

University Library



MINERVA
ACCESS

A gateway to Melbourne's research publications

Minerva Access is the Institutional Repository of The University of Melbourne

Author/s:
Walton, RE

Title:
Theatres of artificial intelligence and the overlooked performances of computing

Date:
2021-09-01

Citation:
Walton, R. E. (2021). Theatres of artificial intelligence and the overlooked performances of computing. *Theatre Journal*, 73 (3), pp.279-298. <https://doi.org/10.1353/TJ.2021.0067>.

Persistent Link:
<https://hdl.handle.net/11343/290614>

Theatres of Artificial Intelligence and the Overlooked Performances of Computing

Robert Walton

An early prototype for my site-responsive performance work *Vanitas* required audience members to download a custom app to their own smartphones, listen to headphone audio, and look at onscreen pictures in a format we called the "illuminated podcast."¹ Each audience member later received a text message ostensibly from a "real" person that required switching to the SMS app and texting back a response. The message contained instructions to leave the theatre alone and locate a nearby abandoned florist's shop. To do this, they had to switch among email, phone, maps, and SMS before finding the shop and switching back to the *Vanitas* app to listen to episode 2 of the illuminated podcast. This combination of a smartphone app and a transmedia server able to orchestrate correspondence, media, and performance across platforms created, in miniature, a simplified version of the globally distributed apparatus of networked computing pervading everyday life. During the performance, *Vanitas* temporarily repurposed corporate computing infrastructures normally rendered intangible to draw attention to the seams between the realities it remixed (fig. 1).

After the performance, I asked audience members to recount their journeys in chronological order, paying particular attention to how they knew where to go and when. The accounts of the experience diverged from the way the app and the automated transmedia messaging system were programmed. For example, some audience members believed that they received instructions via a telephone call at the beginning of the experience; others thought that all the instructions came from within the app. Some thought that they were listening to the app as they walked to the shop, but others were not sure how they knew to go to the shop and had forgotten that they received text messages (fig. 2).

After completing the prototype, audience members could not accurately recall the order in which they received information or the medium in which it was delivered. That all the audience members completed *Vanitas* attests that the prototype "worked." Yet, the diversity of their accounts revealed that it could be made to work in a variety of ways. Listening to headphone audio, switching apps, reading SMS, and finding a location are everyday activities, yet the prototype produced an elision of the participant's autonomous discovery of how to function within *Vanitas*. Switching between media, combining interaction techniques, and keeping up with the perceived demands of the performance shaped audience memories in ways that were at odds with what they actually encountered. How might this phenomenon be explained?

Anthropologist Lucy Suchman offers a possible response by focusing on the difference between what people *think they are doing* and what they *actually do* when executing a plan.² Suchman's analysis of the relationship between plans and "situated actions" in everyday life has

become important in human–computer interaction (HCI) design, as computers are not able to enact plans with the same flexibility as humans. Central to her theory is the power of plans retrospectively to render the actions required to complete them as inconsequential and forgettable, which helps explain the surprising oversights in audience member accounts of the *Vanitas* prototype.

Suchman notes that "instructions serve as a resource for describing what was done not only because they guide the course of action, but also because they filter out of the retrospective account of the action, or treat as 'noise,' everything that was actually done that the instructions fail to mention."³ In this respect, a connection can be made among instructions, plans, scripts, and scores that are seen as prior to situated actions and performances. Unlike a play's script, which is given in advance, instructions in the *Vanitas* prototype were delivered at the very moment that they were required to be enacted. Instead of being provided in a single document, the instructions were orchestrated across media and communicated by text message, email, app audio, phone call, and in person, similar to the way Wendy Hui Kyong Chun associates with the condition of being "subject to ceaseless updates" in the era of "new media."⁴ This intensified combination and timing are likely to have exacerbated what Lauren Berlant terms "crisis ordinary" to describe the mild confusion and anxiety caused by everyday usage of internet technologies.⁵ Despite the prototype being dependent on audience complicity and active participation in this heightened form of transmedia interaction, audience members filtered out and treated as "noise" their own contributions to enabling *Vanitas* to function. This selective filtering and nonobservance of situated actions became a starting point for discussing overlooked performances. This essay asks: What other performances are overlooked in proximity to computing? And what can theatre and performance studies offer to the discourses of computing technologies?

The term *performance* within this context complements Suchman's situated actions. First, it positions the audience member within the event, and acknowledges the participant as a co-constituent of it. Second, performance invokes dramaturgy and an appreciation of the impression management being undertaken by the performers: the smartphone, and the audience member in the case of *Vanitas*. This dramaturgy extends to the idea of crafting an overlookable performance (attempting imperceptibility), to overlooking performance (studiously nonobserving and denying), and to recovering the overlooked (practicing undoing habituated modes of looking). Third, performance allows consideration of the citational nature of habits and situated actions that aspire to the tactical recreation of past techniques in response to the immediate circumstances of the present (as in performing a previously successful problem-solving technique for finding a location). And last, performance indexes the intersection of fictional, everyday, and virtual realities in which action is situated "to express both [the] mixing of the real and virtual as well as [the] combination of live performance and interactivity."⁶

The audience members' accounts of *Vanitas* indicated that smartphone interactions, normally overlooked as part of the dramaturgy of everyday life, are by necessity embroidered into any wider conception of artistic site-responsive performance. Indeed, such performances may provide fertile opportunity to critique and disrupt habituated experiences of smartphones as an instance of what influential technologist Mark Weiser termed "ubiquitous computing" to describe a "physical world richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects of our lives and connected through a continuous network."⁷ The ever-present, ever-observant apparatus of ubiquitous computing is onstage, but backgrounded, like a Greek chorus of machines, framing the attention of the audience. The chorus models "the ideal spectator," as August Wilhelm von Schlegel explained, with the function of mirroring back to the actual audience an "expression of his own emotions [that] elevates him to the region of contemplation."⁸ The smartphone is present though habitually overlooked, discretely directing attention and modeling an ideal human that is efficient, connected, available, updatable, and able to flow seamlessly within any environment. While such technologies offer many alleged enhancements to everyday life, they are at best, as Chun notes, "wonderfully creepy," and at worst deliver, as David Berry and Michael Dieter articulate, "a systematic production and maintenance of ignorance."⁹

Computing technologies and the overlooked performances occurring in proximity to them are bound up in habits, which Chun notes "are practices acquired through time that are seemingly forgotten as they move from the voluntary to the involuntary, the conscious to the automatic."¹⁰ Habits are acquired and sedimented through repeated performances in citation of themselves. Intervening in habits has been a preoccupation of avant-garde arts practices that employ what Viktor Shklovsky termed the "technique of art" to make the sensation of objects lost to habit "unfamiliar," so "that one may recover the sensation of life, to make one feel things, to make the stone *stony*."¹¹ However, the miniaturization and acceleration of computing means that it is impossible for the human body to "get a grip" on impalpable "computational things," rendering Shklovsky's technique of art unable to recover the sensation of computing and data.¹² This crisis necessitates what Berry identifies as "a passive trust in [the] widely delegated, yet obfuscated, actions" of ubiquitous computing, which may only ever be encountered in performance, staged as interfaces that the human body can sense.¹³ Theatre's locus in action, ritual, and performance offers practices and theories that can mobilize in response to this crisis. Not by seeking to recover the sensation of computing and data, but by interrogating algorithmic rituals, dramaturgies, and habits, with an eye to intervention in these live practices. This begins by addressing computation in action, as a performance, through the observations of key inventors and commentators, starting with Alan Turing and machine performance of computers.

