[3]

Queerying Homophily

Wendy Hui Kyong Chun

To recap, in *Pattern Discrimination*:

1. YOU is always singular plural:
   - Recognition is never at the level of the individual
   - You = YOUS value
2. Machines engage in deep dreaming, creating patterns from noise.
   - Crab in = crap out
   - As with the gibbering muses, interpretation and hermeneutics enter through pattern discrimination, but now through the "back door"
   - We live in mythic times, but without knowing we do
3. The singularity of the market = the crapularity of the world:
   - the dumbing down of humans
   - the integration of subjectivity into information technologies
   - the reality of paranoia

4. To come out, we have to come in:
   - we are inside when we think we are outside.
   - Open societies need enemies to be "open"

This chapter continues these points by examining homophily—the axiom that similarity breeds connection—which grounds contemporary network science. If we are inside-out, it is because homophily, love as love of the same, closes the world it pretends to open; it makes cyberspace a series of echo chambers. This transformation ironically fulfills its purpose as a portal: a portal is an elaborate façade that frames the entrance to an enclosed space. Cyberspace was always a horizon trapped within in U.S. military-academic networks. Thus, to start with a more contemporary myth:

> *Once upon a time, a U.S. commerce-free, military, and academic inter-networking protocol, Transmission Control Protocol/Internet Protocol, became reborn as cyberspace. A consensual hallucination, it transformed TCP/IP into its opposite: a global, government-free, and anonymous space that was fundamentally discrimination-free (because if you can't see it, how can you hate it?). A decentralized network allegedly designed to survive a massive, catastrophic flattening (i.e., nuclear war), it would flatten all hierarchies through its boundless expansion. Unfortunately, things did not quite turn out as planned. Rather than an endless difference-free utopia, the internet became a series of poorly gated communities that spawned towering, hate- and terror-filled, racist—or to some even worse, banal, star-obsessed, cat-infested—echo chambers. This Internet made cyberpunk dystopian futures look banal in comparison. Rather than state-free, it became a breeding ground for state surveillance, in which governments spied on citizens, on foreign nationals, and on each other, and in which corporations perfected global tracking techniques. The future it augured looked even darker: the dusk of human spontaneity via the dawn of Big Data. Soon all human actions would be captured, calibrated, predicted,*

and preempted. Networks, it would seem, were born free and yet everywhere were enchained.

People bemoaned, accepted, or embraced this situation and offered various explanations for it. They revealed that the initial dreams of cyberspace were delusional (as if this was profound: the term "cyberspace," after all, came from science fiction; William Gibson in Neuromancer *described it as a "consensual hallucination"); they argued that the internet had to be purged of the anonymity (it never really had) because anonymity was the root of all evil (as if people were only obnoxious or nasty under cover); they pointed out that echo chambers were produced by "personalization": corporate attempts to target individual consumers. What we were experiencing: the nightmare of buying "happily ever after."*

This tale is both right and wrong. Yes, the internet changed dramatically after its opening/commercialization, but personalization alone is not the culprit—and purging the internet of anonymity will not make networks any less nasty. "Real Names" or unique identifiers lie at heart of Big Data analytics, for they are crucial to synching disparate databases and calibrating recycled data. Further, if Big Data predictive analytics work, it is not because everyone is treated like a special snowflake but because network analyses segregate users into "neighborhoods" based on their intense likes and dislikes. Further, it "trains" individuals to expect and recognize this segregation. Instead of ushering in a postracial, postidentitarian era, networks perpetuate identity via "default" variables and axioms. In network science, differences and similarities—differences as a way to shape similarities—are actively sought, shaped, and instrumentalized in order to apprehend network structures. Networks are neither unstructured masses nor endless rhizomes that cannot be cut or traced. Networks, because of their complexities, noisiness, and persistent inequalities, foster techniques to manage, prune, and predict. This new method—this pattern discrimination—makes older, deterministic, or classically analytic methods of control seem innocuous.

Homophily (love as love of the same) fuels pattern discrimination. The fact that networks perpetuate segregation should surprise no one because, again, segregation in the form of homophily lies at their conceptual core. Homophily launders hate into collective love, a transformation that, as Sara Ahmed has shown, grounds modern white supremacism (2004, 123). Homophily reveals and creates boundaries within theoretically flat and diffuse networks; it distinguishes and discriminates between allegedly equal nodes: it is a tool for discovering bias and inequality and for perpetuating it in the name of "comfort," predictability, and common sense. Network and data analyses compound and reflect discrimination embedded within society. Like the trolls Whitney Phillips has diagnosed as the "grimacing poster children for the socially networked world," they engage in "a grotesque pantomime of dominant cultural tropes" (2015, 8). Most broadly, this pattern discrimination is linked to a larger subsumption of democratic politics to neoliberal market economics, with its naïve overvaluing of openness (as discussed by Cramer in the preceding chapter) and authenticity (diagnosed brilliantly by Elizabeth Bernstein [2007]).

To intervene, we need to realize that this pantomime is not simply dramatic, it is also performative—it puts in place the world it discovers. It also depends on constantly repeated actions to create and sustain nodes and connections. We must thus embrace network analyses and work with network scientists to create new algorithms, new hypotheses, new grounding axioms. We also need to reembrace critical theory: feminism, ethnic studies, deconstruction, and yes, even psychoanalysis, data analytics' repressed parent. Most crucially, what everyone needs now: training in critical ethnic studies.

Machine Learning: Money Laundering for Bias?

On June 19, 2016, Pinboard—an account linked to a site advertised as "Social Bookmarking for Introverts"—posted the following comment to *Twitter*: "Machine learning is like money laundering for bias" (Pinboard 2016). This post, which was retweeted over a thousand times by the end of that summer, encapsulated growing suspicions about the objectivity of artificial intelligence and data-driven algorithms, suspicions confirmed by Cathy O'Neil in her remarkable *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy* (2016). During this time period, news reports about biases embedded in machine learning abounded. Just two of the stories reported in the mainstream media the week of August 28, 2016, include news that:

- *Facebook* unexpectedly fired its news curators, in a delayed response to allegations that its editors deliberately suppressed conservative news, charges it had previously denied (Thielman 2016). This resulted, as *the Guardian* reported, in the algorithms going "crazy." Among the top stories: a fraudulent one that then Fox News moderator Megyn Kelly was fired after she revealed that she was backing Hillary Clinton and a real video of a man masturbating with a McDonald's sandwich. According to some, this was because Facebook had not addressed the human problem embedded in machine algorithms: *Fortune* contended that "getting rid of human editors won't solve *Facebook*'s bias problem" because, in the end, the algorithms are written by human programmers (Ingram 2016).
- A coalition of civil liberties and civil rights organizations issued a statement against predictive policing technologies. According to this group, the crime data embedded in these programs poisoned the results. This data is "notoriously suspect, incomplete, easily manipulated, and plagued by racial bias" (Lartey 2016). These allegations followed a report by *Upturn* that revealed that these systems are not only overhyped, they also "reinforce disproportionate and discriminatory policing practices" (Robinson and Koepke 2016).

These are two of many. There are, as my coauthors have pointed out, many more instances of discriminatory algorithms. Other stories that broke in 2015–16 include news that:

- Google's photo app tagged two black people as "gorillas." Vivienne Ming, an artificial intelligence expert argued, "some systems struggle to recognize non-white people because they were trained on Internet images which are overwhelmingly white . . . the bias of the Internet reflects the bias of society." (Revealingly, Babak Hodjat, chief scientist at Sentinet Technologies, hypothesized that this error might have stemmed from the fact that the algorithm had not seen enough pictures of gorillas; Blarr 2015). This misrecognition of nonwhite people by cameras was hardly new: as Cramer also notes in his chapter in this volume, in 2009 it was revealed that HP Face-Tracking Webcams could not recognize black people, and the Nikon S360 asked its users if smiling Asians were "blinking" (see Frucci 2015; Lee 2009).
- The COMPAS software used by several U.S. courts to predict recidivism—and thus by some to determine sentencing and parole—was biased against racial minorities (Angwin et al. 2016).

These cases "revealed" well-documented biases that should not have been news. Historically, standard film stock was optimized for white skin; for the longest time, interracial filming was difficult not only for social reasons but also for technological ones (see Dyer 1997). As well, racial bias in sentencing within the United States has been debated and analyzed for years.[1] Further, racism within machine learning algorithms had been highlighted and predicted by numerous scholars: from Dr. Latanya Sweeney's revelation that "a black-identifying name was 25% more likely to get an ad suggestive of an arrest record" to predictions of price discrimination based on "social sorting"; from "inadvertent" and illegal discriminatory choices embedded in hiring software to biased risk profiles within terrorism-deterrence systems. These all highlighted the racism latent within seemingly objective systems, which, like money laundering, cleaned "crooked" data. To many, the solution was thus better, cleaner data: crime data, scrubbed free of police bias; more images of black folks in libraries; more diversity within the tech industry, so technologies not tested on minorities would not reach the consumer market (Harris 2016). The problem, in other words, was the still-lingering digital divide.

