

Radical Technologies

The Design of Everyday Life

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see just how they interact to produce the condition we recognize as everyday life, we'll need a manual.

That is the project of this book. In the pages to come, we will explore a wide band of the technologies that are already implicated in our everyday lives, and will be to a still greater extent in the years just ahead: the smartphone and the internet of things; augmented and virtual reality; 3D printing and other technologies of digital fabrication; cryptocurrency and the blockchain; and the dense complex of ideas surrounding algorithms, machine learning, automation and artificial intelligence.

We'll see what commitments were made in the design of these systems. We'll try to puncture the hype that surrounds them, and evaluate the claims made about their function and effect more closely than is generally the case. And we'll pay particular attention to the ways in which these allegedly disruptive technologies leave existing modes of domination mostly intact, asking if they can ever truly be turned to liberatory ends.

Networked digital information technology looms ever larger in all of our lives. It shapes our perceptions, conditions the choices available to us, and remakes our experience of space and time. It requires us to master arcane bodies of knowledge, forcing us into a constant cycle of obsolescence and upgrade that, with startling rapidity, makes nonsense of our most diligent attempts to reckon with it. It even inhibits our ability to think meaningfully about the future, tending to reframe any conversation about the reality we want to live in as a choice between varying shades of technical development. The extent to which it organizes the everyday is one of the defining characteristics of our era, and for all the apparent power it offers us, our attempts to master it observably leave most of us feeling overwhelmed and exhausted. If we are to have any hope of retaining our agency and exerting some measure of control over the circumstances of our being in the years to come, we will need to know a lot more about where these radical technologies came from, how they accomplish their work in the world, and why they appear to us in the way that they do. What follows is an attempt to shed light on all of these questions.

Smartphone

The networking of the self

The smartphone is the signature artifact of our age. Less than a decade old, this protean object has become the universal, all-but-indispensable mediator of everyday life. Very few manufactured objects have ever been as ubiquitous as these glowing slabs of polycarbonate.¹

For many of us, they are the last thing we look at before sleep each night, and the first thing we reach for upon waking. We use them to meet people, to communicate, to entertain ourselves, and to find our way around. We buy and sell things with them. We rely on them to document the places we go, the things we do and the company we keep; we count on them to fill the dead spaces, the still moments and silences that used to occupy so much of our lives.

They have altered the texture of everyday life just about everywhere, digesting many longstanding spaces and rituals in their entirety, and transforming others beyond recognition. At this juncture in history, it simply isn't possible to understand the ways in which we know and use the world around us without having some sense for the way the smartphone works, and the various infrastructures it depends on.

For all its ubiquity, though, the smartphone is not a simple thing. We use it so often that we don't see it clearly; it appeared

in our lives so suddenly and totally that the scale and force of the changes it has occasioned have largely receded from conscious awareness. In order to truly take the measure of these changes, we need to take a step or two back, to the very last historical moment in which we negotiated the world without smartphone in hand.

There are few better guides to the pre-smartphone everyday than a well-documented body of ethnographic research carried out circa 2005, by researchers working for Keio University and Intel Corporation's People and Practices group.² Undertaken in London, Tokyo and Los Angeles, the study aimed to identify broad patterns in the things people carried in their wallets, pockets and purses on a daily basis. It found a striking degree of consistency in what Londoners, Angelenos and Tokyoites thought of as being necessary to the successful negotiation of the day's challenges:

Pictures, firstly, and similar mementoes of family, friends and loved ones. Icons, charms and other totems of religious or spiritual significance. Snacks. Personal hygiene items, breath mints, chewing gum—things, in other words, that we might use to manage the bodily dimensions of the presentation of self. Things we used to gain access of one sort or another: keys, identity cards, farecards and transit passes. Generally, a mobile phone, which at the time the research was conducted was just that, something used for voice communication and perhaps text messaging. And invariably, money in one or more of its various forms.

If the Intel/Keio study found in the stuff of wallets and handbags nothing less than circa-2005 in microcosm, its detailed accounting provides us with a useful and even a poignant way of assessing just how much has changed in the intervening years. We find that a great many of the things city dwellers once relied upon to manage everyday life as recently as ten years ago have by now been subsumed by a single object, the mobile phone. This single platform swallowed most all the other things people once had floating around in their pockets and purses, and in so doing it became something else entirely.

Once each of the unremarkable acts we undertake in the

course of the day—opening the front door, buying the groceries, hopping onto the bus—has been reconceived as a digital transaction, it tends to dematerialize. The separate, dedicated chunks of matter we needed to use in order to accomplish these ends, the house keys and banknotes and bus tokens, are replaced by an invisible modulation of radio waves. And as the infrastructure that receives those waves and translates them into action is built into the ordinary objects and surfaces all around us, the entire interaction tends to disappear from sight, and consequently from thought.