<A>Machines Perform Computers

Turing's celebrated 1937 paper specifying "the universal computing machine" provided the first theoretical proof that a machine could perform the tasks previously undertaken by a human computer. The paper contains many references to performance and reveals that Turing acted as his computer to prove his theory before asserting, "we may now construct a machine to do the work of this computer."¹⁴ Turing used mathematics to define an algorithm called a computer that both human and machine could perform. Subsequently, human-engineered machines began to perform as computers and taking on the roles previously undertaken by people, including the first modern computers, who, as Chun reminds us, were groups of women during the Second World War.¹⁵

Turing was highly sensitized to the distinction between computer and machine, but contemporary usage of the term *computer* conflates the machine with the abstract mathematical specification it performs. By imagining the simplest possible operations required by a computer, Turing arrived at a theory that could be translated into the physical realm of engineered machines: "Let us imagine the operations performed by the computer to be split up into 'simple operations' which are so elementary that it is not easy to imagine them further divided. Every such operation consists of some change of the physical system consisting of the computer and his tape."¹⁶ Turing's breakthrough was to express a computer in logic that would "automatically" guide the functioning of a machine as its "state of mind" moved through a series of the simplest possible operations. The machine performs this act of computation. During its performance, the machine temporarily becomes a physical instantiation of the computer (that which computes). Therefore computers are performed and cease to exist when the event of their performance ends. The engineered machine is not a computer unless it is performing.

Conflation of machine and computer led to the overlooking of computation as a live performance event occurring in time and space. Revisiting this overlooked performance ontology of computing refreshes the conceptualization of new media, interfaces, data, human habits, and AI as events. Computer scientists like Turing regularly mobilize performance, theatre, and drama, often as a conclusion or afterthought, to grasp what Michael Mahoney evokes as the "elusively intangible . . . behavior of the machines when running."¹⁷ Yet relatively few studies begin where these observations end: with performance, theatre, or drama. For example, Martina Leeker et al. observe that "digital devices and infrastructures perform, and they make humans (and non-humans) perform,"¹⁸ but it remains unclear how to move beyond the realization that computing is an event, what the implications of this ontology are, and what difference such understanding can make beyond theatre and performance studies.

Returning to Turing's 1937 paper reveals further implications for the performance ontology of computing. Looking to the simplest acts that can be performed by machines provides a way to talk

about the smallest quanta of nonhuman machine performance. Turing machines perform a limited set of logical operations with computable numbers. These equate to 1) sensing presence or absence then; 2) comparing sensation of presence or absence; followed by 3) acting to create presence or absence. These processes are usually referred to as reading, comparing, and writing. However, the relation to reading and writing is metaphorical, anthropomorphic, and might equally be called sensing, feeling, and acting, for example. At the level of the manipulation of individual symbols and latterly bits of information, there is no concept of the significance of what is represented by the task "in mind," only a compulsion to keep performing reading, comparing, and writing within the logical strictures engineered into the physical parameters of the machine. All "higher" representation and signification within computing machines are the aggregated product of the performance of these "simple operations."

These performance quanta may also be the building blocks of machinic thinking and being, of nonconscious cognition and conatus. Turing describes the central processes that remain at the heart of today's computing machines. At its core the computer must act; it must know what to do next, when the moment comes, after it compares the symbol it has "in mind" with the symbol it "reads" or "senses." Computation in these terms is a material process of comparing the absence or presence of symbols or electronic charges, which correlate to both logical positions in mathematics and the physical state of components. Computation takes place in time (at variable frequencies and durations) and space (the dimensions of which expand and contract as the algorithm proceeds) with a forward momentum in movements through the smallest possible set of simple operations. Such is the irreducible "elementary" act of machine cognition—that is, to recognize through comparison and to *know* what to do next as a result, in a single movement.

This force of knowing what to carry into the future may also be the irreducible quantum of the computer's conatus. Animated matter sets the computer in motion. Thus in one movement of the machine both computer cognition and conatus might flicker into being. Performing such moves as contemporary processors do at frequencies in the order of 10^9 hertz (thousands of millions of times per second) produces a computational capacity for nonconscious cognition on the brink of emerging as synthetic consciousness, and the persistence of a similarly multiplied conative force. Concern for the elementary procedures of synthetic cognition led Turing and his contemporaries to speculate on the potential of machines to simulate the human brain and mind.

Another of Turing's key moves was not to try to imagine "all numbers which would naturally be regarded as computable," but to ask: "what are the possible processes which can be carried out in computing a number?"¹⁹ In an echo of theatrical production, such a move distinguishes the approach of building a theatre for each performance of a play from building a theatre that can stage the performance of any play. By identifying the minimum number of fundamental actions that a

computer can carry out, Turing established that matter could be animated in a machine to perform computation "automatically." In so doing, he expressed a theory that guided years of technological experimentation toward a threshold where mathematics and matter meet. Turing established that a universal machine was possible mathematically; then he and others went on to manipulate matter into increasingly effective machines able to perform computation.

However, the universal computing machine proposed by Turing has an important tautological paradox at its core: it is "a single machine which can be used to compute any computable sequence."²⁰ The universal computing machine can only compute what is rendered computable. Instructions, formulae, alphabets, and media must all be translated into a language that the machine can compute. A significant portion of the history of computing relates to the project of standardizing digital representations of media to efficiently meet the needs of two orders of meaning: first, the demanding, basic need, of universal computing machines that insist that the universe comes to them and be reduced to computable numbers in base two; and second, to meet the needs of humans who prefer representations that engage their sensorium evocatively and enter their sense of timing and responsiveness. The translation between these needs and desires is the root cause of many of "the injustices, the mistreatments, the insensitivities of data" as David Beer points out, and "are where we are most likely, momentarily, to feel their presence."²¹ The process of rendering the world in computable numbers remains fraught with the entangled habits, ideologies, and prejudices of their creators. As Dianne Nelson asks: "Who counts?"²² Who does the counting and who is counted? Who is seen and how is difference encoded? Whose world is rendered in computable numbers and whose is not?

