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## Series Foreword

As professions go, design is relatively young. The practice of design predates professions. In fact, the practice of design—making things to serve a useful goal, making tools—predates the human race. Making tools is one of the attributes that made us human in the first place.

Design, in the most generic sense of the word, began over 2.5 million years ago when *Homo habilis* manufactured the first tools. Human beings were designing well before we began to walk upright. Four hundred thousand years ago, we began to manufacture spears. By forty thousand years ago, we had moved up to specialized tools.

Urban design and architecture came along ten thousand years ago in Mesopotamia. Interior architecture and furniture design probably emerged with them. It was another five thousand years before graphic design and typography got their start in Sumeria with the development of cuneiform. After that, things picked up speed.

All goods and services are designed. The urge to design—to consider a situation, imagine a better situation, and act to create that improved situation—goes back to our prehuman ancestors.

Making tools helped us to become what we are: design helped to make us human.

Today, the word *design* means many things. The common factor linking them is service, and designers are engaged in a service profession in which the results of their work meet human needs.

Design is first of all a process. The word *design* entered the English language in the 1500s as a verb, with the first written citation of the verb dated to the year 1548. *Merriam-Webster's Collegiate Dictionary* defines the verb *design* as "to conceive and plan out in the mind; to have as a specific purpose; to devise for a specific function or end." Related to these is the act of drawing, with an emphasis on the nature of the drawing as a plan or map, as well as "to draw plans for; to create, fashion, execute or construct according to plan."

Half a century later, the word began to be used as a noun, with the first cited use of the noun *design* occurring in 1588. *Merriam-Webster's* defines the noun as "a particular purpose held in view by an individual or group; deliberate, purposive planning; a mental project or scheme in which means to an end are laid down." Here, too, purpose and planning toward desired outcomes are central. Among these are "a preliminary sketch or outline showing the main features of something to be executed; an underlying scheme that governs functioning, developing or unfolding; a plan or protocol for carrying out or accomplishing something; the arrangement of elements or details in a product or work of art." Today, we design large, complex process, systems, and services, and we design organizations and structures to produce them. Design has changed considerably since our remote ancestors made the first stone tools.

At a highly abstract level, Herbert Simon's definition covers nearly all imaginable instances of design. To design, Simon

writes, is to “[devise] courses of action aimed at changing existing situations into preferred ones” (Simon, *The Sciences of the Artificial*, 2nd ed., MIT Press, 1982, p. 129). Design, properly defined, is the entire process across the full range of domains required for any given outcome.

But the design process is always more than a general, abstract way of working. Design takes concrete form in the work of the service professions that meet human needs, a broad range of making and planning disciplines. These include industrial design, graphic design, textile design, furniture design, information design, process design, product design, interaction design, transportation design, educational design, systems design, urban design, design leadership, and design management, as well as architecture, engineering, information technology, and computer science.

These fields focus on different subjects and objects. They have distinct traditions, methods, and vocabularies, used and put into practice by distinct and often dissimilar professional groups. Although the traditions dividing these groups are distinct, common boundaries sometimes form a border. Where this happens, they serve as meeting points where common concerns build bridges. Today, ten challenges uniting the design professions form such a set of common concerns.

Three performance challenges, four substantive challenges, and three contextual challenges bind the design disciplines and professions together as a common field. The performance challenges arise because all design professions

1. act on the physical world,
2. address human needs, and
3. generate the built environment.

In the past, these common attributes were not sufficient to transcend the boundaries of tradition. Today, objective changes in the larger world give rise to four substantive challenges that are driving convergence in design practice and research. These substantive challenges are

1. increasingly ambiguous boundaries between artifacts, structure, and process;
2. increasingly large-scale social, economic, and industrial frames;
3. an increasingly complex environment of needs, requirements, and constraints; and
4. information content that often exceeds the value of physical substance.

These challenges require new frameworks of theory and research to address contemporary problem areas while solving specific cases and problems. In professional design practice, we often find that solving design problems requires interdisciplinary teams with a transdisciplinary focus. Fifty years ago, a sole practitioner and an assistant or two might have solved most design problems. Today, we need groups of people with skills across several disciplines and the additional skills that enable professionals to work with, listen to, and learn from each other as they solve problems.

Three contextual challenges define the nature of many design problems today. While many design problems function at a simpler level, these issues affect many of the major design problems that challenge us, and these challenges also affect simple design problems linked to complex social, mechanical, or technical systems. These issues are

1. a complex environment in which many projects or products cross the boundaries of several organizations, stakeholder, producer, and user groups;
2. projects or products that must meet the expectations of many organizations, stakeholders, producers, and users; and
3. demands at every level of production, distribution, reception, and control.

These ten challenges require a qualitatively different approach to professional design practice than was the case in earlier times. Past environments were simpler. They made simpler demands. Individual experience and personal development were sufficient for depth and substance in professional practice. While experience and development are still necessary, they are no longer sufficient. Most of today's design challenges require analytic and synthetic planning skills that cannot be developed through practice alone.

Professional design practice today involves advanced knowledge. This knowledge is not solely a higher level of professional practice. It is also a qualitatively different form of professional practice that emerges in response to the demands of the information society and the knowledge economy to which it gives rise.