Other analysts, however, pointed out that it is not simply a question of inclusion or exclusion but also of how differences are "latently" encoded. For example, Chicago police did not use overtly racial categories in their predictive policing algorithm to generate a "heat list" of those most likely to murder or be murdered, because they did not need to: their "neighborhood"-based system effectively discriminated on the basis of race (Saunders, Hunt, and Hollywood 2016). This system created "persons of interest" based on social ties (as well as personal history). As Kate Crawford and Jason Schultz have argued, Big Data compromises privacy protections afforded by the U.S. legal system by making personally identifiable information about "protected categories" legible (Crawford and Schultz 2014). As Faiyaz Al Zamal et al. (2012) have shown in their analysis of Twitter, latent attributes such as age and political affiliation are easily inferred via a user's "neighbors." These algorithms, in other words, do not need to track racial and other differences, because these factors are already embedded in "less crude" categories designed to predict industriousness, reliability, homicidal tendencies, et cetera. These algorithms can more precisely target key intersectional identities. Tellingly, Christopher Wylie—the Cambridge Analytica whistle-blower—told the *Guardian*'s Carole Cadwalladr that Steven Bannon was the only straight man Wylie's ever talked to about feminist intersectional theory. Feminist intersectional theory was first developed by Kimberlé Crenshaw (Crenshaw 1991) to explain the violence against women of color—through Cambridge Analytica, it became a measure to understand "the oppressions that conservative, young white men feel" (Cadwalladr 2018). As Susan Brown (personal communication, June 2015) has noted, imagine what could be revealed in terms of location, class, and race through the category: buys organic bird feed.

Crucially, these algorithms perpetuate the discrimination they "find." They are not simply descriptive but also prescriptive and performative in all senses of that word. Capture systems, as Phil Agre theorized in 1994, reshape the activities they model or "discover." Through a metaphor of human activity as language, they impose a normative "grammar of action" as they move from analyzing captured data to building an epistemological model of the captured activity (364). The Chicago Police's "heat list," for instance, did not result in a reduction of homocides; it did, however, lead to subjects on the list being "2.88 times more likely than their matched counterparts to be arrested for a shooting" (Saunders, Hunt, and Hollywood 2016). It also possibly led to more homicides: those contacted by the police were afraid of being perceived as "snitches" by their neighbors (Gorner 2013). Networks create and spawn the reality they imagine; they become self-fulfilling prophecies (see Chun 2016; Healy 2015). Based on efficiency, they, like all performative systems, bypass questions of justice (see Lyotard 1984).

Performativity, however, does not simply mean the reformatting and reorganizing of the world "into line with theory" (Healy 2015, 175). Performative utterances, as Judith Butler and Jacques Derrida have argued, depend on iterability and community (Derrida 1988; Butler 1997). Butler in particular has revealed the inherent mutability of seemingly immutable and stable categories. Gender, she has argued, is performative: "it is real only to the extent that it is performed" (Butler 1988, 527). What we understand to be "natural" or "essential" is actually "manufactured through a sustained set of acts, positioned through the gendered stylization of the body . . . what we take to be an 'internal' feature of ourselves is one that we anticipate and produce through certain bodily acts, at an extreme, an hallucinatory effect of naturalized gestures" (Butler 1990, xv). These gestures and constant actions are erased/forgotten as they congeal into a "comfortable" fixed identity. As Sara Ahmed provocatively puts it: "regulative norms function in a way as repetitive strain injuries" (Ahmed 2004, 145). This understanding of performativity adds a further dimension to analyses of network performativity, for this performativity courses through networks. As I've argued more fully in *Updating to Remain the Same* (Chun 2016), networks do not simply enact what they describe, their most basic units—nodes and ties—are also themselves the consequence of performative, habitual actions.

So: what would happen if we engaged, rather than decried, network performativity? How different could this pantomime called networks be? Crucially, to take up this challenge we must realize the expressive impact of our mute actions. If Big Data, as Antoinette Rouvroy among others have argued, devalues human language by privileging bodily actions over narratives, it does so via capture systems that, as Agre points out, translate our actions into "grammars of actions" (Rouvroy 2011). Our silent—and not so silent—actions register.

To take up this challenge, we also need to move beyond dismissing Big Data as hype and celebrating "missed" predictions as evidence of our unpredictability. The gap between prediction and actuality should not foster snide comfort, especially since random recommendations are increasingly deliberately seeded to provoke spontaneous behavior. The era of Big Data is arguably a future that we reach, if we do, asymptotically, and the fact that Big Data is hype is hardly profound: most of technology is. Further, Big Data poses fascinating computational problems (how does one analyze data that one can read in once, if at all?). The plethora of correlations it documents also raises fundamental questions about causality: If almost anything can be shown to be real (if almost any correlation can be discovered), how do we know what matters, what is true? The "pre-Big Data" example of the "Super Bowl predictor" nicely encapsulates this dilemma, for one of the best predictors of the U.S. stock market is the result of the Super Bowl: if an NFC team wins, it will likely be a bull market; if an AFC team wins, it will be a bear market (Silver 2012, 185). This example also poses the question: what does knowledge do? What is the relationship between knowledge and action? The best analogy for Big Data is the mapping of the human genome: before this mapping was actualized, it was envisioned as the Holy Grail, or the Rosetta Stone for human illness. Rather than simply resulting in the cure for cancer and so forth, it raised new awareness about the importance of epigenesis, gene interactions, disease pathways, et cetera.

It is critical that we realize that the gap between prediction and reality is the space for political action and agency. Predictions can be "self-canceling" as well as self-fulfilling (Silver 2012, 219). Like global climate change and human population models, they can point to realities and futures to be rejected. They can, through their diagnosis, render impotent the predictive power of a symptom or enable new, unforeseen, grammars. To create new expressions, however, we need to read the scripts and analyze the set we find ourselves in the midst of, that is, the laboratory of network science.

Networks: The Science of Neoliberal Connections

At the most basic level, network science captures—that is, analyzes, articulates, imposes, instrumentalizes, and elaborates—connection (see the five stages of capture, Agre 1994). It is "*the study of the collection, management, analysis, interpretation, and presentation of relational data*"[2] (Brandes et al. 2013, 3). Described as fundamentally interdisciplinary, it brings together physics, biology, economics, social psychology, sociology, and anthropology. Put more extremely, it merges the quantitative social sciences with the physical and computer sciences in order to bypass or eliminate the humanities and media studies, two fields also steeped in theories of representation and networks. According to the acclaimed network scientist and author Albert-László Barabási, network science obviates the need for human psychology: "In the past, if you wanted to understand what humans do and why they do it, you became a card-carrying psychologist. Today you may want to obtain a degree in computer science . . . ." This is because network science, combined with "increasingly penetrating digital technologies," places us in "an immense research laboratory that, in size, complexity, and detail, surpasses everything that science has encountered before." This lab reveals "the rhythms of life as evidence of a deeper order in human behavior, one that can be explored, predicted, and no doubt exploited" (Barabási 2010, 11). Network science unravels a vast collective nonconscious, encased within the fishbowl of digital media.[3] It is the bastard child of psychoanalysis: there are no accidents, no innocent slips of the tongue. Each action is part of a larger pattern/symptom. The goal: to answer that unanswerable question, what do (wo)men want?

Network science responds to increased global connectivity and capitalism, to "a growing public fascination with the complex 'connectedness' of modern society" (Easley and Kleinberg 2010, 11). As Duncan Watts, a pioneer in this field, explains, "if this particular period in the world's history had to be characterized in any simple way, it might be as one that is more highly, more globally, and more unexpectedly connected than at any time before it." Network science is crucial to mapping and navigating "the connected age" (Watts 2004).

Network science is a version of what Fredric Jameson once called "cognitive mapping" (Jameson 1990). It is the neoliberal cure for postmodern ills (see Chun 2016). Postmodernism, according to Jameson, submerged subjects "into a multidimensional set of radically discontinuous realities, whose frames range from the still surviving spaces of bourgeois private life all the way to the unimaginable decentering of global capital itself" (Jameson 1991, 413). Because of this, they were profoundly disoriented, unable to connect their local experience (authenticity) to global systems (truth). To resolve this situation, Jameson called for cognitive mapping, a yet imaginable form of political socialist art, which corresponded to "an imperative to grow new organs, to expand our sensorium and our body to some new, yet unimaginable, perhaps ultimately impossible, dimensions" (39). Like the cognitive mapping Jameson envisioned, network science lifts the fog of postmodernism by revealing the links between the individual to the totality in which she lives. Unlike Jameson's vision, it is hardly socialist or empowering.

Rather than enabling humans to grow new organs, it contracts the world into a map: it forces a mode of authenticity shaped to an artificially intelligent truth.