The implications of the performance ontology of computing at the forensic level established by Turing extends upward through what Berry terms "the digital iceberg" toward the tip of interface, above the waterline, where the computing machine's functioning emerges as palpable to human senses.²³ Performative conventions, standards, and protocols maintain the stricture of machine requirements for computable numbers. A computational protocol, as Alexander Galloway notes, demands a certain minimum level of performance *everywhere*, and failure to perform warrants exclusion.²⁴ When extended to the apparatus of mass computing, the underlying protocols become, as Galloway notes, a far larger and coercive "machine, that massive control apparatus that guides distributed networks, creates cultural objects and engenders life forms."²⁵ However, algorithmic ritual and performances of computing predate the machines that now perform them. The extension of these practices to machines brings their strictures to light in new ways, but they are not without precedent. These concerns extend to my next point of focus: software's overlooked performance of media.

<A>Software Performs Media

In 1968, thirty years after the publication of Turing's seminal paper, Alan Kay created the initial specification of the "Dynabook," a mobile personal computer and early ancestor of the smartphone. During the Dynabook's intensive development during the 1970s, Kay and his team were the first to articulate software as a "metamedium" able to represent "a wide range of already-existing and not-yet-invented media."²⁶ In 1984, Kay went on to note that the computer "is a medium that can dynamically simulate the details of any other medium, including media that cannot exist physically. It is not a tool, although it can act like many tools. It is the first metamedium, and as such it has degrees of freedom for representation and expression never before encountered and as yet barely investigated."²⁷ In the time since Kay's research, a main endeavor of software has been the project of rendering preexisting tools and media in computable formats: the software equivalent of what Marshall McLuhan and later Bolter and Grusin termed "remediation"—the recreation of one medium in another.²⁸ However, as Kay noted, the metamedium of software is not only able to remediate, but also to create new kinds of media, a point taken up by Lev Manovich to mandate the field of software studies. For Manovich, the term "postmedia aesthetics" is useful for describing the impact of software on digital media. He advocates "getting rid of media typology altogether," as the emergence of the metamedium of software makes all prior media distinctions redundant.²⁹

Manovich establishes that all media experiences on a computer are "software performances," because "we are engaging not with pre-defined static documents but with the dynamic outputs of a real-time computation happening on our device and/or the server."³⁰ He continues:

<extract>

Therefore, although some static documents may be involved, the final *media experience constructed by software usually does not correspond to any single static document stored in some media*. In other words, in contrast to paintings, literary works, music scores, films, industrial designs, or buildings, a critic cannot simply consult a single "file" containing all of the work's content.³¹

<\extract>

<no ¶ indent>Theatre studies emerged from a similar concern about the irreducibility of an event to its constituent elements. Manovich arrives at software performance as an endpoint of observation in a line of argument and does not discuss the implications of the switch from a media to a performance ontology. However, that software is a performance becomes less of a surprise when it is understood to emerge from the live machine performance of the computer outlined in the previous section. That computational media are performed is overlooked. Software performance constantly renews new media. Yet the question remains: What difference can appreciating software as a performance make?

If all "digital media" are software performances, remediation within the metamedium of software must be achieved through rehearsal. Rehearsals of software remediation are produced by

machine assemblages trained to deliver the compromise that Friedrich Kittler observed between an engineer and salesperson that “regulates how poor the sound from a TV set can be, how fuzzy movie images can be, or how much a beloved voice on the telephone can be filtered. Our sense perceptions are the dependent variable of this compromise.”³² Remediation achieved through rehearsal therefore becomes less about what can and cannot be remediated, and more about how given systems can mobilize the performance of media networks within their material limitations that are achievable and acceptable to both humans and computer collaborators in an interface. This methodology moves forward with the materials of an interface to enable discovery of effective performances of vestigial media networks through practice and rehearsal, as opposed to the imposition of perceived media forms on material *hylomorphically*. Software is rehearsed into being, not written, although writing is involved. Such a method employs collaborative improvisation to discover what performs well enough with the material limitations of an interface, as opposed to attempting to recreate a preexistent form in different matter. For example, a smartphone employs a phone icon in a red circle to evoke the residual media network behavior of "hanging up" the receiver in its cradle to sever the connection and end a call, when in fact the smartphone does nothing of the sort. A medium can be reproduced when its behavioral network is instantiated by human and machine performing collaboratively. The success of the remediation is equally reliant upon the performance of humans as well as machines.

While digital data might provide software with a script for a performance of a medium written in computable numbers such as a video, software must translate its "reading" into an event within the material confines of the computing machine. If already instantiated and "running," software is itself in a performance that, when combined with the media data, manipulates the computer hardware to produce a further performance of media for human sensory registers. These observations reveal something of the community required to produce a rendition of new media that includes several *players* within a computer, along with the human for whom the media event is staged, vestigial media networks, and networked computers. The overlooking, or studied nonobservance, of software's performance of media is how humans and computers can become complicit in shared metamedial renditions of media networks. It is also one of the central tenets of the performance ontology of computation, which informs the next overlooked performance at the tip of the "digital iceberg": the performance of interfaces.

<A>Machines, Computers, Software, and Humans Collaborate to Perform Interface

Of all the aspects of computing addressed in this essay, interfaces have received the most critical attention from theatre, performance, media, and software studies. Interfaces serve as an obvious human-oriented entry point to computing, as they did in the introduction to this essay.

Because of this anthropomorphic bias, the difference between the interface and the computer is often elided. For example, Brenda Laurel's "dramatic theory of human-computer interaction" at the heart of her classic text *Computers as Theatre* and Jon McKenzie's "computers as performance" might within this context be more precisely understood as pertaining almost exclusively to the human-computer interface onscreen.³³ Despite the fetishization of the screen in much discourse, computer interfaces address the human sensorium across a spectrum of techniques, as the *Vanitas* prototype demonstrated with its apps, SMS, phone calls, maps, and directed walks. In this section, I return to overlooked work undertaken by humans and computers to produce the live, collaborative performance of an interface that, although often generalized, always unfolds within a specific place and moment.

One of Laurel's most useful insights is that "real-time human-computer interaction is mediated collaboration between designers and interactors" that provides a context for unfolding, abductive thought.³⁴ In this procedural view of computation, interfaces are scripted environments that offer affordances of thought, written in advance. This position emerges directly from her classical understanding of dramatic theatre, where audiences use the material sensations of the enactment unfolding onstage to perceive patterns, language, and ultimately to infer the thought, characters, and plot deployed by the playwright. For Laurel, interacting with a computer has the potential to be dramatic like a play: the scripted interactions are instantiated and occur in real-time. Scripting delegates future cognition to the computer, which the human interactor cues. How and when the interface affords access to the cognition that the computer can perform is a matter of both pre-scripted design and real-time collaboration. The action unfolding in the collaboration taking place at the interface causes non-conscious cognition within the computer and inspires cognition, some of it conscious, in the human body. The drama of interaction experienced at "run-time" permits the inference of thought. Through performance, the generic aspects of the procedural (for example, prewritten scripts, standardized interactions, stored media, and so on) instantiate the specific event that comes to pass.