In his essay "Why Design Education Must Change" (from *Core77*, November 26, 2010), Donald Norman challenges the premises and practices of the design profession. In the past, designers operated on the belief that talent and a willingness to jump into problems with both feet gives them an edge in solving problems. Norman writes:

In the early days of industrial design, the work was primarily focused upon physical products. Today, however, designers work on

organizational structure and social problems, on interaction, service, and experience design. Many problems involve complex social and political issues. As a result, designers have become applied behavioral scientists, but they are woefully undereducated for the task. Designers often fail to understand the complexity of the issues and the depth of knowledge already known. They claim that fresh eyes can produce novel solutions, but then they wonder why these solutions are seldom implemented, or if implemented, why they fail. Fresh eyes can indeed produce insightful results, but the eyes must also be educated and knowledgeable. Designers often lack the requisite understanding. Design schools do not train students about these complex issues, about the interlocking complexities of human and social behavior, about the behavioral sciences, technology, and business. There is little or no training in science, the scientific method, and experimental design.

This is not industrial design in the sense of designing products, but industry-related design, design as thought and action for solving problems and imagining new futures. This MIT Press series of books emphasizes strategic design to create value through innovative products and services, and it emphasizes design as service through rigorous creativity, critical inquiry, and an ethics of respectful design. This rests on a sense of understanding, empathy, and appreciation for people, for nature, and for the world we shape through design. Our goal as editors is to develop a series of vital conversations that help designers and researchers to serve business, industry, and the public sector for positive social and economic outcomes.

We will present books that bring a new sense of inquiry to the design, helping to shape a more reflective and stable design discipline able to support a stronger profession grounded in empirical research, generative concepts, and the solid theory that gives rise to what W. Edwards Deming described as profound

knowledge (Deming, *The New Economics for Industry, Government, Education*, MIT, Center for Advanced Engineering Study, 1993). For Deming, a physicist, engineer, and designer, profound knowledge comprised systems thinking and the understanding of processes embedded in systems, an understanding of variation and the tools we need to understand variation, a theory of knowledge, and a foundation in human psychology. This is the beginning of “deep design”—the union of deep practice with robust intellectual inquiry.

A series on design thinking and theory faces the same challenges that we face as a profession. On one level, design is a general human process that we use to understand and to shape our world. Nevertheless, we cannot address this process or the world in its general, abstract form. Rather, we meet the challenges of design in specific challenges, addressing problems or ideas in a situated context. The challenges we face as designers today are as diverse as the problems clients bring us. We are involved in design for economic anchors, economic continuity, and economic growth. We design for urban needs and rural needs, for social development and creative communities. We are involved with environmental sustainability and economic policy, agriculture competitive crafts for export, competitive products and brands for micro-enterprises, developing new products for bottom-of-pyramid markets and redeveloping old products for mature or wealthy markets. Within the framework of design, we are also challenged to design for extreme situations; for biotech, nanotech, and new materials; for social business; as well as for conceptual challenges for worlds that do not yet exist (such as the world beyond the Kurzweil singularity) and for new visions of the world that does exist.

The Design Thinking, Design Theory series from the MIT Press will explore these issues and more—meeting them, examining them, and helping designers to address them.

Join us in this journey.

Ken Friedman

Erik Stolterman

Editors, Design Thinking, Design Theory Series

## Acknowledgments

This book began with a student's curiosity, became viable through a generous act from a senior scholar, and materialized with the help of an incredible support team made up of colleagues, friends, and family—many who occupy more than one of these categories.

In 2015, I walked into a classroom at James Madison University in Harrisonburg, Virginia, prepared to lecture about technological affordances for a small undergraduate course. I did not expect to start a book. However, a young man named Ben asked just the right question (“Don’t rope and wood fences afford differently?”), which led to writing on the classroom whiteboard, a series of blog posts,<sup>1</sup> a journal article in *Bulletin of Science, Technology & Society*,<sup>2</sup> and now, a full monograph. Ben’s thoughtfulness was, literally, inspirational. In 2017, in a new appointment at the Australian National University (ANU) in Canberra, I booked a meeting with Professor Genevieve Bell, a recent transplant from Silicon Valley and founder ANU’s Autonomy, Agency, and Assurance Institute (3Ai).<sup>3</sup> Within a day of that meeting, I had an introduction email to Doug Sery, acquisitions editor for the MIT Press. It was a small act for Professor Bell but monumental for me. Doug was interested in the project and ushered

it through from start to finish, with tireless help from Noah J. Springer, whose dissertation, it turns out, addressed affordances (the topic of this book).<sup>4</sup>

I am forever grateful to D’Lane Compton, who shared her wisdom, time, and materials when I presented my full naivety in the form of a one-line Twitter message that read “how does one write a book?” I was further aided in both process and content through extensive conversations with and feedback from David A. Banks, Nathan Jurgenson, and PJ Patella-Rey. Their careful balance between encouragement and challenge kept my spirits up and my framing sharp. I am also grateful to all past and present contributors to the *Cyborgology* blog<sup>5</sup> and Theorizing the Web conference,<sup>6</sup> who have cultivated a community of thinkers, writers, and activists doing the kind of theory I want to see in the world. Equally influential and generous have been my closest collaborators on other projects. Tony Love, Carla Goar, and Bianca Manago have picked up my slack while I worked on the book, and each has made me a better thinker through years of intellectual discussion, debate, and endless Track Changes. The book was also helped along by three emerging scholars who gave me the privilege of supervising their honors theses. Siobhan Dodds, Hannah Gregory, and Will Orr asked about the book each week during our meetings, motivating me to write. They also kept me on my intellectual toes, the benefits of which cannot be overstated. Finally, thank goodness for James Chouinard. My coauthor, editor, and partner. Not once did you hesitate when I asked, “Is it okay if I read something out loud?” You have cheered me through this book while making sure that the ideas are sound. With you, I have full support and get away with nothing. Truly, thank you.