Network science reduces real-world phenomena to a series of nodes and edges, which are in turn modeled to expose the patterns governing seemingly disparate behaviors, from friendship to financial crises. This mapping depends on dramatic simplifications of real world phenomena.[4] In fact, these “discovered” relations are vast simplifications of vast simplifications, with each phase of network theory—initial abstraction/representation followed by mathematical modeling—producing its own type of abstraction. The first is “applied” and “epistemological”: It suggests and explicates “for given research domains, how to abstract phenomena into networks. This includes, for example, what constitutes an individual entity or a relationship, how to conceptualize the strength of a tie, etc.” (Easley and Kleinberg 2010, 2). Most simply, in this stage, one decides what is a node, what is an edge, and how they should be connected. The second is “pure” network theory, for it deals “with formalized aspects of network representations such as degree distributions, closure, communities, etc., and how they relate to each other. In such pure network science, the corresponding theories are mathematical—theories of networks” (5). In this second phase, the goal is to build a model that reproduces the abstraction produced in stage one. Whatever does so is then considered true or causal. This two-step process highlights the tightrope between empiricism and modeling that network science walks: network science models not the real world but rather the initial representation and truth is what reproduces this abstraction.

These abstract relations reveal and construct a complex relationship between the local and the global. Fundamentally, network science is nonnormative: it does not assume that aggregate behaviors stem from identical agents acting identically. It connects previously discontinuous scales—the local and global, the micro and the macro—by engaging dependencies that were previously “filtered” or controlled for. It, as the authors of the inaugural volume of *Network Science* explain, differs from other sciences in its evaluation of dependency and structure. Rather than defining the domain of variables as a simple set without a structure, it assumes "at least some variables . . . to have structure. The potentially resulting dependencies are not a nuisance but more often than not they constitute the actual research interest" (Brandes et al. 2013, 8).[5] These dependencies go beyond correlations within actor attribute variables (such as the relation between income and age) to encompass the entire set of network variables. Network variables are themselves defined in terms of pairs, which are valued according to their degree (or not) of connection (for instance, 1 for connected; 0 for not). These variables in turn affect one another: "the crucial point is that the presence of one tie may influence the presence of another. . . . While this will appear an unfamiliar point of view to some, it is merely a statement that networks may be systematically patterned. Without dependence among ties, there is no emergent network structure (Brandes et al. 2013, 10).[6] At all levels, networks are dynamic and interdependent. What matters then is understanding and creating interdependencies.

Currently, modeling these interdependencies—tying global events to individual interactions—entails the marriage of graph theory with game theory, or other agent-based modeling. Computer scientist Jon Kleinberg's collaboration with economist David Easley exemplifies this fruitful combination. In their canonical and excellent textbook, *Networks, Markets, and Crowds,* based on their class at Cornell (now a popular EdX MOOC with Eva Tardos), they explain that understanding networks requires apprehending two levels of connectedness: "connectedness at the level of structure—who is connected to whom—and . . . connectedness at the level of *behavior*—the fact that each individual's actions have implicit consequences for the outcomes of everyone in the system" (Easley and Kleinberg 2010, 4). Global concerns impact local decisions, and local effects often only manifest themselves at global scales.[7] Network science thus spans the two extremes—macro-level structure and micro-level behavior—by mapping the ways that “macroscopic effects . . . arise from an intricate pattern of localized interactions” (6). *Networks, Markets, and Crowds* explicitly draws from graph theory and game theory, showing how this combination can explain seemingly “irrational” phenomena such as information cascades.

As the turn to game theory reveals, a market-based logic permeates network science models (a theme pursued later in this series by the *Markets* book by Armin Beverungen, Philip Mirowski, Edward Nik-Khah, and Jens Schroeter). Most generally, capture systems are justified and praised as inherently more efficient and empowering (and thus more democratic) than older disciplinary or firm-based ones. Agre hypothesizes that

> the computer practitioner’s practice of capture is instrumental to a process by which economic actors reduce their transaction costs and thereby help transform productive activities along a trajectory towards an increasingly detailed reliance upon (or subjection to) market relations. The result is a generalized acceleration of economic activity whose social benefits in terms of productive efficiency are clear enough but whose social costs ought to be a matter of concern. (Agre 1994, 121–22)

Most succinctly: capture systems transform all transactions into market-based ones so that computerization = liberalization. Although Agre stresses that this relation is historically contingent and itself the product of a “kind of representational crusade” (120), he nonetheless hypothesizes that this relation, which “presupposes that the entire world of productive activities can be conceptualized, *a priori,* in terms of extremely numerous episodes of exchanges among economic actors,” constitutes the political economy of capture (121). The language of “costs” not only underlies Agre’s own critical language, it also litters the literature on networks: from attempts to model (and thus understand) collective action and critical mass (Centola 2013) to those that map differential networking techniques of women and minorities (Ibarra 1993) to those that model social learning (DiMaggio and Garip 2012); from those that seek to identify the impact of influential or susceptible members of social networks (Aral and Walker 2012) to those that analyze the "payoffs" of social capital within immigrant networks (Ooka and Wellman 2006). As this last example reveals, this market-based logic also presumes the existence of "social capital," a concept Pierre Bourdieu tied to group membership and accreditation.[8]

In the current literature, social capital explains lingering inequality among individuals. It explains disparities in success that cannot be explained in terms of individual differences in "human capital," that is, differences in intelligence, physical appearances, and skill (Burt 2002). According to sociologist Ronald S. Burt, social capital is a "metaphor or advantage" within a society "viewed as a market in which people exchange all variety of goods and ideas in pursuit of their interests." It reveals that

> the people who do better are somehow better connected. Certain people or certain groups are connected to certain others, trusting certain others, obligated to support certain others, dependent on exchange with certain others. Holding a certain position in the structure of these exchanges can be an asset in its own right. That asset is social capital, in essence, a concept of location effects in differentiated markets. (Burt 1992, 150)

A relational form of capital, it grants advantage to those who invest in social relations. It thrives off "trust" and obligation.

Marion Fourcade and Kieran Healy have refined this notion of relational capital, arguing that this form of capital is really "über-capital," which is tied to "one's position and trajectory according to various scoring, grading, and ranking methods. . . . An example would be the use of credit scores by employers or apartment owners as an indicator of an applicant's 'trustworthiness'" (Fourcade and Healy 2016, 10).[9] Fourcade and Healy's analysis thus reveals the actuarial mechanisms that construct the "trust" that Burt assumes. The term "über" denotes "the meta-, generalized, or transcendent, nature of this capital, largely stored in the "cloud". . . . the term über also connotes something or someone who is extra-ordinary, who stands above the world and others . . ." (23). This form of capital categorizes consumers based on their "habitus" in order to make "good matches" between products and consumers. Crucially, the categories employed by corporations do not explicitly reference race/gender/class, for they are based on actions rather than inherent traits. Thus,

> everyone seems to get what they deserve. Eschewing stereotypes, the individualized treatment of financial responsibility, work performance, or personal fitness by various forms of predictive analytics becomes harder to contest politically, even though it continues to work as a powerful agent of symbolic and material stratification. In other words, Übercapital subsumes circumstance and social structure into behavior. (33, 38)

The emphasis—in all capture systems—is on translating and figuring actions.

As the above discussions of social capital and capture imply, network science, as currently formulated, is the science of neoliberalism. To be clear, this is not to blame network science for neoliberalism—or to claim that network scientists are inherently neoliberal—but to highlight the fact that the many insights network science currently produce are deeply intertwined with the neoliberal system they presuppose. Neoliberalism, as Wendy Brown has argued, is based on inequality and "financialized human capital": "When we are figured as human capital in all that we do and in very venue," she reveals, "equality ceases to be our presumed natural relation with one another" (Brown 2015, 179). Brown elucidates the social impact of capture systems, with their relentless rendering of all human actions in terms of "transactions costs," namely the destruction of democracy through the reduction of "freedom and autonomy to unimpeded market behavior and the meaning of citizenship to mere enfranchisement." Crucially,

> this evisceration of robust norms of democracy is accompanied by unprecedented challenges to democratization, including complex forms and novel concentrations of economic and political power, sophisticated marketing and theatricality in politics, corporately owned media, and a historically unparalleled glut of information and opinion that, again, produced an illusion of knowledge, freedom, and even participation in the face of their opposites. (179)

These unprecedented challenges enumerated by Brown are exactly the challenges that network science manages by reducing public life to "problem solving and program implementation, a casting that brackets or eliminates politics, conflict, and deliberation about common values or ends" (127). Network science, as the rest of this chapter will explain, valorizes consensus, balance, and "comfort": it validates and assumes segregation by focusing on individual "preference," rather than institutional constraints and racism.

