuses of security, considering how:

the apparatus of security inserts the phenomenon in question, namely theft, within a series of probable events. Second, the reactions of power to this phenomenon are inserted in a calculation of cost. Finally, third, instead of a binary between the permitted and the prohibited, one establishes an average considered as optimal on the one hand, and, on the other, a bandwidth of the acceptable that must not be exceeded.<sup>66</sup>

Foucault’s comments resonate with changes in statecraft and governance in Germany, France, and the Britain that Desrosières attributes to various forms of state statistics. And while the history of statistical management is no doubt important, the *Brookes* example also insists that optimizing techniques are rooted colonial exploitation, chattel slavery, and other dominations, and have always relied on erasing certain people and histories from its calculations. Instead, what Browne terms “the view from ‘under the hatches’” and the “‘absented presence’ of blackness” offer important challenges to histories of the optimization of control.<sup>67</sup>

Further, the *Brookes* sailed the Triangle Trade route—rum, slaves, and cotton—that organized the British Empire. The abolitionist diagram, then, reminds us of the scales of optimization articulated by such vessels as part of trade routes that Harold A. Innis once described as constitutive of the price system and now global supply chains.<sup>68</sup> Simultaneously, the *Brookes* foreshadows the rise of scientific management and control through communication in American business. The capitalist organization of slavery was a laboratory for data-driven management that shaped all sectors of society. Here da Silva’s ends and necessities reverberate.<sup>69</sup> As historian Caitlin Rosenthal argues,

planters paid more attention to labor productivity than did many northern manufacturers, foreshadowing the rise of scientific management in the 1880s and beyond. They excelled in determining the most labor their slaves could perform and in pushing them to attain that maximum.<sup>70</sup>

Following scholars such as Lisa Lowe, this is to say that “the fortunes created by the slavery-based societies in the Americas gave rise to the French bourgeoisie, producing the conditions for the ‘rights of man’ demanded in the Revolution of 1789.”<sup>71</sup> In this way, slavery, among other forms of imperial and settler violence, dispossession, and killing, was integral to the emergence of optimization and yet largely ignored by its official histories.

## War

Contemporary understandings of optimization are further consolidated by social digitization in the aftermath of World War II. The imbrication of Cold War social sciences, computing, and information theory marked an intensification of social quantification that demarcates the general period of comparable techniques, institutions, and ideologies that might benefit from a concept such as optimization. Though best known in the United States, these cyborg sciences had variations that still haunt specific optimizations

today.<sup>72</sup> If Desrosières emphasizes the relationship between space and equivalence, then Donna J. Haraway helps us recognize the scale of digitization as an “informatics of domination.”<sup>73</sup> The cyborg sciences led to three breakdowns: between human and animal, organism and machine, and physical and non-physical. They function as foundational aspirations and discourses that hold to the world and enable new institutions—particularly institutions related to the U.S. academic–industrial–military complex—to apply mathematical techniques (e.g., game theory and linear programming) to social problems. Optimization’s success owes much to the success of Operations Research and Systems Analysis that adapted cybernetics to be what historian Andrew Pickering calls a “general theory of everything.”<sup>74</sup> These applications, as we discussed in relation to Project SCOOP above, were partial, limited, and prone to failure. There is a real tragedy in these techniques too as pacifists, socialists, and humanitarians turned toward optimization as a way out of the insanity of nuclear war or capitalism only to find new articulations of power.

### **Neoliberalism**

Neoliberalism, and more precisely financialization, integrated and propagated these cyborg sciences into a globalizing financial system. While there has always been perhaps a conflation of the optimal and the profitable, optimization must now be considered in the aftermath, and in the disjunctures, of global capitalism. Financial engineering applied optimization to the economic system in unforeseen ways. Indeed, the embrace of cybernetics in economics allowed for the market to be seen as an information processor.<sup>75</sup> Today the field of mechanism design considers market engineering as a form of optimization. These innovations occurred against the backdrop of regulatory liberalism, privatization, and speculation that experimented with all sorts of financial optimization techniques. The state’s shift to regulatory liberalism legitimated this experimentation as the so-called entrepreneurial state privatized its innovations, shifting the locus of the cyborg sciences from the state to the corporation. Institutions of global finance and rhetorics of neoliberalism transformed such practices into global ideologies, with economic reason and self-entrepreneurialism as the new values shaping a “greed is good” business culture in the 1980s and beyond.<sup>76</sup>