# 1 Introduction

## **A Trolley Problem of a Particular Sort**

In January 2017, I relocated from the United States to begin an academic appointment in Canberra, Australia. This moment was marked by competing pulls of excitement and trepidation. The allure of adventure and the esteem I felt for my new institution were punctuated by anxiety about the unknown and uncertainty about life abroad. I had been warned that Australia was unlike America, despite the familiarity of a shared language. Heeding this advice, I spent my first weeks in Canberra watching others with anthropological vigilance, certain I would order coffee incorrectly or breach public transit decorum. I kept my voice at a soft timbre and Googled everything before I did it. I was determined to blend in, which I did successfully, for a while.

My first fish-out-of-water moment came unexpectedly, and it had nothing to do with Australian culture. In fact, it was tied to an activity for which I had presumed full competence: acquiring a shopping cart or, in Australian parlance, a shopping trolley. It was a hot day in the peak of summer and I was moving from temporary campus housing to a more permanent place outside the city. Having left behind nearly all my worldly possessions,

I needed starter supplies to set up a new home. After a quick internet search for “how to get gas in Australia” and a precarious drive on the left side of the road to a nearby big-box store, I took a deep breath and looked for the largest shopping cart I could find.

To my surprise, I found only hand-held baskets and carts that were linked and locked together. I asked a clerk, “Do you have any trollies available for immediate customer use, and if not, could you please unlock one for me?” The clerk informed me that the trollies took a \$2 coin deposit. Besides the fact that I had no idea Australia’s currency included \$2 coins, I verged bewildered: “Are you telling me I need to pay to use a cart?” The clerk blinked, started to explain, and then used a key around his belt to unlock a cart before sending me on my way.

After a few moments of studying the cart’s blue handle—it had three small currency slots, a lock device, and an opening into which the lock device fits—I understood. Customers don’t rent the carts, but use coins as collateral. When returning the cart, shoppers retrieve their money by locking the used cart back in place, which releases the coin deposit.

Coin-locks are a theft-prevention measure and a now common feature of commerce in many urban environments. However, because I grew up in the suburbs and lived in small towns for most of my adult life, coin-locks were new to me. I was used to seeing shopping carts that were free-standing and abundant. In fact, I once lived in an apartment complex in Texas with an informal shopping cart repository in the parking lot. The local supermarket chain sent employees to retrieve the carts once a day. But in Australia’s capital city, coin-locks are standard.<sup>1</sup>

The problem of shopping cart retention is an ironic one in the context of the cart’s history. In 1937, Sylvan Goldman introduced

the wheeled shopping cart to reluctant customers at his Humpty Dumpty grocery chain in Oklahoma. By that time, the design of shops had shifted from a model where clerks stood behind a counter and fetched items for customers to a self-service model where customers selected their own items from displays around the store.<sup>2</sup> At first, customers used hand-held baskets to collect and deliver their goods to the checkout counter. As store sizes expanded and grocery loads grew, the conventional hand-held baskets proved less convenient. Clerks had to watch for customers with full baskets, hold customers' items until checkout, and provide fresh baskets for continued shopping. This could be inconvenient for shoppers and relied on paid labor from store staff. Goldman's wheeled cart model—which looks similar to the carts used in most stores today—enabled shoppers to buy more goods with greater convenience, while undercutting staffing costs.

Goldman's customers needed convincing. Women rejected the idea of pushing a cart because it too closely resembled a baby buggy. Apparently, women wanted shopping to feel like a break from childcare, not an extension of it. Men found carts too effeminate and rejected them on normative gender grounds. So Goldman mobilized a public relations and outreach campaign. Along with advertisements, Goldman hired attractive men and women to use shopping carts in his stores. The tactic worked. Shopping carts quickly spread to other retail outlets, becoming a fixture in the contemporary marketplace.

If Goldman had trouble persuading people to adopt his new technology, the existence of coin-locks represents an opposite problem: persuading people to give back the carts they've taken. The coin-lock was patented in various forms during the 1980s and 1990s and is one of several theft-prevention measures. Others