That is, to complement Fourcade and Healy's analysis and to draw from my *Updating to Remain the Same: Habitual New Media,* we need to understand how seemingly individualized scores coincide with "older" racial and class categories. Network categorizations do not only depend on your actions but on actions of your so-called neighbors—you are constantly compared to and lumped in with others. Advertisers divide the population into types such as "rising prosperity" and then subdivide that category into others such as "city sophisticates," which in turn produces categories such as "townhouse cosmopolitans" (see ACORN, developed by CACI). Neoliberalism destroys society by proliferating neighborhoods. Networks preempt and predict by reading all singular actions as indications of larger collective habitual patterns, based not on our individual actions but rather the actions of others. Correlations, that is, are not made based solely on an individual's actions and history but rather the history and actions of others "like" him or her. Through the analytic of habits, individual actions coalesce bodies into monstrously connected chimeras. That is, if as Barabási argues, "in order to predict the future, you first need to know the past" and if information technologies have made uncovering the past far easier than before, they have done so not simply through individual surveillance but through homophily (McPherson, Smith-Lovin, and Cook 2001). Homophily is the mechanism by which individuals "stick" together, and "*we*s" emerge. It is crucial to what Sara Ahmed has diagnosed as "the cultural politics of emotion": a circulation of emotions as a form of capital.

Homophily: Laundering "Our" Past

At the heart of network science is the principle of homophily: the axiom that "similarity breeds connection" (McPherson, Smith-Lovin, and Cook 2001). Homophily structures networks by creating clusters; by doing so, it also makes networks searchable (Marsden 1988; Jackson 2008). Homophily grounds network growth and dynamics, by fostering and predicting the likelihood of ties. Homophily—now a "commonsense" concept that slips between effect and cause—assumes and creates segregation; it presumes consensus and similarity within local clusters, making segregation a default characteristic of network neighborhoods. In valorizing "voluntary" actions, even as it troubles simple notions of "peer influence" and contagion, it erases historical contingencies, institutional discrimination, and economic realities (Kandel 1978; Aral, Muchnik, and Sundaraajan 2013). It serves as an alibi for the inequality it maps, while also obviating politics: homophily (often allegedly of those discriminated against)—not racism, sexism, and inequality—becomes the source of inequality, making injustice "natural" and "ecological." It turns hate into love and transforms individuals into "neighbors" who naturally want to live together, which assumes that neighborhoods should be filled with people who are alike. If we thus manage to "love our neighbor"—once considered a difficult ethical task—it is because our neighbors are virtually ourselves. Homophily makes anomalous conflicting opinions, cross-racial relationships, and heterosexuality, among many other things.

According to Miller McPherson, Lynn Smith-Lovin, and James Cook, in their definitive review article on homophily, "the homophily principle . . . structures network ties of every type, including marriage, friendship, work, advice, support, information transfer, exchange, co-membership, and other types of relationship" (2001, 415). As a result, "people's personal networks are homogeneous with regard to many sociodemographic, behavioral, and intrapersonal characteristics." Rather than framing homophily as historically contingent, they understand it as fundamental and timeless: indeed, they start their review with quotations from Aristotle and Plato about similarity determining friendship and love (which they admit in a footnote may be misleading, since Aristotle and Plato also claimed that opposites attract—indeed, homophily renders heterosexuality anomalous—a mysterious fact to be explained). Homophily, according to McPherson et al., is the result of and factor in "human ecology" (415).

Homophily sits at the fold between network structure and individual agency. As McPherson et al. summarize the "remarkably robust" patterns of homophily across numerous and diverse studies, they also break down homophily into two types: baseline homophily ("homophily effects that are created by the demography of the potential tie pool") and inbreeding homophily ("homophily measured as explicitly over and above the opportunity set") (419). McPherson et al. also reiterate Paul F. Lazarsfeld and Robert K. Merton's influential division of homophily into "status homophily," and "value homophily":

> Status homophily includes the major sociodemographic dimensions that stratify society—ascribed characteristics like race, ethnicity, sex, or age, and acquired characteristics like religion, education, occupation, or behavior patterns. Value homophily includes the wide variety of internal states presumed to shape our orientation toward future behavior. (McPherson, Smith-Lovin, and Cook, 419)

In their review, the authors note that race and ethnicity are clearly the "biggest divide in social networks today in the United States," due both to baseline and inbreeding homophily" (420). They list the following causes of homophily: geography ("the most basic source of homophily is space," (429); family ties (431); organizational foci, occupational, family, and informal roles (80); cognitive processes (434); and selective tie dissolution (435). Remarkably missing are: racism and discrimination, at personal or institutional levels, and history. In the world of networks, love, not hate, drives segregation.

Given that the very notion of homophily emerges from studies of segregation, the "discovery" of race as a divisive factor is hardly surprising. Lazarsfeld and Merton's 1954 text, in which they coined the terms "homophily" and "heterophily" (inspired by friendship categorizations of the "savage Trobianders whose native idiom at least distinguishes friendships within one's in-group from friendships outside this social circle") analyzes friendship patterns within two towns: "Craftown, a project of some seven hundred families in New Jersey, and Hilltown, a bi-racial, low-rent project of about eight hundred families in western Pennsylvania" (Lazarfeld and Merton 1954, 18–66, 23, 21). Crucially, they do not assume homophily as a grounding principle, nor do they find homophily to be "naturally" present. Rather, documenting both homophily and heterophily, they ask: "what are the dynamic processes through which the similarity or opposition of values shape the formation, maintenance, and disruption of close friendships?" (28). Homophily in their much-cited chapter is one instance of friendship formation—and one that emerges by studying the interactions between "liberal" and "illiberal" white residents of Hilltown (27). The responses of the black residents were ignored, since all these residents were classified as "liberal." As Samantha Rosenthal has noted, the very concept of value homophily is thus enfolded within status homophily (personal correspondance). Value and status are not separate—and value increasingly is used as a "code word" for race- and class-based distinctions. The implications of this segregation have been profound for the further development of network principles, as well as U.S. housing policy.

This history has been erased in the current form of network science, in which homophily has moved problem to solution. In the move from "representation" to "model," homophily is no longer something to be accounted for, but rather something that "naturally" accounts for and justifies persistence of inequality within facially equal systems. It has become axiomatic, that is, common sense, thus limiting the scope and possibility of network science.[10] As Easley and Kleinberg—again two of the most insightful and important scholars working in the field—explain: "one of the most basic notions governing the structure of social networks is *homophily*—the principle that we tend to be similar to our friends." To make this point, they point to the distribution of "our" friends. "Typically," they write,

> your friends don't look like a random sample of the underlying population. Viewed collectively, your friends are generally similar to you along racial and ethnic dimensions: they are similar in age; and they are also similar in characteristics that are more or less mutable, including the places they live, their occupations, their interests, beliefs, and opinions. Clearly most of us have specific friendships that cross all these boundaries; but in aggregate, the pervasive fact is that links in a social network tend to connect people who are similar to one another. (Easley and Kleinberg, 78)

Homophily is a "pervasive fact" that governs the structure of networks. As a form of natural governance—based on presumptions about "comfort"—it grounds network models, which not surprisingly also "discover" segregation.[11] Like many other texts, Damon Centola et al.'s analysis in "Homophily, Cultural Drift, and the Co-Evolution of Cultural groups," lists "comfort" as one of the reasons "why homophily is such a powerful force in cultural dynamics." Referencing the work of Lazarsfeld and Merton, Centola states: "Psychologically, we often feel justified in our feel more comfortable opinions when we are surrounded by others who share the same beliefs—what Lazarsfeld and Merton (1954) call "value homophily" . . . we also feel more comfortable when we interact with others who share a similar background (i.e., status homophily)" (Centola et al. 2007, 906). To model the effects of cultural drift—and thus to show why globalization does not/will not impose a monoculture—the authors make the following assumption:

> in our approach to studying cultural dynamics, if cultural influence processes create differentiation between two neighbors such that they have no cultural traits in common, we allow these individuals to alter the structure of the social network by dropping their tie and forming new ties to other individuals. Thus, in our specification of homophily, the network of social interactions is not fixed . . . but rather evolves in tandem with the actions of the individuals. (908)

Embedded, then, in the very dynamics of network science is the presumption that there can be no neighbors without common cultural traits. Remarkably, this assumption uses Lazarsfeld and Merton's work—which, as noted earlier, did not find homophily to be "natural"—to ground their model's dynamics. Not surprisingly, Centola et al. "discover" that homophily creates "cultural niches" (926). Homophily, in so many ways, "governs" networks structure.