Intangible though this infrastructure may be, we still need some way of communicating with it. The 2005-era mobile phone was perfect in this role: a powered platform the right shape and size to accommodate the various antennae necessary to wireless communication, it was quite literally ready-to-hand, and best of all, by this time most people living in the major cities of the world already happened to be carrying one. And so this one device began to stand in for a very large number of the material objects we previously used to mediate everyday urban life.

Most obviously, the smartphone replaced conventional telephones, leading to the widespread disappearance from streetscapes everywhere of that icon of midcentury urbanity, the telephone booth, and all the etiquettes of negotiated waiting and deconfliction that attended it. Where phone booths remain, they now act mostly as a platform for other kinds of services—WiFi connectivity, or ads for sex workers.

In short order, the smartphone supplanted the boombox, the Walkman and the transistor radio: all the portable means we used to access news and entertainment, and maybe claim a little bubble of space for ourselves in doing so. Except as ornamentation and status display, the conventional watch, too, is well on its way to extinction, as are clocks, calendars and datebooks. Tickets, farecards, boarding passes, and all the other tokens of access are similarly on the way out, as are the keys, badges and other physical means we use to gain entry to restricted spaces.

The things we used to fix cherished memory—the dogeared, well-worried-over Kodachromes of lovers, children, schoolmates

and pets that once populated the world's plastic wallet inserts—were for the most part digitized at some point along the way, and long ago migrated to the lockscreens of our phones.

Most of the artifacts we once used to convey identity are not long for this world, including among other things name cards, calling cards and business cards. Though more formal identity-authentication documents, notably driver's licenses and passports, are among the few personal effects to have successfully resisted assimilation to the smartphone, it remains to be seen how much longer this is the case.

What else disappears from the world? Address books, Rolodexes and “little black books.” The directories, maps and guidebooks of all sorts that we used to navigate the city. Loyalty and other stored-value cards. And finally money, and everything it affords its bearer in freedom of behavior and of movement. All of these have already been transfigured into a dance of ones and zeroes, or are well on their way to such a fate. Of all the discrete artifacts identified by the Intel/Keio studies, after a single decade little more remains in our pockets and purses than the snacks, the breath mints and the lip-balm.

Time flows through the world at different rates, of course, and there are many places where the old ways yet reign. We ourselves are no different: some of us prefer the certainty of transacting with the world via discrete, dedicated objects, just as some still prefer to deal with a human teller at the bank. But as the smartphone has come to stand between us and an ever-greater swath of the things we do in everyday life, the global trend toward dematerialization is unmistakable. As a result, it's already difficult to contemplate objects like a phone booth, a Filofax or a Palm Pilot without experiencing a shock of either reminiscence or perplexity, depending on the degree of our past acquaintance with them.

However clumsy they may seem to us now, what's important about such mediating artifacts is that each one implied an entire way of life—a densely interconnected ecosystem of commerce, practice and experience. And as we've overwritten those

ecosystems with new and far less tangible webs of connection based on the smartphone, the texture of daily experience has been transformed. The absorption of so many of the technics of everyday life into this single device deprives us of a wide variety of recognizably, even distinctively urban sites, gestures and practices. Stepping into the street to raise a hand for a cab, or gathering in front of an appliance-shop window to watch election results or a championship game tumble across the clustered screens. Stopping at a newsstand for the afternoon edition, or ducking into a florist shop or a police booth to ask directions. Meeting people at the clock at Grand Central, or the Ginza branch of the Wako department store, or in the lobby of the St. Francis Hotel. What need is there for any of these metropolitan rituals now?

It isn't particularly helpful to ask whether this new everyday life is “better” or “worse”; I very much doubt we'd have permitted the smartphone to supplant so many other objects and rituals in our lives if we didn't, on balance, perceive some concrete advantage in doing so. But there are a few circumstances that arise as a result of this choice that we might want to take careful note of.

Firstly, the most basic tasks we undertake in life now involve the participation of a fundamentally different set of actors than they did even ten years ago. Beyond the gargantuan enterprises that manufacture our devices, and the startups that develop most of the apps we use, we've invited technical standards bodies, national- and supranational-level regulators, and shadowy hackers into the innermost precincts of our lives. As a result, our ability to perform the everyday competently is now contingent on the widest range of obscure factors—things we'd simply never needed to worry about before, from the properties of the electromagnetic spectrum and our moment-to-moment ability to connect to the network to the stability of the software we're using and the current state of corporate alignments.