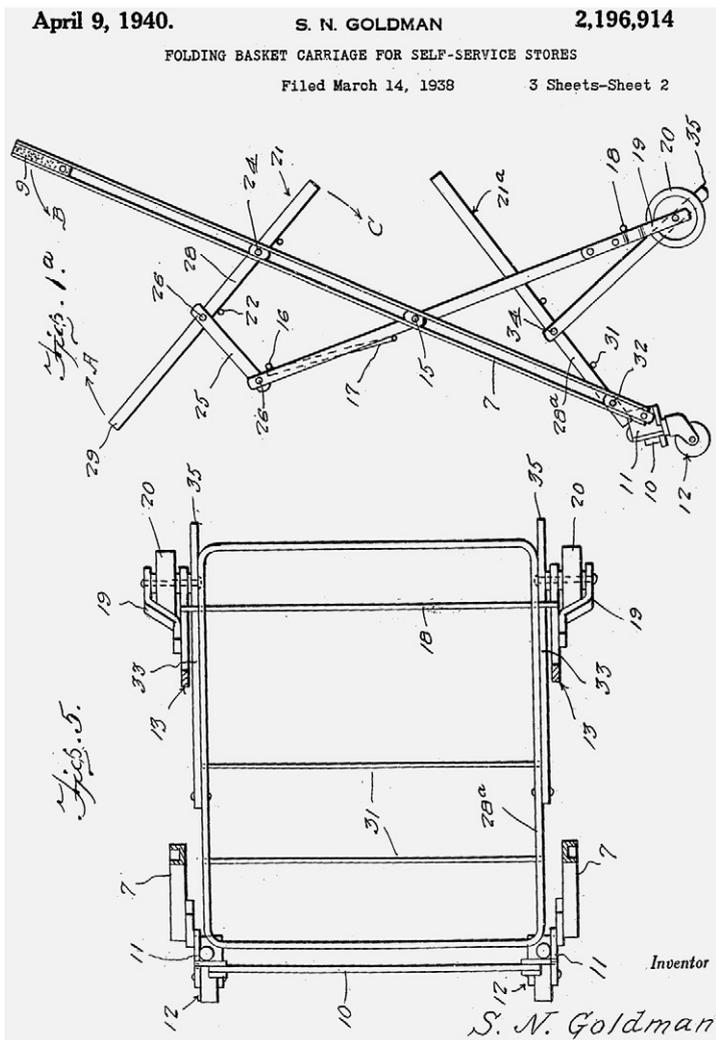


Image of Sylvan Goldman's early shopping cart

include electronic and magnetic features that lock a cart's wheels when it passes a perimeter; long poles attached to shopping carts that block them from fitting through exits; global positioning system (GPS) trackers; and even services that find, retrieve, and return carts for a fee. Not only do stolen or misplaced carts place a financial burden on stores (which pay from \$150 to \$400 for each replacement), but cities struggle with safety issues when stolen carts are left in roads, on sidewalks, and in creeks and streams. In short, both shops and cities have an interest in keeping shopping carts on company property, and developments in theft-prevention technologies reflect these interests. For customers, theft-prevention features may be a mere inconvenience (they need to remember to carry change) or may dramatically affect the flows of daily life (people without vehicles cannot easily transport large purchases by foot and so must allot time each day to stop by the store and buy provisions).

The evolution of the shopping cart from a labor-replacing technology that encourages high-volume purchases to a tightly controlled commodity fitted with material constraints shows that objects, even the most mundane, are imbued with values that reflect and have the capacity to shape social, political, and economic relations. Goldman's initial shopping cart was created under the drive of capital accumulation. The cart maximized buying while minimizing paid human labor. Cart usage (or lack thereof) was linked with issues of gender: women wanted to distance the shopping experience from the work of childcare, and men wanted to distance themselves from effeminate connotations of womanhood. Commercial strategies paved the way for widespread shopping cart adoption, and eventually, some carts and shops were redesigned in ways that limited and regulated cart use, with varying effects on consumers.<sup>3</sup> In short, the

shopping cart has politics, affects behavior, and shapes the flow of daily life. These dynamics are built into the cart's material form, with results that are subtle, powerful, and far reaching.

### **Affordances**

This book is about the social dynamics of technology. It is about the ways that ethics, values, and interests are built into technological objects and the ways these objects take shape through interactions with human subjects. More specifically, this book is about technological affordances. Formally, an affordance is defined as “the ‘multifaceted relational structure’<sup>4</sup> between an object/technology and the use that enables or constrains potential behavioral outcomes in a particular context.”<sup>5</sup> That is, affordances mediate between a technology's features and its outcomes. Technologies don't *make* people do things but instead, push, pull, enable, and constrain. Affordances are *how* objects shape action for socially situated subjects.

The concept of affordance was first introduced by the ecological psychologist James J. Gibson in the 1960s and 1970s.<sup>6</sup> For Gibson, “affordance” was a way to approach the mutual constitution between people and environments. Donald A. Norman brought affordances to design studies a decade later to address human-machine interactions.<sup>7</sup> In recent years, the concept has picked up considerable steam as the study of computer-mediated communication (CMC) and information communication technologies (ICTs) have become firmly entrenched in the academic canon.

It is unsurprising that the concept of affordance has surged amid vast and rapid technological change. The ubiquity of smartphones, infusion of digital platforms, and rise of automation are

(re)shaping social relationships, information flows, political participation, and economic relations. Social thinkers are eager to understand these societal shifts and are thus interested in how new technologies work and to what effect. “Affordance” is a useful conceptual tool in such a project because it lets analysts interrogate the effects of emergent technologies while avoiding hardline determinism.

Technology studies offers the persistent reminder that materiality and human agency always operate together. Hence, Goldman’s shopping cart does not force customers to purchase more goods, and hand-held baskets do not stop customers from buying in bulk. However, carts and baskets have features that differ in ways that structure the shopping experience and alter the distribution of labor between employees and consumers. In this way, front-facing digital cameras don’t make people to take selfies but afford this photographic convention in ways that diverge from the affordances of traditional film-reliant devices. Touch-activated dictionaries interact with vocabulary acquisition differently than paper-bound volumes do. Drop-down menus shape choice in more confining ways than write-in boxes do. And large “REPORT” buttons on social media platforms afford user-generated content moderation differently than an administrator email hidden behind several clicks.