Laurel was writing in the early 1990s when computers were arriving on desktops, very few were connected to the internet, and the World Wide Web had just been invented. The analogy to theatre is clear: computers are rehearsed to perform interfaces for people; therefore they must be perceptible to the human sensorium. Offstage functions are kept imperceptible, while desired "outputs" onstage are tuned to human scales of time, space, and sensory tolerances. The human looks from the dark onto the lit stage, one way. Since then, and with the rise to ubiquity of smartphones and internet-of-things devices, the house lights have gone up and the computer looks back at the human, tuning-in, listening, waiting. Now, people rehearse to become adept at performing interfaces to increase the chances of their intentions being perceived by the computer as interaction by

adapting, among other things, their posture, voice, language, accent, level of focus, and timing. And these rehearsals, as noted in the introduction, form habits, described by Chun as "'remnants' of the past—past goals/selves, past experiences—that live on in our reactions to the environment today, as we anticipate tomorrow. Through habit, we inhabit and are inhabited by alterity."³⁵ The *Vanitas* prototype showed that interacting with smartphones, switching between apps, and making connections among media is inherently messy, and that the "crisis" of discovering of how to perform with and for a computer yields a surprising variety of innovations. No one teaches you how to use a smartphone; you come to understand it through usage, and each person develops their own habits.

Creators of technology picked up this last point. At the end of the first decade of the millennium, HCI researchers Genevieve Bell and Paul Dourish became aware that ubiquitous computing is characterized by an inherent and everyday "messiness" that is "not a property of prototype technologies, of the bleeding edge, or of pragmatic compromise; messiness is a property of infrastructure itself."³⁶ Louise Barkhuus and Valerie Polichar went on to hypothesize that it is "the power of the ability to mix, match and interconnect individual apps [that] in large part [is] what has made the smart phone [*sic*] so successful as a ubicomp device."³⁷ Indeed, they note that smartphone interactions "are characterized by *seamfulness*, and we see users taking advantage of those seams," they "'make-do' . . . with less than adequate technology by putting considerable effort into getting what they have to work."³⁸ In this way, Barkhuus and Polichar claim that a "seamful" approach to ubicomp is empowering for human users. And yet this understanding held by computer scientists and the "make-do," "crisis ordinary" practices developed by end-users do not impact on the marketing myths that still promulgate an ideology of seamlessness that denies the mess.

Interfaces are the palpable seams attempting to join the human sensorium and the synthetic, parallel representations of reality underpinned by computable numbers. Seamlessness denies this work. Further, there is overlap across the ontological divide: the perceived affordance of the interface exists within the human body (an emulation of the computer in the brain), and the perceived desires of the body's senses exist within the computer (in the tuning of hardware and software). Considering this mirroring, Chun argues that habit offers a framework for conceptualizing both the human and computer side of new media interfaces.³⁹ Habits sedimented within the body and computer are vestigial imprints of one another's performances of interface. But what difference does performance make to this understanding of habit?

In *Updating to Remain the Same*, Chun references neurobiologist Ann Graybiel, who proposes that the basal ganglia region of the brain "can chunk the representations of motor and cognitive action sequences so that they can be implemented as performance units."⁴⁰ "Chunking" describes the brain's ability to package information in a format that can be committed to memory. Graybiel proposes that action sequences undertaken within the body can be broken into

"performance units" by this system, stored in the physical structure of the brain, and the units reassembled to trigger a rendition of the action sequence. This outline of a physical process for the formation of habit moves algorithmically from behavior, observation, and storage to reenactment. Performing the habit strengthens the neurological bonds between performance units in the brain, literally taking up more headspace, enabling the habit to function with increasing autonomy, as second nature. This description of "performance units" in the basal ganglia echoes Turing's "simple operations," but are comparable only in the sense of unitizing time-based processes of the "automatic" functioning of a system. A performance ontology of habit would note that once a sequence of performance units is triggered in the basal ganglia, the corresponding areas of the body are recruited and coordinated to stage the habit *in the flesh*, as a whole community's new performance of an old habit. Thus habits are performed in citation of themselves but always afresh and never the same twice, only ever the *same enough*. The performance is distributed throughout the body and is irreducible to the performance units stored in the basal ganglia. During the performance, the basal ganglia *automatically* feedback the motor and cognitive action of the body through the performance units in modification and further sedimentation of the habit.

Habits gain traction in the body through performance. They are powerful because they must be re-membered afresh in each performance. Habits form the repertoire of tried and tested performances of ourselves learning how to behave in the world. In this sense, habit is closely aligned to Judith Butler's sense of an iterated performance that "is not a singular 'act' or event, but a ritualized production, a ritual reiterated under and through constraint . . . controlling and compelling the shape of the production, but not, I will insist, determining it fully in advance."⁴¹ Habits are the performance units of algorithmic rituals of interface.

Interfaces have become the site of intense scrutiny in an age of contested fidelity in computer performances of interaction, leading to the question: For whom does the computer perform? While myths of technological progress allow many computer users to operate under the assumption that machines perform solely in their interests as an individual audient, most interactions are more complex. Interface performances serve many audiences simultaneously, and the local human interactor is less an audient than an increasingly observed character in a wider drama of big data.

The state of the art of interface is such that while "computers 'understand' as little as ever about human experience" as Sherry Turkle explains, "they do, however, perform understanding better than ever, and we are content to play our part."⁴² The converse is also true: that most people "understand" as little as ever about how computers work, yet perform understanding better than ever, adapting our performances to maximize the affordances perceived to be on offer. The considerable work that people do to modify and hone their performance only to overlook it, as though it did not happen, is testament to our complicity in events that we are not audience to, but players within.

The remarkable achievements in computing are the result of an apparent absolute stricture that appears predetermined. Such stricture produces the edifice of stability that enables operating systems to "run" or "stage" applications predictably, reliably, and with seeming ease, as among the most precise performances ever created. The fact that such reliable software tools and media are produced by repeated, local command performances within specific material and temporal conditions is both masked and overlooked. Instead, operating systems are presented as stable, fixed realities that are universal and independent from the material world, adapting each individual hardware configuration into the same virtual stage. Subsequently, software applications "run" within the virtual environment created and are policed by an operating system, ensuring that the "show" produced appears to be *the same enough* on any compatible stage. Operating systems enable fully automated live performances that present themselves to the human senses as static and stable, aiding the overlooking of their ephemerality.

Renditions of performance that are *not the same, but the same enough* also apply to humans crafting a performance that a computer will accept as an input. Acceptance in this case is underpinned by the requirement, willingness, and ability to perform a rendition of "human" acceptable to computers historically designed predominantly by white, able-bodied, English-speaking men. Archival decolonist Nathan "Mudyi" Sentance reminds creators of collection technologies that "your neutral is not our neutral."⁴³ Computing is riddled with what Lewis Gordon termed "the notion of white prototypicality," precipitating Simone Browne's call for a "critical biometric consciousness" that resists the racial inscription of biometrics, "a technology of measuring the living body."⁴⁴ Computing is also riddled with ableist prototypicality that aspires to seamlessness through conformity to an idealized state of ease with the world. Whereas Aimi Hamraie and Kelly Fritsch's "Crip Technoscience Manifesto" leans on the reality of *seamfulness*, "committed to access as friction" because "technologies, architectures, and infrastructures are often designed and implemented without committing to disability as a difference that matters."⁴⁵ The exclusionary history of computer interfaces illustrates their demand for performance. Failure to perform warrants exclusion.