The point is this: although many authors such as Easley and Kleinberg insist that homophily "is often not an end point in itself but rather the starting point for deeper questions—questions that address why the homophily is present, how its underlying mechanisms will affect the further evolution of the network, and how these mechanisms interact with possible outside attempts to influence the behavior of people in the network" (83), homophily as a starting point cooks the ending point it discovers. Not only does it limit the databases used for models—these studies often draw from the same database, such as the National Longitutindal Study of Adolescent Health (ADD Health) or Facebook or Myspace, since these studies already include "friend" as a category—homophily also accentuates the clusters network science "discovers." In particular, homophily both accounts for and accentuates "triadic closure," another fundamental and "intuitive" principle of networks, which posits that "if two people in a social network have a friend in common, then there is an increased likelihood they will become friends themselves at some point in the future" (44) Although sometimes considered as a "structural" cause outside of homophily, it also presumes homophilous harmony and consensus. The reasons often given for this "very natural" phenomena are: opportunity (if A spends time with both B and C, then there is an increased chance that they will become friends), trust, and incentive ("if A is friends with B and C, then it becomes a source of latent stress in these relationship if B and C are not friends with each other" [45]). Network science posits nonconnection as unsustainable—a cause of stress. Conflict as a tie is difficult to conceive. Crucially, social networks such as Facebook (again the model organism for network science) amplify the effects of "triadic closure" and "social balance." By revealing the friends of friends—and by insisting that friendship be reciprocal—it makes triadic closure part of its algorithm: it is not simply predicted, it is predicative. As Andreas Wimmer and Kevin Lewis point out in "Beyond and Below Racial Homophily: ERG Models of a Friendship Network Documented on Facebook," Facebook's demands for reciprocity produces homophilous effects (Wimmer and Lewis 2010).

Again, homophily not only erases conflict, it also naturalizes discrimination. Segregation is what's "recovered" and justified if homophily is assumed. Easley and Kleinberg state quite simply that "one of the most readily perceived effects of homophily is the formation of ethnically and racially homogeneous neighborhoods in cities" (96). To explain this, they turn to the "Schelling model" of segregation, a simulation that maps the movement of "two distinct types of agents" in a grid. The grounding constraint is the desire of each agent "to have at least some other agents of its own as type of neighbors" (97). Showing results for this simulation, they note that spatial segregation happens even when no individual agent seeks it: the example for t = 4 (therefore, each agent would be happy as a minority) yields overwhelmingly segregated results. In response, they write:

> Segregation does not happen because it has been subtly built into the model: agents are willing to be in the minority, and they could all be satisfied if only we were able to carefully arrange them in an integrated pattern. The problem is that, from a random start, it is very hard for the collection of agents to find such integrated patterns. . . . In the long run, the process tends to cause segregated regions to grow at the expense of more integrated ones. The overall effect is one in which the local preferences of individual agents have produced a global pattern that none of them necessarily intended.
>
> This point is ultimate at the heart of the model: although segregation in real life is amplified by a genuine desire within some fraction of the population to belong to large clusters of similar people—either to avoid people who belong to other groups, or to acquire a critical mass of members from one's own group—such factors are not necessary for segregation to occur. The underpinnings of segregation are already present in a system where individuals simply want to avoid being in too extreme a minority in their own local area. (101)

I cite this at length because this interpretation reveals the dangers of homophily. The long history and legacy of race-based slavery within the United States is completely erased, as well as the importance of desegregation to the civil rights movement. There are no random initial conditions. The "initial conditions" found within the United States and the very grounding presumption that agents have a preference regarding the number of "alike" neighbors are problematic. This desire not to be in a minority—and to move if one is—maps most accurately the situations of white flight, a response to desegregation. Further, if taken as an explanation for gentrification, it portrays the movement of minorities to more affordable and less desirable areas as voluntary, rather than as the result of rising rents and taxes. Most importantly, if it finds that institutions are not to blame for segregation, it is because institutional actions are rendered invisible in these models.

Thomas C. Schelling's original publication makes this deliberate erasure of institutions and economics, as well as its engagement with white flight (or "neighborhood tipping"), clear. His now classic "Dynamic Models of Segregation" was published in 1971, during the heart of the civil rights movement and at the beginning of forced school desegregation.[12] Schelling, in his paper, acknowledges that he is deliberately excluding two main processes of segregation: organized action (it thus does not even mention the history of slavery and legally enforced segregation) and economic segregation, even though "economic segregation might statistically explain some initial degree of segregation" (145). Economic assumptions, however, are embedded at all levels in his model. Deliberate analogies to both economics and evolution ground his analysis of the "surprising results" of unorganized individual behavior.[13] He uses economic language to explain what he openly terms "discriminatory behavior."[14] At the heart of his model lies immutable difference: "I assume," he asserts,

> a population exhaustively divided into two groups; everyone's membership is permanent and recognizable. Everybody is assumed to care about the color of the people he lives among and able to observe the number of blacks and whites that occupy apiece of territory. Everybody has a particular location at any moment; and everybody is capable of moving if he is dissatisfied with the color mixture where he is. The numbers of blacks and whites, their color preferences, and the sizes of 'neighborhoods' will be manipulated. (149)

These assumptions are troubling and loaded. They erase the history of redlining and other government sanctioned programs that made it almost impossible for black citizens to buy homes in certain neighborhoods, while helping white citizens buy homes in new developments (Rothstein 2017). They also cover over the oftentimes troubling fluidity of racial identity within the United States, in particular the "one drop rule," which grounded segregation and effectively made black and white identity *not* about visible differences. As well, homophily maps hate as love. How do you show you love the same? By running away when others show up.

The erasure of history and qualitative theories about race, gender, and sexuality within social network models represents and reproduces troubling assumptions that many, within the humanities especially (but not only: think here of the overwhelming notion of the United States as "postracial" during the beginning of the Obama presidency) had thought were history. Judith Butler's definitive analysis of gender performativity at the end of the last century, combined with work in queer theory and trans studies, has made gender mutability a default assumption. The critique of race as socially constructed, which gained widespread acceptance after the horrors of the Holocaust, have been buttressed by careful historical, empirical, and theoretical studies: from Michael Omi and Howard Winant's canonical *Racial Formation in the United States* (1994) to Alondra Nelson's analysis of the genetics and race in the *Social Life of DNA: Race, Reparations, and Reconciliation after the Genome* (2016), from Paul Gilroy's controversial and provocative *Against Race: Imagining Political Culture beyond the Color Line* (2000) to Grace Elizabeth Hale's thorough examination of the Southern myth of absolute racial difference in *Making Whiteness: The Culture of Segregation in the South, 1890–1940* (1998).

Combined with so many more works, these texts document the rise of the modern concept of race during the era of Enlightenment; its centrality to colonization and slavery; its seeming zenith during the era of eugenics; its transformations after World War II; and its resurgence as an "invisible" marker in genetics. All of this is ignored within network science, when "race," "gender," and other differences are solidified as node characteristics. All of this drives twenty-first century echo chambers and politics. So what to do?

Crucially, simply insisting on the fluidity of racial categories or "deconstructing" assumptions is not enough. Some work in network science does question assumptions behind racial homophily. As mentioned previously, Andreas Wimmer and Kevin Lewis have revealed that effects, understood as caused by "racial homophily," are usually caused by other factors: from homophily among coethnic groups rather than racial groups (so, underlying "Asian" homophily are tendencies of South Asians to befriend South Asians; Chinese other Chinese, et cetera) to homophily based on "socioeconomic status, regional background, and shared cultural taste" (143), to the "balancing mechanisms" employed by social media sites. (Importantly, this study was based on an extensive analysis of Facebook pages of an entire college cohort of 1,640 students.) Although this work in intersectionality is important, it is not enough, especially since intersectionality, as mentioned earlier, is exactly what "proxy factors" target, and also because this work still assumes homophily, but at different "ethnic" levels.

To create a different world, we need to question default assumptions about homophily. As Sara Ahmed has argued in *The Cultural Politics of Emotion,* "love of the same" is never innocent: white supremacist love, for instance, is based on a hatred of others (Ahmed 2004). The movement away from others, which grounds models of homophily, reveals the extent to which hatred precedes homophily. The hatred that networks foster, then, should surprise no one. Hatred, Ahmed stresses, organizes bodies. It is an emotional "investment" that makes certain bodies responsible for pain or injury. It organizes by bringing things and bodies together—by linking certain figures together so they become a common threat, an X to "our" O. Hate transforms the particular into the general: it transforms individuals into types so they become a common threat (I hate you because you are Y). It also transforms *I*s into *we*s who are threatened by this other. Homophily is never innocent: the very construction of Xs and Os, who define their discomfort in relation to the presence of others, reveals hatred, not love. Hatred is what makes possible strong bonds that define a core against a periphery. Thus, it is not only that network science seemingly makes the modeling of conflict impossible, it does so while also hiding conflict as friendship.

What this makes clear is the following: rather than mutual ignorance, apathy, or revulsion, what is needed is engagement, discussion, and yes, even conflict, in order to imagine and perform a different future. The proliferation of echo chambers and the erasure of politics is not inevitable—we can make them self-canceling prophecies. Although this will entail more than different network algorithms, these algorithms are a good place to start. What if we heeded Safiya Noble's analysis of how Google searches spread sexism and racism, and her call for better, public search engines (2018)? What if we took up Joanne Sison and Warren Sack's challenge to build democratic search engines, that is, search engines that gave users the most diverse rather than the most popular results)? How would this challenge assumptions about the "power law" (rich get richer; poor get poorer), which these algorithms foster, as well as discover? What would happen if ties did not represent friendship but rather conflict? What other world would emerge if clusters represented difference rather than similarities? What other ways would be revealed of navigating the world and of making recommendations?