Secondly, all of the conventions and arrangements that constitute our sense of the everyday now no longer evolve at any

speed we'd generally associate with social mores, but at the far faster rate of digital innovation. We're forced to accommodate some degree of change in the way we do things every time the newest version of a device, operating system or application is released.

And thirdly, and perhaps most curiously of all, when pursuits as varied as taking a photograph, listening to music and seeking a romantic partner all start with launching an app on the same device, and all of them draw on the same, relatively limited repertoire of habits and mindsets, a certain similarity inevitably comes to color each of them. We twitch through the available options, never fully settling on or for any one of them.

This is our life now: strongly shaped by the detailed design of the smartphone handset; by its precise manifest of sensors, actuators, processors and antennae; by the protocols that govern its connection to the various networks around us; by the user interface conventions that guide our interaction with its applications and services; and by the strategies and business models adopted by the enterprises that produce them.

These decisions can never determine our actions outright, of course, but they do significantly condition our approach to the world, in all sorts of subtle but pervasive ways. (Try to imagine modern dating without the swipe left, or the presentation of self without the selfie.) Fleshing out our understanding of the contemporary human condition therefore requires that we undertake a forensic analysis of the smartphone and its origins, and a detailed consideration of its parts.

Though its precise dimensions may vary with fashion, a smartphone is fundamentally a sandwich of aluminosilicate glass, polycarbonate and aluminum sized to sit comfortably in the adult hand, and to be operated, if need be, with the thumb only. This requirement constrains the device to a fairly narrow range of shapes and sizes; almost every smartphone on the market at present is a blunt slab, a chamfered or rounded rectangle between eleven and fourteen centimeters tall, and some six to seven wide. These compact dimensions permit the

device to live comfortably on or close to the body, which means it will only rarely be misplaced or forgotten, and this in turn is key to its ability to function as a proxy for personal identity, presence and location.

The contemporary smartphone bears very few, if any, dedicated ("hard") controls: generally a power button, controls for audio volume, perhaps a switch with which to silence the device entirely, and a "home" button that closes running applications and returns the user to the top level of the navigational hierarchy. On many models, a fingerprint sensor integrated into the home button secures the device against unauthorized access.

Almost all other interaction is accomplished via the device's defining and most prominent feature: a shatter-resistant glass touchscreen of increasingly high resolution, covering the near entirety of its surface. It is this screen, more than any other component, that is responsible for the smartphone's universal appeal. Using a contemporary touchscreen device is almost absurdly easy. All it asks of us is that we learn and perform a few basic gestures: the familiar tap, swipe, drag, pinch and spread³. This interaction vocabulary requires so little effort to master that despite some tweaks, refinements and manufacturer-specific quirks, virtually every element of the contemporary smartphone interface paradigm derives from the first model that featured it, the original Apple iPhone of summer 2007.

Beneath the screen, nestled within a snug enclosure, are the components that permit the smartphone to receive, transmit, process and store information. Chief among these are a multi-core central processing unit; a few gigabits of nonvolatile storage (and how soon that "giga-" will sound quaint); and one or more ancillary chips dedicated to specialized functions. Among the latter are the baseband processor, which manages communication via the phone's multiple antennae; light and proximity sensors; perhaps a graphics processing unit; and, of increasing importance, a dedicated machine-learning coprocessor, to aid in tasks like speech recognition. The choice of a given chipset will determine what operating system the handset can run; how fast it can process input and render output; how many pictures,

songs and videos it can store on board; and, in proportion to these capabilities, how much it will cost at retail.

Thanks to its Assisted GPS chip—and, of course, the quarter-trillion-dollar constellation of GPS satellites in their orbits twenty million meters above the Earth—the smartphone knows where it is at all times. This machinic sense of place is further refined by the operation of a magnetometer and a three-axis microelectromechanical accelerometer: a compass and gyroscope that together allow the device to register the bearer's location, orientation and inclination to a very high degree of precision. These sensors register whether the phone is being held vertically or oriented along some other plane, and almost incidentally allow it to accept more coarsely grained gestural input than that mediated by the touchscreen, i.e. gestures made with the whole device, such as turning it upside down to silence it, or shaking it to close applications and return the user to the home screen.

A microphone affords voice communication, audio recording and the ability to receive spoken commands, while one or more speakers furnish audible output. A small motor allows the phone to produce vibrating alerts when set in silent mode; it may, as well, be able to provide so-called “haptics,” or brief and delicately calibrated buzzes that simulate the sensation of pressing a physical button.

Even cheap phones now come with both front and rear cameras. The one facing outward is equipped with an LED flash, and is generally capable of capturing both still and full-motion imagery in high resolution; though the size of the aperture limits the optical resolution achievable, current-generation cameras can nonetheless produce images more than sufficient for any purpose short of fine art, scientific inquiry or rigorous archival practice. The user-facing camera generally isn't as capable, but it's good enough for video calls, and above all selfies.