The achievement of the edifice of stability masks the fact that software and all the interfaces and media it produces are performed in high-fidelity rendition from moment to moment, is a reality not to be underestimated. However, this study takes place at a turning point in the history of computation when consciousness of its performance ontology is reawakened by automated design practices that tailor interfaces and their media to each user "on the fly." There is growing awareness that computing interfaces may perform disingenuously by exploiting human vulnerabilities in perception to "suggest, enable, solicit, instigate, encourage, and prevent certain actions, thoughts, affects or promote others" and are therefore not neutral, apolitical sites for humans to collaborate in

abductive reasoning.⁴⁶ This capacity to improvise, however, may be considered an inevitable outworking central to computation's performance ontology, which produces interfaces on demand with a process of cognition able to incorporate new parameters, if available, with each moment of its rendition. What is seen as a violation of the neutrality of technology immune to politics is revealed as a site of commercial commodification, where human attention is not only bought, but becomes a raw material to be trapped, domesticated, and increasingly exploited as the source of capital in an attention economy. Computers no longer perform exclusively in the interests of the human immediately before them, but at the junction of competing audience needs as the vassal of developer, corporate, state, human, and inevitably software's own interests. These players all have a role in the theatres of artificial intelligence (AI).

,<A>Theatres of Artificial Intelligence

In her 1842 memoir on the Babbage Analytical Engine, Ada Lovelace observed that "[t]he Analytical Engine has no pretensions to *originate* anything. It can do *whatever we know how to order it to perform*."⁴⁷ Her invocation of performance introduces the commonly held belief that machines can only perform by rote and cannot go off-script to "originate" anything else. Turing frames this argument as "Lady Lovelace's Objection" in his 1950 paper "Computing Machinery and Intelligence" where he introduces the Imitation Game, later termed the Turing Test, as a way to deduce if a machine can think.⁴⁸ Turing's response to the Lovelace Objection is not convincing, being primarily based in his lived experience where "machines take me by surprise with great frequency," although he did "not expect" his instinct that computers will one day think independently "to silence my critic."⁴⁹ *Surprise*, however, as the excitement caused by the entrance into awareness of an unexpected event and its opposite, the *unsurprising*, unremarkable, overlooked entrance, are useful concepts in the staging of machine intelligence. Lovelace's and Turing's positions also represent two kinds of performance: the former relating to behavior without agency, and the latter to the ability to act, to perform with agency. Both positions remain present in the popular understanding of AI, lodged pejoratively as an arch theatre of dissembling illusion and distortion and therefore to be treated with suspicion.

The vestigial idea from Turing, that AI relates to an imitation of intelligence performed via a computer interface, crucially in a human language, continues to fuel the popular imaginary of AI, and is now a common part of everyday interfaces via anthropomorphized bots such as Apple's Siri or Amazon's Alexa. However, most AI research and computation are primarily concerned with algorithms that occur "behind the scenes" of human interface, and as Matteo Pasquinelli notes, "technically speaking, it would be more accurate to call Artificial Intelligence machine learning or computational statistics but these terms would have zero marketing appeal for companies,

universities and the art market."⁵⁰ While not seen directly, AI and machine learning (ML) algorithms underpin the most popular computer interfaces such as social media and the chorus of ubiquitous computing machines "embedded seamlessly in the everyday objects of our lives and connected through a continuous network" such as "smart home" devices and smartphones.⁵¹ AI/ML algorithms are perceptible less as an explicit conversation in the mode of the Turing Test, and more as a series of well-timed, small updates and suggestions guiding a task or doing something for you before you need to ask for it. Indeed, most of the time AI intervention is "offstage" completely, imperceptibly serving what it anticipates you need *before you know what you need*, thus allegedly relieving you of the burden of myriad small decisions and actions or of forming a plan.

Therefore, as Turing expressed with the imitation game, only the impression of intelligence is required to stage intelligence. The intelligences of interface are dramaturgical, subtle manipulations of impression management that establish and maintain the presentation of a staged reality. We rehearsed this technique in the *Vanitas* prototype.

The *Vanitas* app communicated with transmedia server software via a mobile internet connection "behind the scenes" of the interface, using radio-frequency energy that the human body cannot sense. The app could trigger the server to send return messages, which the smartphone translated and staged as text messages, emails, and phone calls in sensory registers that the body could perceive, interrupting the smooth flow of the *Vanitas* app's audio-visual experience. As a microcosm of the global apparatus of ubiquitous computing, *Vanitas* achieved the impression of multiple intelligences and virtual characters by orchestrating media and communications across channels usually reserved for everyday life, and so ventured into the territory of phishing and internet hoaxes. However, it lacked a sophisticated approach to AI/ML and was not "data-driven." The proprietorial algorithms and "big data" that pervade life online present a challenging threshold for artistic experimentation because they remain discrete and inaccessible despite their ubiquity. Nevertheless, it is useful to outline the dramaturgies of increasingly intelligent interfaces that dynamically tailor their performance to, and illicit specific performances from, the "people formerly known as the audience."⁵²

AI/ML algorithms can extrapolate from and predict human behavior because, as introduced in the previous section, the computer looks back and listens, surveilling the human user's performance of interface across a range of registers, most commonly their choices and timings. The theatre of interface no longer has a darkened auditorium; it is increasingly all stage, starkly illuminated, *and all the men and women merely players*.

Mass surveillance of human performance by machines is a primary source of big data, a growing volume of noisy data generated from automatized observation of human action, a compost heap of remains from interface performances past.⁵³ Computationally intensive AI/ML algorithms

sift this mass repository of observed habits to identify patterns of behavior. These algorithms are audience to *what* people perform within a given context, but not *why*. When the same algorithms are audience to billions of performances within the same given context, *why* is not required: statistics reveal the habits of large human populations and make behavior predictable. Big data as an analytical engine has, to paraphrase Lovelace, no pretensions to *originate* anything, it merely must *perform* its computations to predict what is likely to happen next, before what happens next happens. Machine performance of AI/ML algorithms can predict what a person will perform next based on their prior performances and the performances of "similar" people observed in the past. The tables have turned: ubiquitous computing's Greek chorus of machines now observes human performance, distributed across continents and occurring simultaneously at a colossal scale, as a chorus. You step out of this chorus of past selves every time you act, only to rejoin it again in the same moment, as the present reenforces the machine-learned habits of the past.