Vi Hart, in her remarkable remodeling of Schelling—*The Parable of the Polygons* (2017)—makes explicit the relationship between initial conditions and history. Further, her model takes the desire for desegregation, rather than segregation, as the default. The lessons learned are thus:

1. Small individual bias ⟶ Large collective bias.
   When someone says a culture is shapist, they're not saying the individuals in it are shapist. They're not attacking you personally.

2. The past haunts the present.
   Your bedroom floor doesn't stop being dirty just coz you stopped dropping food all over the carpet. Creating equality is like staying clean: it takes work. And it's always a work in progress.

3. Demand diversity near you.
   If small biases created the mess we're in, small anti-biases might fix it. Look around you. Your friends, your colleagues, that conference you're attending. If you're all triangles, you're missing out on some amazing squares in your life—that's unfair to everyone. Reach out, beyond your immediate neighbors. (Hart and Case 2017)

Fox Harrell, a pioneer in computational media studies, also offers a different way to engage computational modeling. Fox Harrell's work asks: how can A.I. generate new and more humane interactions? In contrast to most computational identity systems that incorrectly *reify* identity categories by implementing them as simple data fields (e.g., selecting gender from a brief drop-down menu) or a collection of attributes (e.g., races represented as modifiers to numerical statistics and constrained graphical characteristics in computer games), he has developed the AIR (Advanced Identity Representation) project to produce "computational models of *subjective* identity phenomena related to categorization such as specific forms of marginalization that are overlooked in engineering" (Harrell 2013, 1). Crucially, systems he has built, such as *Chimeria: Gatekeeper,* confront users with the fluidity of racial identifications and the difficulties of managing discrimination based on stereotypes and the limitations of passing. Further, his analyses of existing systems and user interactions with his systems based on "archetypal analyses," exposes and analyzes the "ideal players" embedded within popular games and how they can perpetuate stereotypes through the actions they enable and prohibit. For instance, he reveals how certain "species" within games line up with certain stereotypical assumptions about races, as well as how user actions with differently gendered avatars reveal assumptions about gender.

Harrell's work most critically engages the creativity embedded within artificial intelligence. *Phantasmal Media: An Approach to Imagination, Computation, and Expression* (2013), drawn from his work with Define Me and GRIOT, groundbreaking social networking and expressive A.I. projects, asks: can A.I. have the same impact as great literature, such as Ralph Ellison's *Invisible Man*? That is, through its powerful imagery and literary innovations, can A.I. enable its readers to experience the world of social invisibility? Can A.I. imagine different, more just worlds, while also exposing the extent to which society and ideology are linked to the imagination? To produce computational and interactive narratives that do this, Harrell in his first book developed a theory of phantasmal media, in which a phantasm is a combination of imagery and ideas. By focusing on the role of phantasms, Harrell addresses not simply the centrality of the imagination to individual experience but also the relationship between individuals and larger cultural and political issues. Significantly, Harrell does not simply condemn phantasms as unreal and unjust but rather reveals how they can be both empowering and oppressive. They are forms of agency play. Through a comparative analysis that reveals the experiences of those normally excluded from mainstream society, his work thus both exposes the negative impact of phantasms and produces new phantasms that allow his users to imagine new worlds. That is, his work in cultural computing makes visible cultural phantasms in order to diversify the range and impact of computing systems. For instance, by revealing the cultural phantasms behind notions of grey/black sheep (persons who do not fit nicely into preconceived identity and behavioral categorizations), Harrell transforms them from errors into rich sources of knowledge. As well (and as noted earlier), critical computing enables empowerment and agency, where agency is not the freedom to do anything one wants but rather the situated mechanisms for user action within the context of cultural phantasms. By thinking expressive, cultural, and critical computing together, Harrell shows how embodied individual experiences are created and how the social and the computational are linked together through the phantasmal.

As well as this new type of artificial intelligence, new theories of connection—which do not presume a dangerously banal and reciprocal notion of friendship—are needed. Rather than similarity as breeding connection, we need to think, with Ahmed, through the generative power of discomfort. We need to queer homophily, a concept that should in its very nature be queer. Ahmed views queerness as an inability to be comfortable in certain norms:

> To feel uncomfortable is precisely to be affected by that which persists in the shaping of bodies and lives. Discomfort is hence not about assimilation or resistance, *but about inhabiting norms differently.* The inhabitance is generative or productive insofar as it does not end with the failure of norms to be secured, but with the possibilities of living that do not "follow" those norms through. (emphasis in original, 155).

To be uncomfortable, then, is to inhabit norms differently, to create new ways of living with others—different ways of impressing upon others. Working with Ahmed and others, we can imagine new defaults, new forms of engagement. Different, more inhabitable, patterns.

We also need to examine theoretical moves and assumptions within the humanities. That the humanities and cultural theory more generally have moved away from questions of cultural difference and identity at a time when such an engagement could not be more crucial is mind-boggling. The various turns toward "less coarse" and "static" concepts such as nonhuman allure (themselves inspired by networks and new media), not to mention the embrace of an instrumentalist technological logic that demeans critical analysis and celebrates digital tinkering, are oddly contradictory and self-defeating. The early twenty-first century has witnessed a move away from theories of performativity, mutability, and deep interpretation, just when such theories are crucial to unpacking, re-imagining and remaking the retrograde identity politics embedded within the world of networks. By refusing to analyze and engage these patterns—by refusing to use the "old" keys in our pocket—we lock ourselves into a future we allegedly oppose.

The future lies in the new patterns we can create together, new forms of relation that include liveable forms of indifference. The future lies in unusual collaborations that both respect and challenge methods and insights, across disciplines and institutions.

Notes

1 For an overview, see Sweeney and Haney 1992. During this same period, this was made clear in the disparity between jail sentences given to two U.S. male college athletes for sexually assaulting unconscious women. Corey Batey, a nineteen-year-old African American football player at Vanderbilt was sentenced to a mandatory minimum sentence of fifteen to twenty-five years; Brock Turner, a nineteen-year-old swimmer at Stanford was sentenced to six months, which could be shortened for good behavior (see King 2016).

2 These editors of *Network Science* made the following claims in their introduction to the inaugural issue:

> Claim 1: Network science is the study of network models.
> Claim 2: There are theories about network representations and network theories about phenomena: both constitute network theory.
> Claim 3: Network science should be empirical—not exclusively so, but consistently—and its value assessed against alternative representations.
> Claim 4: What sets network data apart is the incidence structure of its domain.
> Claim 5: At the heart of network science is dependence, both between and within variables.
> Claim 6: Network science is evolving into a mathematical science in its own right.
> Claim 7: Network science is itself more of an evolving network than a paradigm expanding from a big bang. (Brandes et al. 2013, 1–15)

3 Barabási's description resonates with cyberpunk fiction, which posits artificial intelligence and supreme cowboy hackers as capable of detecting "patterns . . . in the dance of the street" and thus foresee events that elude mere humans (see Gibson 1984, 250).

4 As Duncan Watts notes: "The truth is that most of the actual science here com-

prises extremely simple representations of extremely complicated phenomena. Starting off simple is an essential stage of understanding anything complex, and the results derived from simple models are often not only powerful but also deeply fascinating. By stripping away the confounding details of a complicated world, by searching for the core of a problem, we can often learn things about connected systems that we would never guess from studying them directly. The cost is that the methods we use are often abstract, and the results are hard to apply directly to real applications. It is a necessary cost, unavoidable in fact, if we truly desire to make progress" (Watts 2004).

5 The example they give of the difference between network science and statistic is quite illuminating: "While the range of attributes is structured, in much of science, the domain on which variables are defined is assumed to have no structure, i.e., simply a set. This may be for good reason. If we are interested in associations between, say, education and income controlled for age, we actually do not want there to be relations between individuals that also moderate the association. Much of statistics is in fact concerned with detecting and eliminating such relations. Network science, on the other hand, seeks to understand the correspondence and impact of these relations, rather than control for any variable" (Brandes et al. 2013, 8).

6 As Easley and Kleinberg explain, "the pattern of connections in a given system can be represented as a network, the components of the system being the network vertices and the connections the edges. Upon reflection it should come as no surprise (although in some fields it is a relatively recent realization) that the structure of such networks, the particular pattern of interactions, can have a big effect on the behavior of a system. . . . A network is a simplified representation that reduces a system to an abstract structure capturing only the basics of connection patterns and little else (Easley and Kleinberg 2010, 2).