Wound around these modules, or molded into the chassis itself, are the radio antennae critical to the smartphone's basic functionality: separate ones for transmission and reception via cellular and WiFi networks, an additional Bluetooth antenna

to accommodate short-range communication and coupling to accessories, and perhaps a near-field communication (NFC) antenna for payments and other ultra-short-range interactions. This last item is what accounts for the smartphone's increasing ability to mediate everyday urban interactions; it's what lets you tap your way onto a bus or use the phone to pay for a cup of coffee.

Finally, all of these components are arrayed on a high-density interconnect circuit board, and powered by a rechargeable lithium-ion or lithium-polymer battery capable of sustaining roughly 1,500 charging cycles. This will yield just about four years of use, given the need to charge the phone daily, though experience suggests that few of us will retain a given handset that long.

There is one final quality of the smartphone that is highly significant to its ability to mediate everyday experience: it is incomplete at time of purchase. For all its technical capability, the smartphone as we currently conceive of it remains useless unless activated by a commercial service provider. In the business of mobile telephony, the process by which this otherwise-inactive slab of polycarbonate and circuitry is endowed with functionality is called “provisioning.” A user account is established, generally with some means of payment authenticated, and only once this credential has been accepted do you find that the object in your hands has come alive and is able to transact with the things around it.

Even once provisioned, the smartphone is not particularly useful. It can be used to make voice calls, certainly; it generally comes loaded with a clock, a calendar, weather and map applications, a web browser, and—rather tellingly—a stock ticker. But the overwhelming balance of its functionality must be downloaded from the network in the form of “apps,” designed and developed by third parties with wildly differing levels of craft, coding ability and aesthetic sensibility.

This immediately confronts the would-be user with a choice to make about which corporate ecosystem they wish to participate in. The overwhelming majority of smartphones in the world

run either on Apple's iOS or on some flavor of the open-source Android operating system, and these are incompatible with one another. Apps designed to work on one kind of device and operating system must be acquired from the corresponding marketplace—Apple's App Store, Google Play—and cannot be used with any other. In this light, we can see the handset for what it truly is: an aperture onto the interlocking mesh of technical, financial, legal and operational arrangements that constitutes a contemporary device and service ecosystem.

The smartphone as we know it is a complicated tangle of negotiations, compromises, hacks and forced fits, swaddled in a sleekly minimal envelope a few millimeters thick. It is, by any reckoning, a tremendously impressive technical accomplishment. Given everything it does, and all of the objects it replaces or renders unnecessary, it has to be regarded as a rather astonishing bargain. And given that it is, in principle, able to connect billions of human beings with one another and the species' entire stock of collective knowledge, it is in some sense even a utopian one.

But behind every handset is another story: that of the labor arrangements, supply chains and flows of capital that we implicate ourselves in from the moment we purchase one, even before switching it on for the first time.

Whether it was designed in studios in Cupertino, Seoul or somewhere else, it is highly probable that the smartphone in your hand was assembled and prepared for shipment and sale at facilities within a few dozen kilometers of Shenzhen City, in the gritty conurbation that has sprawled across the Pearl River Delta since the Chinese government opened the Shenzhen Special Economic Zone for business in August 1980.⁴ These factories operate under circumstances that are troubling at best. Hours are long; the work is numbingly repetitive, produces injuries at surreal rates,⁵ and often involves exposure to toxic chemicals.⁶ Wages are low and suicide rates among the workforce are distressingly high.⁷ The low cost of Chinese labor, coupled to workers' relative lack of ability to contest these conditions,

is critical to the industry's ability to assemble the components called for in each model's bill of materials, apply a healthy markup⁸ and still bring it to market at an acceptable price point. Should Chinese wages begin to approximate Western norms,⁹ or local labor win for itself anything in the way of real collective bargaining power, we may be certain that manufacturers will find other, more congenial places to assemble their devices. But for now Shenzhen remains far and away the preeminent global site of smartphone manufacture.

Take a step or two further back in the production process, and the picture gets bleaker still. To function at all, the smartphone—like all electronic devices—requires raw materials that have been wrested from the Earth by ruthlessly extractive industries. The cobalt in its lithium-ion batteries was mined by hand in the Congo, often by children; the tin in the soldered seams that bind it together most likely comes from the Indonesian island of Bangka, where the water table is irreparably fouled, 70 percent of the coral reefs have been destroyed by mine runoff, and on average one miner a week is killed on the job.¹⁰ The damage caused by the processes of extraction fans out across most of a hemisphere, mutilating lives, human communities and natural ecosystems beyond ready numbering. And so the polluted streams, stillborn children and diagnoses of cancer, too, become part of the way in which the smartphone has transformed everyday life, at least for some of us.