Chun points out that machine-learning algorithms develop a computational form of habituation by discovering patterns in messy, noisy data and crystalizing them into purposed, structured data.⁵⁴ Machine-learned habits are refined by iteration over constantly updated data repositories, taking time, physical space, and considerable energy. Once an algorithm's habits can reliably predict human habits, and they can, it may prime the computer's interface to direct human performance by carefully curtailing choice, timing, entrances, exits, focus, flow, and surprise. Interfaces staged "on the fly" by AI/ML algorithms trained on the mass observation of human habits can thus begin actively intervening in current performances of the same peoples' habits, directing current action and training habits toward ideal future performances.

AI/ML cannot be easily separated from discussions of big data and ubiquitous computing, because they are experienced as part of the same distributed computing system. Within this context, both Lovelace's and Turing's perspectives on machine performance can be true: with vast amounts of data, the computer does not need to originate a thought, but can create surprise and the appearance of thoughtfulness by means of computational performance.

This technology is used in a range of ways to direct the performance of people in their everyday life and intervene in their habits. The resulting ethical challenge for the creators of ubiquitous computing is outlined by Antti Oulasvirta et al.: "If we accept that habits are a cognitively 'inexpensive' element of behavior . . . understanding them is essential in the pursuit of making computing devices natural, 'invisible,' and pervasively used. At the other extreme, habits that are repetitively triggered by external cues reduce the intrinsic locus of control of an individual."⁵⁵ Their first point reiterates ubiquitous computing's founding ideal, to reduce the effort of interface and therefore attempt to be more helpful by tacitly directing human performances without them realizing it. The second point is ambiguous and suggests that the system triggering an individual risks losing

control of them, or that the individual risks losing control of themselves. Both readings are ominous and highlight the anxieties issuing from the desire to reduce the "expense" of human cognition by delegating intelligence to machines, points taken up by Mark Hansen and others in critique of habituated ubiquitous interfaces.⁵⁶ The academic field of persuasive technologies exemplifies the complexities of explicitly seeking to modify human behavior by interrupting habits.⁵⁷ The field legitimates experiments in targeted behavior change in relation to, for example, health and wellness, climate change awareness, and addiction, with scholars often publishing codifications of successful techniques as design heuristics that can be deployed within other contexts. Persuasive technology, like much of computing research, can be problematically repurposed beyond its initial domain, including to aid refinement of what Tiziana Terranova discusses as "the attention economy" and what Shoshana Zuboff introduces as "surveillance capitalism."⁵⁸

In contrast to persuasive technology, the founding president of Facebook, Sean Parker, admitted that he and the other creators of social networks were consciously "exploiting a vulnerability in human psychology" with their design practices, where "[t]he thought process that went into building these applications, Facebook being the first of them . . . was all about: 'How do we consume as much of your time and conscious attention as possible?'"⁵⁹ Since their founding, social media companies have developed large research groups of professionals trained in university human-computer interaction (HCI) and psychology departments that operate privately without ethical oversight, effectively refining Parker's vision. All work in this field is politicized by the unprecedented scale of its application. There is no neutrality in these habituated AI/ML interfaces, as Chun notes, because "by finding seemingly unrelated correlations, Big Data can aggravate existing inequalities and lead to racist and discriminatory practices, justified through the use of seemingly innocuous proxies."⁶⁰ Despite these abuses, AI/ML-driven interfaces remain compulsive, because they are the elaborate outworking of Laurel's dramatic theory of interaction, enabling human complicity, suspension of disbelief, and satisfaction in machine performances.⁶¹ Far from being perceived as malpractice by the state-corporate industrial complex that produces them, such seductive interfaces are lauded as "good design" and used habitually by billions of people, often simultaneously, usually suspending their disbelief of the implications of their own performance, all around the world.⁶² Saying "no" ruptures the performance and denies it from continuing. For continued usage, terms and conditions, end-user license agreements, and cookies must all be "accepted," despite rarely knowing, or wanting to know, the details of what they contain. Further, every pickup, click, swipe, and tap says "yes" to continuing the performance, and "yes" to your role in the chorus of big data, and "yes" to your job as a bit part actor in a distributed theatre of intelligent computing.

<A>Conclusion

Observation of the audience's overlooked performances in *Vanitas* guided the project's development over the coming years. We rationed the number of channels used to contact the audience and honed their dramaturgical potential by focusing on just one character who attempted to rendezvous with each audience member. The status of this elusive spectral character as a real or virtual person evoked by audio description and *intelligent enough*, well-timed text messages shifted throughout the performance. Incorporating mobile computing into the performance as a part of the site *and* a part of the audience enabled reflection on and intervention into the habits entangling smartphones within human life. *Vanitas* gently defamiliarized how to perform with and for a smartphone (fig. 3).

The research accompanying *Vanitas* moved from a question of computing in performance toward questioning performances of computing. This essay explored how AI/ML is staged in the age of ubiquitous computing and big data, where references to the theatricalization of everyday life have themselves, as Sarah Bay-Cheng notes, become "so ubiquitous as to be nearly invisible."⁶³ I suggested that performances of, and in proximity to, computation are themselves so ubiquitous as to be nearly invisible and easily overlooked. Immediately after completing the *Vanitas* prototype, participants were unable to piece together the chain of events that they enacted. Every one of them completed *Vanitas*, but it turned out they did so by feeling their way through the performance in very different ways, bringing their idiosyncratic habits to bear.

Reengaging with the central overlooked performance introduced in this essay—that machines perform computers—mobilizes theatre and performance studies around the phenomena of computing beyond the "surface theatre" of the interface. The second overlooked performance—software's performance of new media—emphasizes the live, iterative, and citational networks of remediation, perennially in rehearsal. Software now coordinates diverse individual hardware configurations of speakers, screens, and other output devices to produce media renditions that are *not the same performance, but are the same enough* on any computer. That each rendition is, however, unique and produced on command in real time as an extraordinarily accurate, high-fidelity performance is conventionally overlooked for convenience. Approaching this phenomenon as an overlooked performance moves beyond acceptance of *same enough* renditions, to increase sensitivity to idiosyncratic variation, mutability, and the broader context of material conditions in which the event occurs. The third overlooked performance—of machines, computers, software, and humans collaborating to perform the interface—acknowledges human complicity in the perpetuation of the theatre of interface. People adapt their performance to increase the likelihood of a computer

accepting their performance as an input. Once accepted by the computer, these human performances are overlooked, effectively discounting human participation in a wider algorithmic ritual.

Engineering expediencies seek to guarantee that every rendition offered by machine or human is the *same enough* to operate efficiently, yet the overlooked performances introduced here are live and bound to the material conditions that produce them. Ultimately, they comprise, as Erika Fischer-Lichte notes of theatrical performance, "a unique, unrepeatable constellation which can only be determined and controlled to a limited degree."⁶⁴ One approach to controlling performance elaborates Chun's work on habituation: first, through the refinement of habituated performance in the human body, neuronal learning; and second, through the observation and mimicry of habit in big data, machine learning. Habits have an intimate relationship with performance and what Suchman discusses as plans and situated actions, where "agencies—and associated accountabilities—reside neither in us nor in our artefacts but in our intra-actions."⁶⁵ By drawing on Karen Barad's term "intra-action" in this way, Suchman comes close to evoking the live, performed, and ongoing renewal of habits as the residue of our experience in the world with our technologies. The practice of merging plans into action and habits into performances is the site of contestation between human agency and its negotiations with finely tuned, often irresistible computational interfaces. While design has always been persuasive, the automation of interface techniques shifts the locus from serving the interests of individuals to manipulating and controlling their habitual actions, from performing for them to directing their performance.