### **Platforms**

A final major development in a study of optimization involves the turn toward platforms-as-infrastructure that function as global operating systems to program globalization in close to real-time.<sup>77</sup> September 23, 2008, is as good as any date for the beginnings of this period. A little over a year after the U.S. launch of Apple’s iPhone (June 29, 2007), Google launched its own competitor named Android. Part of a play to capture the future of mobile search, Android marked the expansion of the internet into a more ubiquitous networked operating system—a sort of global base coordinated by Google (now Alphabet), alongside tech giants in other parts of the world. Phones became one sensor, so to speak, that added to Google’s emphasis on internal data analytics, part of what Nick Srnicek identifies as its business innovation in using internal data to optimize itself.<sup>78</sup> Google’s Android exemplifies a wider turn in technology firms that is simultaneously

more granular and far reaching. Every touch of the screen becomes a moment to experiment—or A/B test—the results of which allow for the plasticity of optimization discussed earlier to now focus on short-term behavioral responses. If the world has become a laboratory, according to Rebecca Lemov, then platforms-as-infrastructure has only extended the scale, scope, and tempo of the laboratory well beyond past ambitions.<sup>79</sup>

## Conclusion and preview of essays

At the start of this Introduction, we offered a provisional definition of optimization that bridges the key themes taken up by the contributions to this themed issue of *Review of Communication*. This includes the specific techniques of calculation, the institutions that legitimate these techniques, and the actual social and media practices (re)animating optimization. Never neutral, these facets must also be situated within the histories of colonialism, capitalism, and control that have nourished them. But optimization is never complete. Our working definition, then, begins from optimization's official modalities and self-descriptions but also works to render, at least conceptually, those aspects that are obscured, exploited, or erased by much of the existing scholarship about optimization. In this way, our themed issue both brings together four new essays centered on optimization in media and culture, and is a call for new critical scholarship tracing the entanglements overlooked in optimization's formal definitions, including the dis-optimized, counteroptimizations, and other radical re-appropriations of technology invested in remaking optimization itself.

In “The Unremarked Optimum,” Nikki Stevens, Anna Lauren Hoffmann, and Sarah Florini resituate classic works of the so-called database revolution within a larger history of racialized control. Through an analysis of Edgar F. Codd's “relational model,” Jean-Raymond Abrial's “data semantics,” and Peter Pin-Shan Chen's “entity relationship diagram,” the authors show how projects to model data and database use—including debates about convenience, efficiency, and natural representation—do much more than seek solutions for optimization problems. Instead, they consolidate prototypical whiteness as a design telos or optimum in ways that continue to inform today's computer databases. Moving beyond Cold War rationality and models in “Optimize User Experience,” Rebecca Uliasz examines the “good enough” solutions that distinguish contemporary algorithmic optimization. Centered on algorithmic markets for online ads, Uliasz traces a shift from John von Neumann's cellular automata to the Facebook pixel, considering how current tensions between automation and optimization both shape the platform economy and reframe familiar questions about prediction, plasticity, and the “human in the loop.”

In “The Ambivalent Assemblages of Sleep Optimization,” Ben Lyall takes up user optimization from the perspective of sleep-monitoring apps, wearables, and related projects to sense, manage, and optimize rest and non-waking hours. Drawing on participant interviews and data, Lyall analyzes how consumer self-tracking technologies both transform ideas about sleep, vitality, and productivity, and highlight expanding “data frontiers” marked by ambivalences about surveillance and agency, data as truth, and data as intervention. Finally, in “Engineering Culture,” Jeremy Wade Morris, Robert Prey, and David B. Nieborg introduce “cultural optimization” as a condition shared by cultural

workers dependent on platforms for exposure, access, and revenue. At a moment when the producer has turned to data analytics, the authors helpfully look at both the operations of optimization that manage platforms and how creators internalize these optimizations to make music, games, and apps that fit the platforms.

## Acknowledgements

Both Guest Editors wish to thank Clemens Apprich for his feedback on an earlier version. Fenwick McKelvey wishes to thank Rob Hunt, Janna Frenzel, and Dominique Alexandre for participating in a reading group about optimization; Seda Gürses, Nick Seaver, and Luke Stark for their early interest in the concept of optimization and helping to begin this journey; and Elinor Carmi and Niels ten Oever for developing an approach to networked optimization.