Though these facts might give us pause in just about any other context, we don't appear to be too troubled by them when it comes to the smartphone. The smartphone *isn't* like any other product, and in fact ranks among the most rapidly adopted technologies in human history.¹¹ And so we suppress whatever qualms we may have about the conditions in the mines and factories, the environmental footprint, the energetic cost of the extended supply chain, or the authoritarian governments we ultimately support through our act of purchase. To the degree that we're even aware of it, we leave this deniable prehistory behind the moment we plunk down our cash and take home our new phone.

And for whatever it may be worth, our desire for the smartphone has yet to reach its saturation point. As prices fall, an ever-higher proportion of the planetary population acquires some sort of device with this basic feature set. It is always dangerous to imagine futures that are anything like linear extrapolations from the present, but if the augurs can be relied upon, we balance on the cusp of an era in which every near- or fully adult person on Earth is instrumented and connected to the global network at all times.¹² Though we've barely begun to reckon with what this implies for our psyches, our societies, or our ways of organizing the world, it is no exaggeration to say that this capability—and all the assumptions, habits, relations of power and blindspots bound up in it—is already foundational to the practice of the everyday.

Part of the difficulty in approaching the smartphone analytically is that there is so very much to say about it. Entire books could be written, for example, about how the constant stream of notifications it serves up slices time into jittery, schizoid intervals, and may well be eroding our ability to focus our attention in the time between them.¹³ Or how its camera has turned us all into citizen photojournalists, and in so doing significantly altered the social dynamics surrounding police violence. We might find some purchase, though, by considering a single one of its functions: the ability it grants us to locate ourselves.

Consider that for the entire history of cartography, using a map effectively meant decoding a set of abstract symbols that had been inscribed on a flat surface, and then associating those symbols with the various three-dimensional features of the local environment. The ability to do so, and therefore to successfully determine one's position, was by no means universally distributed across the population, and this scarcity of knowledge was only compounded by the fact that until relatively recently, maps themselves were rare (and occasionally militarily sensitive) artifacts.

But the maps we see on the screen of a phone cut across all this. Everyone with a smartphone has, by definition, a free,

continuously zoomable, self-updating, high-resolution map of every part of the populated surface of the Earth that goes with them wherever they go, and this is in itself an epochal development. These maps include equally high-resolution aerial imagery that can be toggled at will, making them just that much easier for the average user to comprehend and use. Most profoundly of all—and it's worth pausing to savor this—they are the first maps in human history that follow our movements and tell us where we are on them in real time.

It's dizzying to contemplate everything involved in that achievement. It fuses globally dispersed infrastructures of vertiginous scale and expense—the original constellation of American NAVSTAR Global Positioning System satellites, and its Russian, European and Chinese equivalents; fleets of camera- and Lidar-equipped cars, sent to chart every navigable path on the planet; map servers racked in their thousands, in data centers on three continents; and the wired and wireless network that yokes them all together—to a scatter of minuscule sensors on the handset itself, and all of this is mobilized every time the familiar blue dot appears on the screen. By underwriting maps of the world that for the first time include our real-time position, center on us, and move as we do, two dollars' worth of GPS circuitry utterly transforms our relationship to place and possibility. Thanks to a magnetometer that costs another dollar or so, they automatically orient themselves to the direction we're looking in and pivot as we turn, helping us perform the necessary cognitive leap between the abstraction on screen and the real world we see around us. And in a neatly Borgesian maneuver, the touch-screen controller and the onboard RAM let us fold a map that would otherwise span some 30 miles from side to side, if the entire world were rendered at the highest level of detail, into an envelope small and light enough to be gripped in a single hand and carried everywhere.

The maps we see on the screen of a smartphone help us rebalance the terms of our engagement with complex, potentially confounding spatial networks, allowing newcomers and tourists alike to negotiate the megacity with all the canniness and

aplomb of a lifelong resident. By furnishing us with imagery of places we've never yet been, they can help to banish the fear that prevents so many of us from exploring unfamiliar paths or districts. They are the most generous sort of gift to the professional lover of cities, and still more so to everyone whose livelihood and wellbeing depends on their ability to master the urban terrain. But they also furnish us with a great deal of insight into the networked condition.