The analytic balance between materiality and human agency makes affordance a valuable concept that has sustained over time and spread across disciplines. However, the scholarly application of affordance has outpaced its careful theoretical consideration. The concept has been mired by misuse, overuse, false binaries, and inadequate treatment of dynamic subjects and circumstances. For these reasons, some scholars argue that the

concept has lost analytic value and should be relinquished altogether.<sup>8</sup> As evidenced by my book-length attention to the topic, I believe this response is wrongheaded. Instead, I read the critiques of affordance as an opportunity for clarity and precision, and the concept's ascent alongside technological advancements as an indicator that such clarity and precision are needed now more than ever.

One persistent critique is that affordance has remained a binary construct. In its binary depiction, features either afford some action or do not afford that action. Coin-locked carts either afford transportability or do not; social media platforms either afford network building or do not; artificial intelligence (AI) either affords emotional attachment or does not. By this logic, features make actions either inevitable or impossible. In practice, we know that the relationship between people and things is never cut and dry. Human-technology relations are a subtle dance in which technological objects push and pull with varying degrees of insistence while human subjects navigate with more and less motivation, creativity, and skill. Concretely, the coin-lock system does not unequivocally or universally preclude the removal of shopping carts from store premises but instead creates conditions that make removal less likely. Indeed, while researching the history of the shopping cart, I found many tutorials and products aimed at surpassing wheel-locks, coin-locks, and GPS tracking devices. Thus, affordances are never determinations, nor are they uniform. Instead, features apply varying levels of pressure on socially situated subjects.

Luckily, affordance's binary problem has a simple analytic solution: shifting from questions about *what* technologies afford to *how* they afford. The shift from what to how undergirds the argument I delineate throughout this text. As a general rule,

social analyses are much richer when approached with questions of how rather than what. The how captures processes and nuances, while the what remains one dimensional. By asking how technologies afford, we can identify and articulate variation in a given feature's social impact.

For instance, compared to systems without theft-prevention instruments, the coin-lock system creates a light barrier to using shopping carts. To use a coin-locked cart, customers need the proper resources (usually coins of a particular currency) and need to be willing to engage in extra tasks to obtain the cart at both the front and back ends of a shopping trip. These tasks include finding a coin, unlocking a cart, returning the cart when they are finished, locking it, and retrieving their coin. In practice, these actions take only about thirty extra seconds of work and are relatively inconsequential for many people in most circumstances. Nevertheless, the coin-lock feature creates friction and is thus antithetical to Goldman's early initiative to make carts as appealing and available as possible. The coin-lock prevents people from stealing the carts but also dissuades them from using the carts at all. Such dissuasion, however, is milder than if carts were held behind a counter and dispensed only by a clerk or if carts kept their coin deposits, which would change the system from collateral to rent-based (though the latter would also disincentivize cart return).

In comparing features of different theft prevention implementations, both a coin-lock apparatus and magnetically triggered wheel-locks reduce the transportability of grocery carts, but the coin-lock system generally presents fewer barriers to taking carts off-site. A customer who takes a coin-locked cart off-site may lose \$2, but the wheel-locked trolley stops rolling after crossing a perimeter. Both coin-locks and wheel-locks reduce

transportability, but they do so with varying degrees of force, and neither makes the cart entirely nontransportable. Customers who encounter coin-locks may elect to forgo their \$2 investment, leave the store with the cart and then come back to recoup their \$2, use a universal cart key (they are easily found and purchased online), or simply wait to find a loose cart and take that cart off the lot. Customers who encounter wheel-locks may lift the cart over the magnetic locking strip, push the cart over the magnetic perimeter with significant force, load the cart into a vehicle, or if especially motivated and sufficiently able, carry the cart after the wheels go into lock mode. The point is that asking *how* instead of *what* objects afford shows nuanced relationships between technical features and their effects on human subjects while accounting for creative and subversive human acts.

A second critique is that analysts too often depict affordances as universal when in fact, they are relational and conditional. Given that technical features exert varying degrees of force, the next question to ask is *for whom and under what circumstances?* For example, for me as a coin-lock novice, the coin-locks posed a stronger barrier to use than they would for customers more familiar with the system. Over time, I became accustomed to Canberra's coin-locks, and the affordances varied between my past and present selves. The barrier to use amplifies when I'm in a hurry (am I willing to expend the extra thirty seconds?) and reduces when I'm not on a schedule. The consequences for taking a shopping cart off site are relatively minor for me (\$2 will not noticeably affect my bank account), but may be more consequential for someone experiencing homelessness or fending off hunger. (The need to take a cart off site may also be more pronounced for people in the latter group, who are less likely to

have personal transportation and may use the cart for reasons other than grocery shopping).

In short, affordances refer to *how* objects enable and constrain. This will vary across people and contexts. Shifting from *what* to *how* and accounting for diverse subjects and circumstances represent a simple but crucial advancement in affordance theory. A more substantial advancement, which is the main project of this book, is to operationalize the concept of affordance such that *how*, *for whom*, and *under what circumstances* are incorporated into a concise analytic tool.