## Funding

Fenwick McKelvey is supported in part by funding from the Social Sciences and Humanities Research Council of Canada. Joshua Neves' research was undertaken, in part, thanks to funding from the Canada Research Chairs Program.

## ORCID

Fenwick McKelvey  <http://orcid.org/0000-0002-7584-1133>

## Notes

1. Christodoulos A. Floudas and Panos M. Pardalos, eds., *Encyclopedia of Optimization*, 2nd ed. (New York: Springer, 2009), np.
2. Jia Tolentino, "Always Be Optimizing," in *Trick Mirror: Reflections on Self-Delusion* (New York: Random House, 2019), 66.
3. "Communities, Schools, Workplaces, & Events," *Centers for Disease Control and Prevention*, April 30, 2020, <https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/race-ethnicity.html>; Joshua Neves and Marc Steinberg, "Pandemic Platforms: How Convenience Shapes the Inequality of Crisis," in *Pandemic Media: Preliminary Notes Toward an Inventory*, ed. Philipp Dominik Keidl, Laliv Melamed, Vinzenz Hediger, and Antonio Somaini (Lüneburg, Germany: Meson Press, 2020), 105–14.
4. Fenwick McKelvey, *Internet Daemons: Digital Communications Possessed* (Minneapolis: University of Minnesota Press, 2018); Keller Easterling, *Extrastatecraft: The Power of Infrastructure Space* (New York: Verso, 2016).
5. Anthony Ha, "Mark Zuckerberg Makes the Case for Facebook News," *TechCrunch*, October 25, 2019, <https://social.techcrunch.com/2019/10/25/mark-zuckerberg-facebook-news/>.
6. Nigel Thrift, *Knowing Capitalism* (Thousand Oaks, CA: Sage, 2005), 219–20.
7. Natasha Dow Schüll, *Addiction by Design: Machine Gambling in Las Vegas* (Princeton, NJ: Princeton University Press, 2014).
8. Orit Halpern, Robert Mitchell, and Bernard Dionysius Geoghegan, "The Smartness Mandate: Notes Toward a Critique," *Grey Room* 68 (Summer 2017), 110.
9. Tania Murray Li, *The Will to Improve: Governmentality, Development, and the Practice of Politics* (Durham, NC: Duke University Press, 2007), 7.
10. Martin French et al., "Corporate Contact Tracing as a Pandemic Response," *Critical Public Health* (October 8, 2020): <https://doi.org/10.1080/09581596.2020.1829549>; Sean McDonald, "Technology Theatre," *Centre for International Governance Innovation*, July 13, 2020, <https://www.cigionline.org/articles/technology-theatre/>.