7 They write: "in a network setting, you should evaluate your actions not in isolation but with the expectation that the world will react to what you do." This makes "cause-and-effect relationships . . . quite subtle" and may only become evident at the population level" (Easley and Kleinberg 2010, 5).

8 Pierre Bourdieu defined social capital as: "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition—or in other words, to membership in a group" (Bourdieu 1986). Social capital is a form of credit or credentialing that relies on reciprocal and networked acknowledgement and exchange. This form of capital, he stresses, exists "only in the practical state, in material and/or symbolic exchanges which help to maintain them." The ties, that is, are dynamic and constantly enacted.

9 As Cramer writes: "The reduction of audience members to countable numbers—data sets, indices—is thus a self-fulfilling prophecy of stability" (Cramer in this volume).

10 By 1977, homophily was already accepted as an axiomatic if problematic aspect of society. In an equally key early text, *Inequality and Heterogeneity: A Primitive Theory of Social Structure,* Peter Blau outlined what would become "contact

theory": the theory that contact creates integration. An ambitious attempt to create a roadmap of "macrosociological theory" (written in the spirit of Karl Marx and Georg Simmel), it argued for the importance of "weak ties" and heterogeneity to combat inequality within society. As he put it, heterogeneity and inequality were "complementary opposites" and "there can be too much inequality, but cannot be too much heterogeneity" (Blau 1977, 11). Blau argued strongly for the replacement of "strong ingroup bonds," which "restrain individual freedom and mobility . . . and sustain rigidity and bigotry" with "diverse intergroup relations" (85). These heterogeneous relations, "though not intimate, foster tolerance, improve opportunities, and are essential for the integration of a large society" (85). In terms that resonated with Jameson's description of postmodernism and the possibilities of "cognitive mapping," he states, "the loss of extensive strong bonds in a community of kin and neighbors undoubtedly has robbed individuals of a deep sense of belonging and having roots, of profound feelings of security and lack of anxiety. This is the price we pay for the greater tolerance and opportunities that distinguish modern societies, with all their grievous faults, from primitive tribes and feudal orders. The social integration of individuals in modern society rests no longer exclusively on strong bonds with particular ingroups but in good part on multiple supports from wider networks of weaker social ties, supplemented by a few intimate bonds" (85). This insight itself draws from the work of another early progenitor of network science, Mark Granovetter's 1973 theorization of "weak ties" as essential to information dissemination and success. For more on this in relation to networks as dissolving postmodern confusion, see Chun (2016). Tellingly, Blau's argument assumes—and indeed takes as axiomatic—the fact that ingroup interactions are greater than intergroup ones (Axiom A1.1). It also divides and identifies individuals based on structural parameters, such as "age, race, education, and socioeconomic status," some of which Blau considers "inborn" (1977, 6).

11 For instance, Lenore Newman and Ann Dalez state: "We feel more comfortable with those like ourselves, even in virtual communities." (2007, 79–90).

12 In 1972, the NAACP filed a class action lawsuit against the Boston School Committee—Bostong is contiguous with Cambridge, Massachusetts, which is where Harvard is located.

13 Schelling writes: "economists are familiar with systems that lead to aggregate results that the individual neither intends nor needs to be aware of, results that sometimes have no recognizable counterpart at the level of the individual. The creation of money by a commercial banking system is one; the way savings decisions cause depressions or inflations is another. Similarly, biological evolution is responsible for a lot of sorting and separating, but the little creatures that mate and reproduce and forage for food would be amazed to know that they were bringing about separation of species, territorial sorting, or the extinction of species" (Schelling 1971, 145). Schelling also uses the term "incentives" to explain segregation: from preferences to avoidance to economic constraints (148).

14 At the start of this article, Schelling explains: “This article is about the kinds of segregation—or separation, or sorting—that can result from discriminatory individual behavior. By ‘discriminatory,’ I mean reflecting an awareness, conscious or unconscious, of sex or age or religion or color or whatever the basis of segregation is, an awareness that influences decisions on where to live, whom to sit by, what occupation to join or avoid, whom to play with or whom to talk to” (144).

References

ACORN. 2013. “What Is ACORN?” *Caci.* Accessed March 1, 2016. http://acorn.caci.co.uk.

Agre, Phil. 1994. “Surveillance and Capture: Two Models of Privacy.” *The Information Society* 100: 101–27.

Ahmed, Sara. 2004. *The Cultural Politics of Emotion.* London: Routledge.

Al Zamal, Faiyaz, Wendy Liu, and Derek Ruths. 2012. “Homophily and Latent Attribute Inference: Inferring Latent Attributes of Twitter Users from Neighbors.” *Proceedings of the Sixth International AAAI Conference on Weblogs and Social Media*. https://www.aaai.org/ocs/index.php/ICWSM/ICWSM12/paper/viewFile/4713/5013.

Angwin, Julio, Jeff Larson, Surya Mattu, and Lauren Kirchner. 2016. “Machine Bias: There’s Software Used Across the Country to Predict Future Criminals. And It’s Biased against Blacks.” *ProPublica.* Accessed May 23, 2016. https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing.

Aral, Sinan, and Dylan Walker. 2012. “Identifying Influential and Susceptible Members of Social Networks.” *Science* 337: 337–41.

Aral, Sinan, Lev Muchnik, and Arun Sundaraajan. 2013. “Engineering Social Contagions: Optimal Network Seeding and Incentive Strategies.” *Network Science* 1, no. 2: 125–53.

Barabási, Albert-László. 2010. *Bursts: The Hidden Patters behind Everything We Do, from Your E-mail to Bloody Crusades.* New York: Plume.

Bernstein, Elizabeth. 2007. *Temporarily Yours: Intimacy, Authenticity, and the Commerce of Sex.* Chicago: University of Chicago.

Blarr, Alistair. 2015. “Google Mistakenly Tags Black People as ‘Gorillas,’ Showing Limits of Algorithms.” *The Wall Street Journal.* Accessed July 1, 2015. http://blogs.wsj.com/digits/2015/07/01/google-mistakenly-tags-black-people-as-gorillas-showing-limits-of-algorithms/.

Blau, Peter M. 1977. *Inequality and Heterogeneity: A Primitive Theory of Social Structure.* New York: The Free Press.

Bourdieu, Pierre. 1986. “The Forms of Capital.” In *Handbook of Theory and Research for the Sociology of Education,* edited by John G. Richardson, 241–58. New York: Greenwood.

Brandes, Ulrik, et al. 2013. “What Is Network Science?” *Network Science* 1, no. 1: 1–15.

Brown, Wendy. 2015. *Undoing the Demos: Neoliberalism’s Stealth Revolution*. Cambridge, Mass.: MIT Press.

Burt, Ronald S. 2002. “Chapter 7: The Social Capital of Structural Holes.” In *The New*

Economic Sociology: Developments in an Emerging Field, edited by Marshall Meyer, Maruo F. Guillen, Randall Collins, and Paula England, 148–92. New York: Russell Sage.

Burt, Ronald S. 1992. *Structural Holes: The Social Structure of Competition*. Cambridge, Mass.: Harvard University Press.

Butler, Judith. 1988. “Performative Acts and Gender Constitution: An Essay in Phenomenology and Feminist Theory.” *Theater Journal* 40, no. 4: 519–31.

Butler, Judith. 1990. *Gender Trouble: Feminism and the Subversion of Identity.* London: Routledge.

Butler, Judith. 1997. *Excitable Speech: A Politics of the Performative*. London: Routledge.

Cadwalladr, Carole. 2018. “‘I Made Steve Bannon’s Psychological Warfare Tool’: Meet the Data War Whistleblower,” *The Guardian*. Accessed July 5, 2018. https://www.theguardian.com/news/2018/mar/17/data-war-whistleblower-christopher-wylie-faceook-nix-bannon-trump.

Centola, Damon M. 2013. “Homophily, Networks, and Critical Mass: Solving the Start-up Problem in Large Group Collective Action.” *Rationality and Society* 15 (1): 3–40.

Centola, Damon, Juan Carlos González-Avella, Vıctor M. Eguíluz, and Maxi San Miguel. 2007. “Homophily, Cultural Drift, and the CO-Evolution of Cultural Groups.” *The Journal of Conflict Resolution* 51, no. 6: 905–29.

Chun, Wendy Hui Kyong. 2016. *Updating to Remain the Same: Habitual New Media.* Cambridge, Mass.: MIT Press.

Crawford, Kim, and Jason Schultz. 2014. “Big Data and Due Process: Toward a Framework to Redress Predictive Privacy Harms.” *Boston College Law Review* 55, no. 1: 93–128. http://lawdigitalcommons.bc.edu/cgi/viewcontent.cgi?article=3351&context=bclr.

Crenshaw, Kimberlé. 1991. “Mapping the Margins: Intersectionality, Identity Politics, and Violence against Women of Color.” *Stanford Law Review* 43, no. 6: 1241–99.