### **Operationalizing Affordances: The Mechanisms and Conditions Framework**

This book delineates the *mechanisms and conditions framework* as a theoretical scaffold for affordance analyses. The mechanisms of affordance refer to the how of human-technology relations, and the conditions refer to variability across subjects and circumstances. Rather than rely on general statements about more and less force exerted by technological objects, the mechanisms of affordance indicate that technologies *request*, *demand*, *encourage*, *discourage*, *refuse*, and *allow* particular lines of action and social dynamics. *Requests* and *demands* are initiated by the object, and *encouragement*, *discouragement*, and *refusal* are responses to subjects' inclinations. *Allow* applies to acts initiated by both subjects and objects.

The conditions of affordance specify the relational nature of human-technology encounters—namely, the conditions of affordance vary by *perception*, *dexterity*, and *cultural and institutional legitimacy*. That is, people perceive a range of functions and constraints presented by technological objects, have varying

levels of skill in operating a set of features, and experience differential support in engaging with a technology due to cultural norms and institutional regulations.<sup>9</sup>

Operationalizing affordances through the mechanisms and conditions framework provides a vocabulary and structure with which to approach affordance analyses. For example, with the mechanisms of affordance, we may say that shopping carts *encourage* large purchases and hand-held baskets *discourage* large purchases. In this vein, the hand-held baskets *request* frequent trips to the shop, and the carts *encourage* fewer trips. Neither baskets nor carts *refuse* frequent or infrequent shopping trips, but they nudge shoppers in one direction or the other. Shoppers using baskets and carts are *allowed* to fill their shopping vessels with sale items, specialty items, frozen goods, or fresh produce (that is, baskets and carts pay no mind to their contents outside of weight and dimensions).

The conditions of affordance let us further parse the push and pull of technologies by their circumstances of use. For example, in the 1930s, the perceived link between carts and baby carriages *discouraged* use by women and men—who experienced the apparatus as an extension of care labor and prohibitively feminine, respectively. Goldman’s early public relations campaign was aimed at rebranding the shopping cart as a gender-neutral labor-saving tool, thus *encouraging* use by shoppers across gender categories (and in turn, *requesting* that shoppers purchase more goods in a single trip). Notably, despite Goldman’s successful efforts to change perceptions and cultural norms, the traditional cart model still *refuses* use by portions of the population. For example, those who use wheelchairs may not have the physical dexterity to utilize Goldman’s original cart design. The cart therefore *encourages* use by walking customers but *refuses* use

among those with certain mobility impairments. Subsequent cart designs that include an adult-sized seat and motorized components undo this *refusal* and instead *encourage* adoption by those for whom walking is difficult or impossible.

Theft-prevention features also work differently depending on context. Wheel-locks *refuse* transportability for people who perceive no workarounds to magnetic perimeters but merely *discourage* transportability for those who are aware of alternatives (such as lifting the cart over the magnetic strip or pushing the cart with enough force to beat the lock device). Similarly, coin-locks *request* that users keep the carts on store premises but *allow* people with the requisite resources to move carts beyond store boundaries. Normative and implicit biases also apply here, as cultural and demographic markers can either mitigate or amplify surveillance, highlighting the relational dynamics of affordances in practice. For instance, customers of color are more likely to be followed by a store employee as they shop, thus *refusing* cart removal in a way that is merely *discouraged* for white customers, whom employees are more likely to grant freedom of movement around the store.

In short, technologies are efficacious in ways that manifest variously across persons and circumstances. The mechanisms and conditions framework offers a conceptual scaffold with which to address these dynamics. The mechanisms of affordance specify *how* technologies afford, while the conditions of affordance situate technologies in context. Crucially, the mechanisms and conditions framework is not a reifying device, but a tool of argumentation. The mechanisms of affordance are neither rigid nor determinative. Rather, they are analytic stopping points with porous boundaries, and the designation of one category versus another remains always up for debate. In turn, the conditions of

affordance are neither static nor mutually exclusive but overlapping and always subject to change. The mechanisms and conditions framework thus provides a schematic onto which analysts and practitioners can map sociotechnical systems, maintaining the richness of dynamism, uncertainty, and robust deliberation.

### **How Affordances Matter**

The mechanisms and conditions framework is rooted in the assumption that technologies are political. I address this base assumption more thoroughly in chapter 3. For now, I use the politics of technology to make a case for how affordances matter. Technologies are designed, implemented, and used through webs of choices. Some of these choices are explicit and reflect a clear intention for the technology to affect human action in some specific way. Other choices are implicit and may not ever enter the conscious minds of designers, distributors, or end users. Each choice—explicit or implicit—reflects and affects value orientations, sociostructural arrangements, and social dynamics.

Because values are not neutral and tend to reinforce power and status structures, technologies are often infused with the politics of the powerful. This is not to say that technologies cannot effect change for oppressed groups or serve as tools of resistance. They can, and they do. However, the mechanisms and conditions framework begins with the assumption that *if left unchecked*, technologies will arc toward privilege and normality. This assumption bears out empirically and repetitively. For example, several versions of facial recognition software have failed to identify dark-hued skin tones, thus excluding people of color from available services while reentrenching default whiteness; Facebook's real-name policy proved exclusionary and at

times dangerous for some LGBTQI users; and a study by Carnegie Mellon University showed that Google's automated targeted ad feature presents men with higher-paying employment opportunities than those presented to women.<sup>10</sup>

The politics of technology stem from objects' integration with human social and structural arrangements. By asking *how*, *for whom*, and *under what circumstances?*, the mechanisms and conditions framework takes a relational position in which humans and technologies are inherently co-constitutive. Although technologies maintain a shaping effect on human subjects, technologies themselves embody human values and politics in their design, implementation, and use. The bad news is that this means technologies will, by default, reflect and reinforce existing inequalities. The good news is that the default is neither necessary nor inevitable. A sharp analytic tool, like the mechanisms and conditions framework, renders politics visible and pliable. Inclined practitioners can thus rework sociotechnical systems toward social good.