11. Halpern, Mitchell, and Geoghegan, “The Smartness Mandate,” 107.
12. Rajesh Kumar Arora, *Optimization: Algorithms and Applications* (New York: Chapman & Hall/CRC, 2015), 1, <https://doi.org/10.1201/b18469>.
13. Paul Erickson et al., *How Reason Almost Lost Its Mind: The Strange Career of Cold War Rationality* (Chicago: University of Chicago Press, 2013); Rebecca Lemov, *World as Laboratory: Experiments with Mice, Mazes, and Men* (New York: Farrar, Straus and Giroux, 2005).
14. McKelvey, *Internet Daemons*; Philip Mirowski, *Machine Dreams: Economics Becomes a Cyborg Science* (Cambridge: Cambridge University Press, 2002); Jennifer S. Light, *From Warfare to Welfare: Defense Intellectuals and Urban Problems in Cold War America* (Baltimore, MD: Johns Hopkins University Press, 2005); Andrew Pickering, “Cyborg History and the World War II Regime,” *Perspectives on Science* 3, no. 1 (1995): 1–48.
15. Mykel J. Kochenderfer and Tim A. Wheeler, *Algorithms for Optimization* (Cambridge, MA: MIT Press, 2019), 1.
16. Daniel Kreiss, *Prototype Politics: Technology-Intense Campaigning and the Data of Democracy* (Oxford: Oxford University Press, 2016); Fred Turner, “Prototype,” in *Digital Keywords: A Vocabulary of Information Society and Culture*, ed. Benjamin Peters (Princeton, NJ: Princeton University Press, 2016), 256–68.
17. Louise Amoore, *Cloud Ethics: Algorithms and the Attributes of Ourselves and Others* (Durham, NC: Duke University Press, 2020), 20.
18. Denise Ferreira da Silva, “Globality,” *Critical Ethnic Studies* 1, no. 1 (2015): 35 original emphases.
19. Elinor Carmi, *Media Distortions: Understanding the Power Behind Spam, Noise, and Other Deviant Media* (New York: Peter Lang, 2020); Laura DeNardis, *The Internet in Everything: Freedom and Security in a World with No Off Switch* (New Haven, CT: Yale University Press, 2020); Jonathan Roberge and Michael Castelle, eds., *The Cultural Life of Machine Learning: An Inursion into Critical AI Studies* (New York: Palgrave Macmillan, 2020); Jathan Sadowski, *Too Smart: How Digital Capitalism Is Extracting Data, Controlling Our Lives, and Taking over the World* (Cambridge, MA: MIT Press, 2020); Nanna Bonde Thylstrup, *The Politics of Mass Digitization* (Cambridge, MA: MIT Press, 2018).
20. Halpern, Mitchell, and Geoghegan, “The Smartness Mandate,” 111.
21. Virginia Eubanks, *Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor* (New York: St. Martin’s Press, 2018).
22. Alain Desrosières, *The Politics of Large Numbers: A History of Statistical Reasoning* (Cambridge, MA: Harvard University Press, 2011), 25.
23. Although thought experiments date back to Ancient Greece, they are a recent phenomenon in the history of sciences. The thought experiment, then, joins threads in game theory, analytic philosophy, mathematics, and computer science. See Friedel Weinert, *The Demons of Science: What They Can and Cannot Tell Us about Our World* (Switzerland: Springer, 2016); Aspasia S. Moue, Kyriakos A. Masavetas, and Haido Karayianni, “Tracing the Development of Thought Experiments in the Philosophy of Natural Sciences,” *Journal for General Philosophy of Science* 37, no. 1 (2006): 61–75; Jeff Atwood, “Classic Computer Science Puzzles,” *Coding Horror*, September 12, 2007, <https://blog.codinghorror.com/classic-computer-science-puzzles/>.
24. Amoore, *Cloud Ethics*, 121.
25. Theodora Dryer, “Designing Certainty: The Rise of Algorithmic Computing in an Age of Anxiety 1920–1970” (Ph.D. diss., University of California San Diego, 2019).
26. William J. Cook, *In Pursuit of the Traveling Salesman: Mathematics at the Limits of Computation* (Princeton, NJ: Princeton University Press, 2015).
27. Erica Klarreich, “Computer Scientists Break the ‘Traveling Salesperson’ Record,” *Quanta*, October 18, 2020, <https://www.quantamagazine.org/computer-scientists-break-traveling-salesperson-record-20201008/>.
28. Erikson et al., *How Reason Almost Lost Its Mind*, 24.