Most obviously, in using them to navigate, *we become reliant on access to the network to accomplish ordinary goals*. In giving ourselves over to a way of knowing the world that relies completely on real-time access, we find ourselves at the mercy of something more contingent, more fallible and far more complicated than any paper map. Consider what happens when someone in motion loses their connection to the network, even briefly: lose connectivity even for the time it takes to move a few meters, and they may well find that they have been reduced to a blue dot traversing a featureless field of grey. At such moments we come face to face with a fact we generally overlook, and may even prefer to ignore: the performance of everyday life as mediated by the smartphone depends on a vast and elaborate infrastructure that is ordinarily invisible to us.

Beyond the satellites, camera cars and servers we've already identified, the moment-to-moment flow of our experience rests vitally on the smooth interfunctioning of all the many parts of this infrastructure—an extraordinarily heterogeneous and unstable meshwork, in which cellular base stations, undersea cables, and microwave relays are all invoked in what seems like the simplest and most straightforward tasks we perform with the device. The very first lesson of mapping on the smartphone, then, is that the handset is primarily a tangible way of engaging something much subtler and harder to discern, on which we have suddenly become reliant and over which we have virtually no meaningful control.

We ordinarily don't experience that absence of control as a loss. Simultaneously intangible and too vast to really wrap our

heads around, the infrastructure on which both device and navigation depend remains safely on the other side of the emotional horizon. But the same cannot be said for what it feels like to use the map, where our inability to make sense of what's beneath our fingertips all too frequently registers as frustration, even humiliation. Here we're forced to reckon with the fact that *the conventions of interaction with the device are obscure or even inexplicable to many*. Spend even a few minutes trying to explain basic use of the device to someone picking it up for the first time, and you'll realize with a start that what manufacturers are generally pleased to describe as "intuitive" is in fact anything but. When we do fail in our attempts to master the device, we are more likely to blame ourselves than the parties who are actually responsible. And while there will no doubt come a point at which everyone alive will have been intimately acquainted with such artifacts and their interface conventions since earliest childhood, that point remains many years in the future. Until that time, many users will continue to experience the technics of everyday life as bewildering, overwhelming, even hostile.

If we are occasionally brought up short by the complexities of interacting with digital maps, though, we can also be badly misled by the very opposite tendency, the smoothness and naturalness with which they present information to us. We tend to assume that our maps are objective accounts of the environment, diagrams that simply describe what is there to be found. In truth, they're nothing of the sort; *our sense of the world is subtly conditioned by information that is presented to us for interested reasons, and yet does not disclose that interest*.

Even at its highest level of detail, for example, it's generally not feasible to label each and every retail store or other public accommodation that may appear on the map. Decisions have to be made about which features to identify by name, and increasingly, those decisions are driven by algorithms that leverage our previous behavior: where we've been in the past, the websites we've visited, what we've searched for, the specific apps we have installed, even who we've spoken with. As a result, it may never be entirely clear to us why a particular business

has been highlighted on the map we're being offered. It would be a mistake to think of this algorithmic surfacing as somehow incidental, or lacking in economic consequence: according to Google, four out of every five consumers use the map application to make local searches, half of those who do so wind up visiting a store within twenty-four hours, and one out of every five of these searches results in a "conversion," or sale.¹⁴

There are two aspects of this to take note of: the seamless, all-but-unremarked-upon splicing of revenue-generating processes into ordinary behavior, which is a pattern that will crop up time and again in the pages to come, and the fact that by tailoring its depiction of the environment to their behavior, the smartphone presents each individual user with a different map. Both of these qualities are insidious in their own way, but it is the latter that subtly erodes an experience of the world in common. We can no longer even pretend that what we see on the screen is a shared, consistent representation of the same, relatively stable underlying reality. A map that interpellates us in this way ensures, in a strikingly literal sense, that we can only ever occupy and move through our own separate lifeworlds.

This is not the only way in which the smartphone sunders us from one another even as it connects. For in the world as we've made it, *those who enjoy access to networked services are more capable than those without*. Someone who is able to navigate the city in the way the smartphone allows them to will, by and large, enjoy more opportunities of every sort, an easier time availing themselves of the opportunities they are presented with, and more power to determine the terms of their engagement with everything around them than someone not so equipped—and not by a little way, but by a great deal.

This will be felt particularly acutely wherever the situations we confront are predicated on the assumption of universal access. If the designers (or funders) of shared space become convinced that "everyone" has a phone to guide them, we may find that other aids to wayfinding—public maps, directional signage, cues in the arrangement of the physical environment—begin to disappear from the world. Under such circumstances, the personal

device is no longer an augmentation but a necessity; under such circumstances, design that prevents people from understanding and making full use of their devices is no longer simply a question of shoddy practice, but of justice.