### Situating the Text

A substantial body of work focuses on the entwining of social and technical systems. This has emerged as a robust and interdisciplinary approach to the politics and values of technologies in society. From social science, we see rigorous analyses that detail the ways in which technical systems reflect and perpetuate inequalities along intersecting lines of race, class, sexuality, (dis)ability, geography, and gender. From engineering and design studies, we see an effort to integrate values, ethics, and politics into design processes. A properly operationalized model of affordances connects these intellectual and practical efforts

by giving language and structure to projects that map the social dynamics of technical systems and to projects that design technical systems with social intent.

Virginia Eubanks's *Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor*<sup>11</sup> and Safiya Umoja Noble's *Algorithms of Oppression: How Search Engines Reinforce Racism*<sup>12</sup> stand out as exemplar works from the social sciences. In design studies, there has been a "practical turn" exemplified by Batya Friedman and colleagues' work on value-sensitive design<sup>13</sup> and Mary Flanagan and Helen Nissenbaum's research on *Values at Play in Digital Games*.<sup>14</sup> I highlight these works here to situate the mechanisms and conditions framework of affordances within a larger cross-disciplinary project of critical approaches to technology and design. I also highlight them to show the utility of the mechanisms and conditions framework as a cohesive analytic and practical tool.

Eubanks's *Automating Inequality* documents the effects of automated decision systems in the US public sector. Billed by government agents as objective and optimally efficient, automated systems have been mobilized to manage public welfare, healthcare, homelessness, and children's protective services. Eubanks shows that as they are built, these automated systems over-monitor and underserve populations in need. For example, any missing data for a user in the healthcare distribution system resulted in an immediate cease of benefits with no clear information about what the problem was or how to fix it. Recipients would simply receive notification that they were unable to access benefits, and the burden was placed on the beneficiary to reconcile with the system. People experiencing homelessness were required to answer a battery of questions to be eligible for

housing, thus placing them in databases for surveillance and monitoring by police and government authorities (while remaining highly unlikely to receive sustainable housing assistance). Automated systems for child protection relied on a point-based algorithm that predicted the likelihood that a child would experience danger. The algorithm was predicated largely on interactions between the family and public services, thus placing poor families under disproportionate scrutiny and increasing the likelihood that parental custody would come under threat. In short, Eubanks shows that “poor and working-class people are targeted by new tools of digital poverty management and face life-threatening consequences as a result.”<sup>15</sup>

Noble’s *Algorithms of Oppression* examines algorithmic biases at the intersection of race and gender in the Google search engine. Opening with an account of the author’s search for “black girls,” the book elucidates the ways search engines incorporate racist and sexist logics into information systems. Her work shows how the design of information systems, particularly search algorithms, do not just store, sort, and distribute data but also reproduce patterns of inequality. At the beginning of her research, when she typed “black girls” into a Google search box, Noble was faced with pornographic imagery and tropes about black women’s “sass” and anger. This contrasted with searches for “white girls,” which displayed images of innocence and childhood. Far from objective, racist and sexist search results are at once a function of cultural norms and technical design. With algorithms trained on search terms and clicks from socially situated users, the patterns, prejudices, and problems that persist in the culture are encoded into Google’s information infrastructure.

Eubanks, Noble, and other critics reveal the politics of design so that we may fix evident problems, create better technologies, and work toward building a better society.<sup>16</sup> As Noble argues, “the more we can make transparent the political dimensions of technology, the more we might be able to intervene.”<sup>17</sup> The practical turn in design studies takes up the task of building better, more ethical, and more equitable things.

The practical turn in design studies is premised on the idea that recognizing values and ethics in technologies will expose problematic politics and enable designers to effect change. The practical turn centralizes ethical considerations in technical design decisions. The tradition posits that engineers and technology producers have an opportunity and responsibility to build products and systems that serve the social good—or at least avoid enacting harm. The value-sensitive design research program and Flanagan and Nissenbaum’s *Values at Play in Digital Games* are key representative works from the practical turn.

The value-sensitive design research program is dedicated to constructing methods of making by which producers remain sensitive to ethics and values from the first stage of the design process and throughout implementation and distribution. Value-sensitive design centralizes power relations and inequalities in its treatment of technical products and systems. It begins with the understanding that default designs often reflect default status structures. The program thus works to avoid and ameliorate material reifications of inequality.<sup>18</sup>

In *Values at Play in Digital Games*, Flanagan and Nissenbaum take on the project of practical intervention by focusing specifically on games. Their analysis of the way leisure products embody implicit and explicit social agendas highlights the pervasiveness of politics in design. With clear implications for

technological design more generally, the authors demonstrate the ways game design can perpetuate or resist intersecting oppressions of race, class, gender, (dis)ability, and social class. They show that technical objects are infused with values such as privacy, autonomy, stewardship, and equality. These values can at times sit in tension with each other and between stakeholders, manifesting in divergent ways for the diverse subjects who play.