29. Michel Foucault, "Technologies of the Self," in *Technologies of the Self: A Seminar with Michel Foucault*, ed. Luther H. Martin, Huck Gutman, and Patrick H. Hutton (Amherst: University of Massachusetts Press, 1988), 16–49; Anjan Chatterjee, "The Promise and Predicament of Cosmetic Neurology," *Journal of Medical Ethics* 32, no. 2 (2006): 110–13.
30. Karen Yeung, "Algorithmic Regulation: A Critical Interrogation," *Regulation & Governance* 12, no. 4 (2018): 505–23; A. Aneesh, "Global Labor: Algorocratic Modes of Organization," *Sociological Theory* 27, no. 4 (2009): 347–70; Sarah Myers West, "Data Capitalism: Redefining the Logics of Surveillance and Privacy," *Business & Society* 58, no. 1 (2019): 20–41; Shoshana Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power* (New York: PublicAffairs, 2019).
31. Sheila Jasanoff, *Designs on Nature: Science and Democracy in Europe and the United States* (Princeton, NJ: Princeton University Press, 2007).
32. Easterling, *Extrastatecraft*; David Graeber, *The Utopia of Rules: On Technology, Stupidity, and the Secret Joys of Bureaucracy* (New York: Melville House, 2016); Ruha Benjamin, *Race after Technology: Abolitionist Tools for the New Jim Code* (Cambridge: Polity, 2019).
33. "Standards," *International Standards Organization*, n.d., <https://www.iso.org/standards.html>.
34. "ISO/IEC 27001: Information Security Management," *International Standards Organization*, n.d., <https://www.iso.org/isoiec-27001-information-security.html>. Links to buy specific reports are at the bottom of the page.
35. Peter Drahos with John Braithwaite, *Information Feudalism: Who Owns the Knowledge Economy* (London: Routledge, 2002); Dal Yong Jin, "The Construction of Platform Imperialism in the Globalization Era," *TripleC: Communication, Capitalism & Critique* 11, no. 1 (2013): 145–72.
36. Erickson et al., *How Reason Almost Lost Its Mind*, 68.
37. Marina Welker, *Enacting the Corporation: An American Mining Firm in Post-Authoritarian Indonesia* (Berkeley: University of California Press, 2014), 4.
38. Marc Steinberg, *The Platform Economy: How Japan Transformed the Consumer Internet* (Minneapolis: University of Minnesota Press, 2019); Deborah Cowen, *The Deadly Life of Logistics: Mapping Violence in Global Trade* (Minneapolis: University of Minnesota Press, 2014). See also Ned Rossiter, *Software, Infrastructure, Labor: A Media Theory of Logistical Nightmares* (London: Routledge, 2016).
39. Cowen, *The Deadly Life of Logistics*, 8–9.
40. Jasper Bernes, "Logistics, Counterlogistics and the Communist Prospect," *Endnotes* 3 (2013): <https://endnotes.org.uk/issues/3/en/jasper-bernes-logistics-counterlogistics-and-the-communist-prospect>.
41. Lisa Parks and Nicole Starosielski, eds., *Signal Traffic: Critical Studies of Media Infrastructures* (Champaign: University of Illinois Press, 2015).
42. David Harvey, *The New Imperialism* (Oxford: Oxford University Press, 2005); Saskia Sassen, *Globalization and Its Discontents: Essays on the New Mobility of People and Money* (New York: The New Press, 1998); Michael Hardt and Antonio Negri *Empire* (Cambridge, MA: Harvard University Press, 2000).
43. G. Koutroukis et al., "Multi-Objective Optimization of Container Ship Design," *Mediterranean Marine Science* (October 7, 2013): 477.
44. George Ritzer, *The McDonaldization of Society: Into the Digital Age*, 9th ed. (Thousand Oaks, CA: Sage, 2019), 20–21.
45. Gina Neff and Dawn Nafus, *Self-Tracking* (Cambridge, MA: MIT Press, 2016).
46. Mike Ananny, "Making Up Political People: How Social Media Create the Ideals, Definitions, and Probabilities of Political Speech," *Georgetown Law Technology Review* 4, no. 2 (2020): 352–66.
47. James W. Carey and John J. Quirk, "The Mythos of the Electronic Revolution," *The American Scholar* 39, no. 2 (Spring 1970): 219.