There's something of an ethical bind here, because if the smartphone is becoming a *de facto* necessity, it is at the same time *impossible to use the device as intended without, in turn, surrendering data to it* and the network beyond. In part, this is simply a function of the way mobile telephony works. Most of us know by now that our phones are constantly tracking our location, and in fact have to do so in order to function on the network at all: the same transaction with a cellular base station or WiFi router that establishes connectivity suffices to generate at least a low-resolution map of our whereabouts. But it is also a function of business model. Your location can be used to refine real-time traffic reports, tailor targeted advertising, or otherwise bolster the map vendor's commercial imperatives, and this means that high-resolution tracking will invariably be enabled by default.

Unless you explicitly go into your device's settings menu and disable such tracking, and possibly several other application-specific functions as well, it's continuously shedding traces of your movement through the world—and the terms and conditions you assented to when you set your phone up for the first time permit those traces to be passed on to third parties. (Here, again, the interface's inherent opacity crops up as an issue: many people don't know how to find the controls for these functions, or even that they can be switched off in the first place.) On top of the map you yourself see, then, superimpose another: the map of your peregrinations that is at least in principle available to the manufacturers of your phone, its operating system and mapping application, and any third-party customers they may have for that data.

That map can be combined with other information to build up detailed pictures of your behavior. Algorithms applied to the rate at which you move are used to derive whether you're on foot or in a vehicle, even what kind of vehicle you're in, and of

Not fun
Public
Google

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course such findings have socioeconomic relevance. More pointedly still, when latitude and longitude are collapsed against a database of “venues,” you’re no longer understood to be occupying an abstract numeric position on the surface of the Earth, but rather Père Lachaise cemetery, or Ridley Road Market, or 30th Street Station. And just like our choice of transportation mode, a list of the venues we frequent is not in any way a neutral set of facts. There are any number of places—an Alcoholics Anonymous meeting, a fetish club, a betting shop or a psychotherapist’s practice—that may give rise to inferences about our behavior that we wouldn’t necessarily want shared across the network. And yet this is precisely what leaches off the phone and into the ether, every time you use the map.

Whenever we locate ourselves in this way, whether we’re quite aware of it or not, *we are straightforwardly trading our privacy for convenience*. For most of us, most of the time, the functionality on offer is so useful that this is a bargain we’re more than happy to strike, yet it remains distressing that its terms are rarely made explicit.

And however much one may believe that it’s an ethical imperative to ensure that people are aware of what their smartphone is doing, this is by no means a straightforward proposition. It is complicated by the fact that *a single point of data can be mobilized by the device in multiple ways*. For example, the map is not the smartphone’s only way of representing its user’s location. The suite of sensors required to produce the map—the GPS, the accelerometer, the magnetometer and barometer—can also pass data to other applications and services on the device via a structured conduit called an API, or application programming interface. Through the API, the same data that results in the familiar blue dot being rendered on the map lets us geotag photos and videos, “check in” to venues on social media, and receive weather forecasts or search results tailored for the particular place in which we happen to be standing. Depending on the applications we have running, and the degree of access to location data we’ve granted them, place-specific information can be served to us the moment we traverse a

“geofence,” the digitally defined boundaries demarcating some region of the Earth’s surface, and this might mean anything from vital safety alerts to discount coupons to new powers in a game.

When we move through the world with a smartphone in hand, then, we generate an enormous amount of data in the course of our ordinary activities, and we do so without noticing or thinking much about it. In turn, that data will be captured and leveraged by any number of parties, including handset and operating system vendors, app developers, cellular service providers, and still others; those parties will be acting in their interests, which may only occasionally intersect our own; and it will be very, very difficult for us to exert any control over any of this.

What is true of the map is true of the device it resides on, as it is of the broader category of networked technologies to which both belong: whatever the terms of the bargain we entered into when we embraced it, *this bargain now sets the conditions of the normal, the ordinary and the expected*. Both we ourselves and the cultures we live in will be coming to terms with what this means for decades to come.

The familiar glowing rectangles of our smartphone screens are by now unavoidable, pretty much everywhere on Earth. They increasingly dominate social space wherever we gather, not even so much an extension of our bodies as a prosthesis grafted directly onto them, a kind of network organ. Wherever you see one, there too is the vast ramified array of the planetary network, siphoning up data, transmuting it into a different form, returning it to be absorbed, acted upon, ignored entirely. Equipped with these devices, we’re both here and somewhere else at the same time, joined to everything at once yet never fully anywhere at all.

The individual networked in this way is no longer the autonomous subject enshrined in liberal theory, not precisely. Our very selfhood is smeared out across a global mesh of nodes and links; all the aspects of our personality we think of as

constituting who we are—our tastes, preferences, capabilities, desires—we owe to the fact of our connection with that mesh, and the selves and distant resources to which it binds us.