Derrida, Jacques. 1988. “Signature, Event, Context.” In *Limited Inc.*, translated by Samuel Weber, 1–23. Evanston, Ill.: Northwestern University Press.

DiMaggio, Paul, and Filiz Garip. 2012. “Network Effects and Social Inequality.” *Annual Review of Sociology* 38:93–118.

Dyer, Richard. 1997. *White: Essays on Race and Culture.* London: Routledge.

Easley, David, and Jon Kleinberg. 2010. *Networks, Crowds, and Markets: Reasoning about a Highly Connected World*. Cambridge: Cambridge University Press.

Fourcade, Marion, and Kieran Healy. 2016. “Seeing Like a Market.” *Socio-Economic Review* 15, no. 1: 1–21.

Frucci, Adam. 2009. “HP Face-Tracking Webcams Don’t Recognize Black People.” *Gizmodo*. Accessed December 21, 2009. http://gizmodo.com/5431190/hp-face-tracking-webcams-dont-recognize-black-people.

Gibson, William. 1984. *Neuromancer.* New York: ACE.

Gilroy, Paul. 2000. *Against Race: Imagining Political Culture beyond the Color Line.* Cambridge, Mass.: Harvard University Press.

Gorner, Jeremy. 2013. “Chicago Police Use ‘Heat List’ as Strategy to Prevent Violence.” *The Chicago Tribune.* Accessed August 21, 2013. http://articles.chicagotribune

.com/2013–08–21/news/ct-met-heat-list-20130821_1_chicago-police-commander-andrew-papachristos-heat-list.

Granovetter, Mark. 1973. "The Strength of Weak Ties." *American Journal of Sociology* 78, no. 6: 1360–80.

Hale, Grace Elizabeth. 1998. *Making Whiteness: The Culture of Segregation in the South, 1890–1940.* New York: Pantheon Books.

Harrell, D. Fox. 2013. *Phantasmal Media: An Approach to Imagination, Computation, and Expression.* Cambridge, Mass.: MIT Press.

Harris, Meena. 2016. "Talking with Black Women Engineers about Diversity in Silicon Valley." *Lenny.* Accessed March 1, 2016. http://www.lennyletter.com/work/a283/talking-with-black-women-engineers-about-diversity-in-silicon-valley/.

Hart, Vi, and Nick Case. 2017. "Parable of the Polygons." Accessed June 29, 2017. http://ncase.me/polygons/

Healy, Kieran. 2015. "The Performativity of Networks." *European Journal of Sociology* 52, no. 2: 175–205.

Ibarra, Herminia. 1993. "Personal Networks of Women and Minorities in Management: A Conceptual Framework." *The Academy of Management Review* 18, no. 1: 56–87.

Ingram, Matthew. 2016. "Why Getting Rid of Human Editors Won't Solve Facebook's Bias Problem." *Fortune.* Accessed August 29, 2016. http://fortune.com/2016/08/29/facebook-trending-human-bias/.

Jackson, Matthew O. 2008. "Average Distance, Diameter, and Clustering in Social Networks with Homophily." In *Internet and Network Economics: Proceedings of the 4th International Workshop WINE 2008,* edited by Christos Papdimitriou and Shuzhong Zhang, 4–11. Berlin: Springer-Verlag.

Jameson, Frederic. 1990. "Cognitive Mapping." In *Marxism and the Interpretation of Culture,* edited by Cary Nelson and Lawrence Grossberg, 347–60. Urbana and Chicago: University of Illinois Press.

Jameson, Frederic. 1991. *Postmodernism, or the Cultural Logic of Late Capitalism.* London: Verso.

Kandel, Denise B. 1978. "Homophily, Selection, and Socialization in Adolescent Friendships." *American Journal of Sociology* 84, no. 2: 427–36.

King, Shawn. 2016. "Brock Turner and Cory Batey, Two College Athletes Who Raped Unconscious Women, Show How Race and Privilege Affect Sentences." *New York Daily News.* Accessed June 7, 2016. http://www.nydailynews.com/news/national/king-brock-turner-cory-batey-show-race-affects-sentencing-article-1.2664945.

Lartey, Jamiles. 2016. "Predictive Policing Practices Labeled as 'Flawed' by Civil Rights Coalition." *The Guardian.* Accessed August 31, 2016. https://www.theguardian.com/us-news/2016/aug/31/predictive-policing-civil-rights-coalition-aclu.

Lazarsfeld, Paul F., and Robert K. Merton. 1954. "Friendship as Social Process: A Substantive and Methodological Analysis." In *Freedom and Control in Modern Society*, edited by Morroe Berger, Theodore Abel, and Charles H. Page, 18–66. Toronto: D. Van Nostrand Company, Inc.

Lee, Odelia. 2009. "Camera Misses the Mark on Racial Sensitivity." *Gizmodo.* Accessed

May 15, 2009. http://gizmodo.com/5256650/camera-misses-the-mark-on-racial-sensitivity.

Lyotard, Jean-François. 1984. *The Postmodern Condition: A Report on Knowledge.* Minneapolis: University of Minnesota Press.

Marsden, Peter V. 1988. "Homogeneity in Confiding Relations." *Social Networks* 10, no. 1: 57–76.

McPherson, Miller, Lynn Smith-Lovin, and James Cook. 2001. "Birds of a Feather: Homophily in Social Networks." *Annual Review of Sociology* 27:415–44.

Nelson, Alondra. 2016. *Social Life of DNA: Race, Reparations, and Reconciliation after the Genome.* Boston: Beacon Press.

Newman, Lenore, and Ann Dalez. 2007. "Homophily and Agency: Creating Effective Sustainable Development Networks." *Environment, Development, and Sustainability* 9:79–90.

Noble, Safiya Umoja. 2018. *Algorithms of Oppression: How Search Engines Reinforce Racism.* New York: New York University Press.

Omi, Michael, and Howard Winant. 1994. *Racial Formation in the United States: From the 1960s to the 1990s*, 2nd edition. New York: Routledge.

O'Neil, Cathy. 2016. *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy.* London: Penguin.

Ooka, Emi, and Barry Wellman. 2006. "Does Social Capital Pay Off More within or between Ethnic Groups? Analyzing Job Searches in Five Toronto Ethnic Groups." In *Inside the Mosaic,* edited by Erik Fong, 199–226. Toronto: University of Toronto Press.

Phillips, Whitney. 2015. *This Is Why We Can't Have Nice Things: Mapping the Relationship between Online Trolling and Mainstream Culture*. Cambridge, MA: MIT Press.

Pinboard. 2016. "Machine Learning Is Money Laundering for Bias." Accessed August 29, 2016. https://twitter.com/pinboard/status/744595961217835008.

Robinson, David, and Logan Koepke. 2016. "Stuck in a Patter: Early Evidence on 'Predictive Policing' and Civil Rights." *Upturn.* Accessed August 30, 2016. https://www.teamupturn.com/reports/2016/stuck-in-a-pattern.

Rothstein, Richard. 2017. *The Color of Law: A Forgotten History of How Our Government Segregated America.* New York and London: Liveright Publishing Corporation, a Division of W.W. Norton & Company.

Rouvroy, Antoinette. 2011. "Technology, Virtuality, and Utopia: Governmentality in an Age of Autonomic Computing." In *The Philosophy of Law Meets the Philosophy of Technology: Autonomic Computing and Transformations of Human Agency,* edited by Mireille Hildebrandt and Antoinette Rouvroy, 136–57. Milton Park, UK: Routledge.

Saunders, Jessica, Priscilla Hunt, and John S. Hollywood. 2016. "Predictions Put into Practice: A Quasi-Experimental Evaluation of Chicago's Predictive Policing Pilot." *Journal of Experimental Criminology* 22, no. 3: 347–71. http://link.springer.com/article/10.1007/s11292–016–9272–0.

Schelling, Thomas C. 1971. "Dynamic Models of Segregation." *Journal of Mathematical Sociology* 1:143–86.

Silver, Nate. 2012. *The Signal and the Noise: Why So Many Predictions Fail—but Some Don't.* New York: Penguin Books.

Sweeney, Laura T., and Craig Haney. 1992. "The Influence of Race on Sentencing: A

Meta-Analytic Review of Experimental Studies." *Behavioral Sciences and the Law* 10, no. 2: 179–95.

Thielman, Sam. 2016. "Facebook Fires Trending Team, and Algorithm without Humans Goes Crazy." *The Guardian.* Accessed August 29, 2016. https://www.theguardian.com/technology/2016/aug/29/facebook-fires-trending-topics-team-algorithm.

Watts, Duncan J. 2004. *Six Degrees: The Science of a Connected Age* (Kindle Locations 191–94). W. W. Norton. Kindle Edition.

Wimmer, Andreas, and Kevin Lewis. 2010. "Beyond and Below Racial Homophily: ERG Models of a Friendship Network Documented on Facebook." *American Journal of Sociology* 116, no. 2: 642–83.