48. James W. Carey and John J. Quick, "The Mythos of the Electronic Revolution," *The American Scholar* 39, no. 3 (Summer 1970): 396.
49. David E. Nye, *American Technological Sublime* (Cambridge, MA: MIT Press, 1994); Rudolf Mrázek, *Engineers of Happy Land: Technology and Nationalism in a Colony* (Princeton, NJ: Princeton University Press, 2002).
50. John Perry Barlow, "A Declaration of the Independence of Cyberspace," *Electronic Frontier Foundation*, February 8, 1996, <https://www.eff.org/cyberspace-independence>.
51. Wendy Hui Kyong Chun, *Control and Freedom: Power and Paranoia in the Age of Fiber Optics* (Cambridge, MA: MIT Press, 2006), 19.
52. Joshua Neves, *Underglobalization: Beijing's Media Urbanism and the Chimera of Legitimacy* (Durham, NC: Duke University Press, 2020), 165–68.
53. Turner, "Prototype," 262.
54. This quote is from a lecture by Ruja Benjamin: McGill University, "Mossman Lecture—Race to the Future? Reimagining the Default Settings of Technology & Society," *YouTube*, October 28, 2020, <https://www.youtube.com/watch?v=i7WvE3rQsgc>. See also Benjamin, *Race after Technology*.
55. Abolition Collective, ed., *Making Abolitionist Worlds: Proposals for a World on Fire* (Brooklyn, NY: Common Notions, 2020); Tiffany Lethabo King, *The Black Shoals: Offshore Formations of Black and Native Studies* (Durham, NC: Duke University Press, 2019).
56. Safiya Umoja Noble, *Algorithms of Oppression: How Search Engines Reinforce Racism* (New York: New York University Press, 2018), 10.
57. Jason Edward Lewis, Noelani Arista, Archer Pechawis, and Suzanne Kite "Making Kin with the Machines," *Journal of Design and Science* 3.5 (July 16, 2018): <https://doi.org/10.21428/bfafd97b>.
58. See Jonathan Crary, *27/7: Late Capitalism at the Ends of Sleep* (New York: Verso, 2013); "Pirate Care, a Syllabus," <https://syllabus.pirate.care/>; Dean Spade, "Solidarity Not Charity: Mutual Aid for Mobilization and Survival," *Social Text* 38, no. 1 (2020): 131–51.
59. Neves, *Underglobalization*.
60. Alessandra Renzi, "Entangled Data: Modelling and Resistance in the Megacity," *Open!*, February 20, 2017, <https://onlineopen.org/entangled-data-modelling-and-resistance-in-the-megacity>.
61. Tiffany Lethabo King, Jenell Navarro, and Andrea Smith, eds., *Otherwise Worlds: Against Settler Colonialism and Anti-Blackness* (Durham, NC: Duke University Press, 2020).
62. Anne-Marie Conway, "Charts Change Minds," *Eye Magazine*, June 13, 2012, <http://www.eyemagazine.com/blog/post/charts-change-minds>.
63. Simone Browne, *Dark Matters: On the Surveillance of Blackness* (Durham, NC: Duke University Press, 2015).
64. Cedric J. Robinson, *Black Marxism: The Making of the Black Radical Tradition* (Chapel Hill: University of North Carolina Press, 2000).
65. *Ibid.*, 2. See also Jodi Melamed, "Racial Capitalism," *Critical Ethnic Studies* 1, no. 1 (2015): 76–85.
66. Michel Foucault, *Security, Territory, Population: Lectures at the Collège de France, 1977–1978*, ed. Michel Senellart, trans. Graham Burchell (New York: Palgrave Macmillan, 2007), 6.
67. Browne, *Dark Matters*, 32, 13 respectively.
68. Harold A. Innis, "The Penetrative Powers of the Price System," *The Canadian Journal of Economics and Political Science / Revue Canadienne d'Économique et de Science Politique* 4, no. 3 (1938): 299–319.
69. da Silva, "Globality."
70. Caitlin Rosenthal, *Caitlin Accounting for Slavery: Masters and Management* (Cambridge, MA: Harvard University Press, 2018), 86.
71. Lisa Lowe, *The Intimacies of Four Continents* (Durham, NC: Duke University Press, 2015), 1.

72. Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: University of Chicago Press, 2009); Eden Medina, *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile* (Cambridge, MA: MIT Press, 2011); Benjamin Peters, *How Not to Network a Nation: The Uneasy History of the Soviet Internet* (Cambridge, MA: MIT Press, 2016); Elgé Rindzevičiūtė, *The Power of Systems: How Policy Sciences Opened Up the Cold War World* (Ithaca, NY: Cornell University Press, 2016).
73. Donna J. Haraway, "Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s," *Socialist Review* 80 (1985): 65–107.
74. Andrew Pickering, "Cyborg History and the World War II Regime," *Perspectives on Science* 3, no. 1 (1995): 1–48; Philip Mirowski, "Cyborg Agonistes: Economics Meets Operations Research in Mid-Century," *Social Studies of Science* 29, no. 5 (1999): 685–718.
75. Scott Lash and Bogdan Dragos, "An Interview with Philip Mirowski," *Theory, Culture & Society* 33, no. 6 (2016): 123–40.
76. William Deringer, "Michael Milken's Spreadsheets: Computation and Charisma in Finance in the Go-Go '80s," *IEEE Annals of the History of Computing* 42, no. 3 (2020): 53–69.
77. Jean-Christophe Plantin, Carl Lagoze, Paul N. Edwards, and Christian Sandvig, "Infrastructure Studies Meet Platform Studies in the Age of Google and Facebook," *New Media & Society* 20, no. 1 (2016): 293–310; Ganaele Langlois, and Greg Elmer, "Impersonal Subjectivation from Platforms to Infrastructures," *Media, Culture & Society* 41, no. 2 (2019): 236–51; McKelvey, *Internet Daemons*; A. Aneesh, *Virtual Migration: The Programming of Globalization* (Durham, NC: Duke University Press, 2006).
78. Nick Srnicek, *Platform Capitalism* (Cambridge: Polity, 2017).
79. Rebecca Lemov, *World as Laboratory* (New York: Farrar, Straus and Giroux, 2005).