How could this do anything but engender a new kind of subjectivity? Winston Churchill, in arguing toward the end of the Second World War that the House of Commons ought to be rebuilt in its original form, famously remarked that “we shape our buildings, and afterwards our buildings shape us.”¹⁵ Now we make networks, and they shape us every bit as much as any building ever did, or could.

It's easy, too easy, to depict the networked subject as being isolated, in contact with others only at the membrane that divides them. But if anything, the overriding quality of our era is porosity. Far from affording any kind of psychic sanctuary, the walls we mortar around ourselves turn out to be as penetrable a barrier as any other. Work invades our personal time, private leaks into public, the intimate is trivially shared, and the concerns of the wider world seep into what ought to be a space for recuperation and recovery. Above all, horror finds us wherever we are.

This is one of the costs of having a network organ, and the full-spectrum awareness it underwrites: a low-grade, persistent sense of the world and its suffering that we carry around at all times, that reaches us via texts and emails and Safety Check notices. The only way to hide from that knowledge is to decouple ourselves from the fabric of connections that gives us everything else we are. And that is something we clearly find hard to do, for practical reasons as much as psychic ones: network connectivity now underwrites the achievement of virtually every other need on the Maslovian pyramid, to the extent that refugees recently arriving from warzones have been known to ask for a smartphone before anything else, food and shelter not excluded.¹⁶

We need to understand ourselves as nervous systems that are virtually continuous with the world beyond the walls, fused to it through the juncture of our smartphones. And what keeps us twitching at our screens, more even than the satisfaction of any practical need, is the continuously renewed opportunity to bathe in the primal rush of communion.

Whether consciously or otherwise, interaction designers have learned to stimulate and leverage this desire: they know full well that every time someone texts you, “likes” your photo or answers your email, it changes you materially, rewiring neurotransmitter pathways, lighting up the reward circuits of your brain, and enhancing the odds that you’ll trigger the whole cycle over again when the dopamine surge subsides in a few seconds. This clever hack exploits our most primal needs for affirmation, generally from the most venal of motivations. But it can also sensitize us to the truth of our own radical incompleteness, if we let it, teaching us that we are only ever ourselves in connection with others. And as we have never been anything but open and multiple and woven of alterity—from the DNA in our cells, to the microbes in our guts, to the self-replicating modules of language and learned ideology that constitute our very selves—in the end maybe the network we’ve wrought is only a clunky way of literalizing the connections that were always already there and waiting to be discovered.

It remains to be seen what kind of institutions and power relations we will devise as selves fully conscious of our interconnection with one another, though the horizontal turn in recent politics might furnish us with a clue. Whatever form they take, those institutions and relations will bear little resemblance to the ones that now undergird everyday experience, even those that have remained relatively stable for generations. The arrangements through which we allocate resources, transact value, seek to exert form on the material world, share our stories with one another, and organize ourselves into communities and politics will from now on draw upon a fundamentally new set of concepts and practices, and this is a horizon of possibilities that first opened up to us in equipping ourselves with the smartphone.

greater chance of bringing just and fruitful configurations of power into existence, and maintaining them over the long term through the new means of production and distribution offered by digital fabrication. But such an infrastructure can only be realized if we know ahead of time what we need, how specifically it serves our values, and what building it will require of us.

What will we be able to make if we do? Not just new things, but new kinds of things—previously unsuspected articulations of matter, limited only by physics and desire. And even in a small way, the chance to live in an environment we've fashioned ourselves, using tools we ourselves have crafted. True to its roots, digital fabrication is helping us work out the shape of the future, one experiment at a time. We remain at the proof-of-concept stage: we now know that in principle, these things can be done. But all the social and intellectual heavy lifting begins now.

Cryptocurrency

The computational guarantee of value

All written accounts of the technological development we know as “the blockchain” begin and end the same way. They note its origins in the cryptocurrency called Bitcoin, and go on to explain how Bitcoin’s obscure, pseudonymous, possibly even multiple inventor “Satoshi Nakamoto” used it to solve the problems of trust that had foxed all previous attempts at networked digital money. They all make much of the blockchain’s potential to transform the way we exchange value, in every context and at every level of society. And they all gesture at the exciting possibilities that lie beyond currency: the world of smart contracts, distributed applications, autonomous organizations and post-human economies, all mediated by “trustless” cryptographic techniques.

Almost all verbal conversations involving the blockchain begin and end the same way, too: in perplexity. This is the first information technology I’ve encountered in my adult life that’s just fundamentally difficult for otherwise intelligent and highly capable people to comprehend. In part, this is due to the very particular framework of assumptions about human nature that drove the blockchain’s design, a framework that (we may rejoice)