Within our theatricalized lives enmeshed with computing, there is no objective position or vantage point outside the event, and so meaning and knowledge of it must be made from the inside, through an emergent methodology that is singular and partial and tactically resistive to sensory isolation and developed in time through rehearsal. We must reconsider the role our bodies play in the performance of algorithmic ritual, and resist the relatively recent idea that only machines perform computing. The emplaced, embodied, procedural production of knowledge through performance and habit emerged from the deep time of human culture. Overlooking enables the convenient myth of seamlessness, but denies the agency and work of machine and human performers alike. Looking again at these inconvenient and subtle performances, even momentarily, offers a glimpse of the agency of machinic others to act for themselves, and, imagine, to perceive a similar freedom for ourselves.

FIGURE CAPTIONS:

Figure 1. *Vanitas* app-screen series showing the data-entry system. The illuminated podcast episode is interrupted while further user data is entered (the phone number was added earlier). Once the episode recommences, the audience member receives a "real" email at the same moment

as a character in the audio. The process is bookended by a detail from *Trouble Comes to the Alchemist* by an unknown seventeenth-century Dutch artist to chime with the surprise arrival of a delivery from behind the scenes. (Photo: Author.)

Figure 2. Audience member peering into an abandoned florist shop during *Vanitas*. (Photo: Author.)

Figure 3. Audience member in cemetery location during *Vanitas*. (Photo: Author.)

FOOTNOTES

-
- ¹ The prototype created by Robert Walton and Jason Maling took place at North Melbourne Town Hall in 2015. The final version of *Vanitas* was released in 2019; see www.vanitas.online.
- ² Lucy Suchman's 1987 book *Plans and Situated Actions: The Problem of Human–Machine Communication* was revised in a 2006 edition as *Human–Machine Reconfigurations: Plans and Situated Actions* (Cambridge: Cambridge University Press, 2006). It remains a classic text in human–computer interaction.
- ³ Suchman, *Human–Machine Reconfigurations*, 112.
- ⁴ Wendy Hui Kyong Chun, "Digital and New Media," in *A Companion to Critical and Cultural Theory*, ed. Imre Szeman, Sarah Blacker, and Justin Sully (Hoboken, NJ: Wiley Blackwell, 2017), 387–402, quote on 393.
- ⁵ Lauren Berlant, *Cruel Optimism* (Durham, NC: Duke University Press, 2011), 9.
- ⁶ Steve Benford and Gabriella Giannachi, *Performing Mixed Reality* (Cambridge: MIT Press, 2011), 1.
- ⁷ Mark Weiser, R. Gold, and J. S. Brown, "The Origins of Ubiquitous Computing Research at PARC in the Late 1980s," *IBM Systems Journal* 38, no. 4 (1999): 693–96, quote on 694. Computer scientist Mark Weiser is credited with coining the term "ubiquitous computing." His aspiration was for computers to "weave themselves into the fabric of everyday life until they are indistinguishable from it." See Weiser, "The Computer for the 21st Century," *Scientific American* 265, no. 3 (1991): 66–75, quote on 66.
- ⁸ August Wilhelm Von Schlegel, *A Course of Lectures on Dramatic Art and Literature*, trans. John Black (London: Henry G. Bohn, 1846), 70.
- ⁹ Wendy Hui Kyong Chun, *Updating to Remain the Same: Habitual New Media* (Cambridge: MIT Press, 2016), ix; David M. Berry and Michael Dieter, *Postdigital Aesthetics: Art, Computation and Design* (New York: Palgrave Macmillan, 2015), 5 (emphasis in original).
- ¹⁰ Chun, *Updating to Remain the Same*, 6.
- ¹¹ Viktor Shklovsky, "Art as Technique (1916)," in *Literary Theory: An Anthology*, 2nd ed., ed. Julia Rivkin and Michael Ryan (Malden, MA: Blackwell, 2004), 16.

-
- ¹² Berry and Dieter, *Postdigital Aesthetics*, 5.
- ¹³ Ibid.
- ¹⁴ Alan Mathison Turing, "On Computable Numbers, with an Application to the Entscheidungsproblem," *Proceedings of the London Mathematical Society* 2, no. 1 (1937): 230–65, quote on 252.
- ¹⁵ Specifically, the first modern computers were performed by the Women's Royal Navy Service (WRENS) of Bletchley Park and the "women of the ENIAC" (Electronic Numerical Integrator and Computer); see Wendy Hui Kyong Chun, *Programmed Visions: Software and Memory* (Cambridge: MIT Press, 2011), 32.
- ¹⁶ Turing, "On Computable Numbers," 250.
- ¹⁷ Michael S. Mahoney, "The History of Computing in the History of Technology," *Annals of the History of Computing* 10, no. 2 (1988): 113–25, quote on 121.
- ¹⁸ Martina Leeker, Imanuel Schipper, and Timon Beyes, *Performing the Digital: Performativity and Performance Studies in Digital Cultures* (Bielefeld, Germany: transcript Verlag, 2017), 11.
- ¹⁹ Turing, "On Computable Numbers," 230, 249.
- ²⁰ Ibid., 241.
- ²¹ David Beer, *The Data Gaze: Capitalism, Power, and Perception* (Thousand Oaks, CA: Sage Publications, 2018), 5.
- ²² Diane M. Nelson, *Who Counts? The Mathematics of Death and Life after Genocide* (Durham, NC: Duke University Press, 2015).
- ²³ David M. Berry, *Critical Theory and the Digital* (London: Bloomsbury, 2014), 69.
- ²⁴ Alexander R. Galloway, *Protocol: How Control Exists after Decentralization*. (Cambridge: MIT Press, 2004).
- ²⁵ Ibid., 243.
- ²⁶ Alan Kay and Adele Goldberg, "Personal Dynamic Media," *Computer* 10, no. 3 (1977): 31–41, quote on 40.
- ²⁷ Alan Kay, "Computer Software," *Scientific American* 251, no. 3 (1984): 52–59, quote on 59.
- ²⁸ See Marshall McLuhan, *Understanding Media: The Extensions of Man* (New York: New American Library, 1964); and J. David Bolter and Richard A. Grusin, *Remediation: Understanding New Media* (Cambridge: MIT Press, 2000).
- ²⁹ Lev Manovich, "Postmedia Aesthetics," in *Transmedia Frictions: The Digital, the Arts, and the Humanities*, ed. Marsha Kinder and Tara McPherson (Berkeley: University of California Press, 2014), 34–44, quote on 36.
- ³⁰ Lev Manovich, *Software Takes Command* (London: Bloomsbury, 2013), 33–34.
- ³¹ Ibid., 34 (emphasis in original).