Both *value-sensitive design* and *values at play* detail methods by which technology producers can account for value tensions and engage in socially intentional design practices. These methods include concrete strategies such as identifying direct and indirect stakeholders, collaborating with diverse stakeholders during all stages of production, making incremental changes in the testing phase (for example, by removing or adding a single feature at a time), externalizing values through sketches and scenarios, prototyping, and creating coding manuals with value orientations. Thus, the practical turn takes a critical perspective on technology and addresses this perspective in material form.

The mechanisms and conditions framework of affordances effectively serves both political analysis of technologies and design-based intervention. The automated decision systems detailed by Eubanks can be presented as *refusals* against poor citizens to maintain privacy and *demands* on welfare recipients to accept monitoring. Eligibility standards construct rigid depictions of responsible and deserving subjects, and the automation of these decision systems strips away the human element. Thus, although eligibility standards have traditionally *requested* that recipients comport themselves in line with state-determined values, automation strengthens these *requests* into *demands*. These demands of responsible personhood do not apply equally to

everyone but exert greater force over those with deeper entrenchment in poverty and state intervention. For instance, automated child protection algorithms count any interaction with services as a risk factor for future abuse. Children whose parents are monitored are entered into the system. When these children grow up and start their own families, they do so with marks already against them. State welfare institutions thus *encourage* all parents to perform (government-sanctioned) responsible parenthood, *refuse* to let poor parents deviate, and *demand* compliance and monitoring in circumstances of intergenerational poverty.

In a similar vein, the information systems described by Noble in *Algorithms of Oppression* *encourage* racism under the guise of objectivity. The systems *demand* curation on the basis of popularity and advertising relevance. Though users are *allowed* to enter any search terms they wish, the results they receive *discourage* critical interpretation. Because media literacy and competence in critical race and gender studies can loosen the constraints of the Google search apparatus, *dexterity* with Google's search features and an understanding or *perception* of results as subject to change alter users' relation to the search tool.

Demarcating the conditions under which technical systems *request*, *demand*, *encourage*, *discourage*, *refuse*, and *allow* not only identifies the politics and values in technical systems but also lays the groundwork for intentional (re)design. Here the mechanisms and conditions framework operates in service of the practical turn. Designers and engineers might rework existing products to encourage gender equity or demand privacy maintenance. They may build goods and services that request sociability or refuse class-based discrimination. The mechanisms and

conditions framework thus emerges as both an analytic tool and as a device for developing desirable outcomes.

In sum, the mechanisms and conditions framework operationalizes “affordance,” providing precise language with which to address human-technology relations. This operationalization is both agile and empirically agnostic, meaning it is not tied to any particular technology but is applicable across myriad sociotechnical systems. The framework can equally address the mechanisms and conditions of bots, social media platforms, chalkboards, seat belts, and shopping carts. This flexible orientation gives affordance analyses both breadth and longevity. One of life’s few inevitabilities is that things change, and technological change persists with striking rapidity. Keeping up with socio-technical change means creating analytic tools that move along with subtle and dramatic technological shifts. The mechanisms and conditions framework is thus transferable by design.

### **Outline of the Book**

The book follows a trajectory from history and politics to conceptualization and methods. Each chapter builds on preceding chapters. However, each chapter is also self-contained and most can be read independently. The only exceptions are chapters 4 and 5, which explicate the mechanisms and conditions framework in detail and should be read together.

The book begins with a brief history of affordance as a concept. One sign of a successful concept is its application across fields. Affordance has certainly achieved this feat. The concept of affordance originated in ecological psychology and has since migrated to design studies, science and technology studies (STS),

communication studies, education, anthropology, sociology, engineering, and elsewhere. In its migration and application, scholars and practitioners have undertaken extensive theoretical reworking and engaged the concept in myriad empirical studies. Chapter 2 weaves the varied threads of affordance's intellectual history into a legible and coherent story.

Chapter 3 gives theoretical grounding to the political nature of the mechanisms and conditions framework. Tracing back to media studies scholars of the 1950s and coming up through contemporary STS perspectives of the new millennium, chapter 3 distinguishes affordance analyses from actor-network theory (ANT)<sup>19</sup> and situates it instead with the critical approach of technology as materialized action.<sup>20</sup> Central to this critical framing is an asymmetrical relationship between subjects and objects and a distinction between technological efficacy and human agency.

Chapters 4 and 5 lay out the mechanisms and conditions framework. Chapter 4 explains and exemplifies *how* technologies afford through a porous continuum of *request, demand, encourage, discourage, refuse, and allow*. Chapter 5 looks at the dynamic relationship between subjects and objects and their contextual contingencies through the conditions of affordance. It demonstrates how the mechanisms of affordance take shape through variations in *perception, dexterity, and cultural and institutional legitimacy*.

Chapter 6 takes up methodology. The mechanisms and conditions framework is an analytic tool. Chapter 6 addresses existing methodological approaches that pair well with this analytic tool. The chapter is geared toward putting affordance analyses into action. The chapter is also of theoretical relevance because it clarifies the criteria by which methodological approaches fit within the scope of the mechanisms and conditions framework.

In clarifying these criteria, chapter 6 rehashes key tenets of the mechanisms and conditions framework and its underlying assumptions.

In the conclusion, I suggest some big questions for future research. The conclusion is meant to be a springboard from which the mechanisms and conditions framework can take flight. My goal throughout the book is to theorize affordances in a way that simplifies rather than complicates. In the conclusion, I urge researchers to apply the mechanisms and conditions framework to the arduous tasks of both analysis and design.