-
- ³² Friedrich A. Kittler, *Gramophone, Film, Typewriter*, trans. Geoffrey Winthrop-Young and Michael Wutz (Palo Alto, CA: Stanford University Press, 1999), 2.
- ³³ Brenda Laurel, *Computers as Theatre* (Boston: Addison-Wesley, 2013), 141; see also Jon McKenzie, "Virtual Reality: Performance, Immersion, and the Thaw," *TDR: The Drama Review* 38, no. 4 (1994): 83–106.
- ³⁴ Laurel, *Computers as Theatre*, 110.
- ³⁵ Chun, *Updating to Remain the Same*, 95.
- ³⁶ Genevieve Bell and Paul Dourish, "Yesterday's Tomorrows: Notes on Ubiquitous Computing's Dominant Vision," *Personal and Ubiquitous Computing* 11, no. 2 (2007): 133–43, quote on 140.
- ³⁷ Louise Barkhuus and Valerie E. Polichar, "Empowerment through Seamfulness: Smart Phones in Everyday Life," *Personal and Ubiquitous Computing* 15, no. 6 (2011): 629–39, quote on 638.
- ³⁸ *Ibid.*, 638, 635.
- ³⁹ Chun, "Digital and New Media."
- ⁴⁰ Ann M. Graybiel, "The Basal Ganglia and Chunking of Action Repertoires," *Neurobiology of Learning and Memory* 70, no. 1 (1998): 119–36, quote on 119.
- ⁴¹ Judith Butler, *Bodies That Matter: On the Discursive Limits of "Sex"* (New York: Routledge, 1993), 95.
- ⁴² Sherry Turkle, *Alone Together: Why We Expect More from Technology and Less from Each Other* (New York: Basic Books, 2011), 26.
- ⁴³ "Your Neutral Is Not Our Neutral," *Archival Decolonist [-O-]*, 2019, available at <https://archivaldecolonist.com/2019/09/27/your-neutral-is-not-our-neutral-3/>.
- ⁴⁴ Lewis R. Gordon, "Is the Human a Teleological Suspension of Man? Phenomenological Exploration of Sylvia Wynter's Fanonian and Biodicean Reflections," in *After Man, Towards the Human: Critical Essays on Sylvia Wynter*, ed. Anthony Bogues (Kingston, Jamaica: Ian Randle Publishers, 2006), 237–57, quote on 240; Simone Browne, *Dark Matters: On the Surveillance of Blackness* (Durham, NC: Duke University Press, 2015), 109–17.
- ⁴⁵ Aimi Hamraie and Kelly Fritsch, "Crip Technoscience Manifesto," *Catalyst: Feminism, Theory, Technoscience* 5, no. 1 (2019): 1–34, quotes on 10, 1.
- ⁴⁶ Maurizio Lazzarato, *Signs and Machines: Capitalism and the Production of Subjectivity*, trans. Joshua David Jordan (Los Angeles: Semiotext[e], 2014), 97; see also Michael Dieter, "Dark Patterns: Interface Design, Augmentation and Crisis," in *Postdigital Aesthetics: Art, Computation and Design*, ed. David M. Berry and Michael Dieter (Basingstoke, UK: Palgrave Macmillan, 2015).
- ⁴⁷ Ada Lovelace (c.1842), cited in Douglas R. Hartree, *Calculating Instruments and Machines* (Cambridge: Cambridge University Press, 1949), 70.

-
- ⁴⁸ Alan Mathison Turing, "Computing Machinery and Intelligence," *Mind* 59, no. 236 (1950): 433–60, quote on 433.
- ⁴⁹ *Ibid.*, 450–51.
- ⁵⁰ Matteo Pasquinelli, "How a Machine Learns and Fails: A Grammar of Error for Artificial Intelligence," *Spheres: Journal for Digital Cultures* 5 (2019): 1–17, quote on 4.
- ⁵¹ Weiser, Gold, and Brown, "The Origins of Ubiquitous Computing Research at PARC," 694.
- ⁵² Phillipa McGuinness, "The People Formerly Known as the Audience: Power Shifts in the Digital Age," *Communication Research & Practice* 2, no. 4 (2016): 520–27.
- ⁵³ See Chris Anderson's influential initial postulation of big data, "The End of Theory: The Data Deluge Makes the Scientific Method Obsolete," *Wired Magazine*, June 23, 2008.
- ⁵⁴ Chun, *Updating to Remain the Same*, 59.
- ⁵⁵ Antti Oulasvirta et al., "Habits Make Smartphone Use More Pervasive," *Personal and Ubiquitous Computing* 16, no. 1 (2012): 105–14, quote on 106.
- ⁵⁶ See Mark B. N. Hansen, *Feed-Forward: On the Future of Twenty-First-Century Media* (Chicago: University of Chicago Press, 2015); Hansen, *Bodies in Code: Interfaces with Digital Media* (Abingdon, UK: Routledge, 2006); and Hansen, "Ubiquitous Sensation: Toward an Atmospheric, Collective, and Microtemporal Model of Media," in *Throughout: Art and Culture Emerging with Ubiquitous Computing*, ed. Ulrik Ekman (Cambridge: MIT Press, 2013), 63–88.
- ⁵⁷ See, for example, the proceedings of the Persuasive Technology Conference 2006–21 for a de facto overview of legitimate areas of research and experimentation into behavior modification.
- ⁵⁸ See Tiziana Terranova, "Attention, Economy and the Brain," *Culture Machine* 13 (2012): 1–19; and Shoshana Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power* (New York: PublicAffairs, 2019).
- ⁵⁹ Qtd. in Mike Allen, "Sean Parker Unloads on Facebook: 'God only knows what it's doing to our children's brains'," *Axios*, November 9, 2017, available at www.axios.com/sean-parker-unloads-on-facebook-god-only-knows-what-its-doing-to-our-childrens-brains-1513306792-f855e7b4-4e99-4d60-8d51-2775559c2671.html.
- ⁶⁰ Chun, *Updating to Remain the Same*, 58.
- ⁶¹ Laurel, *Computers as Theatre*.
- ⁶² For a critique of the "good design" of dark patterns, see Dieter, "Dark Patterns."
- ⁶³ Sarah Bay-Cheng, "The (Not So) Deep Time of Social Media Theater: An Afterword," in *Media Archaeology and Intermedial Performance: Deep Time of the Theatre*, ed. Nele Wynants (Basingstoke, UK: Palgrave Macmillan, 2019), 273–84, quote on 282.
- ⁶⁴ Erika Fischer-Lichte, *The Transformative Power of Performance: A New Aesthetics* (New York: Taylor and Francis, 2008), 35.

⁶⁵ Suchman, *Human–Machine Reconfigurations*, 285.