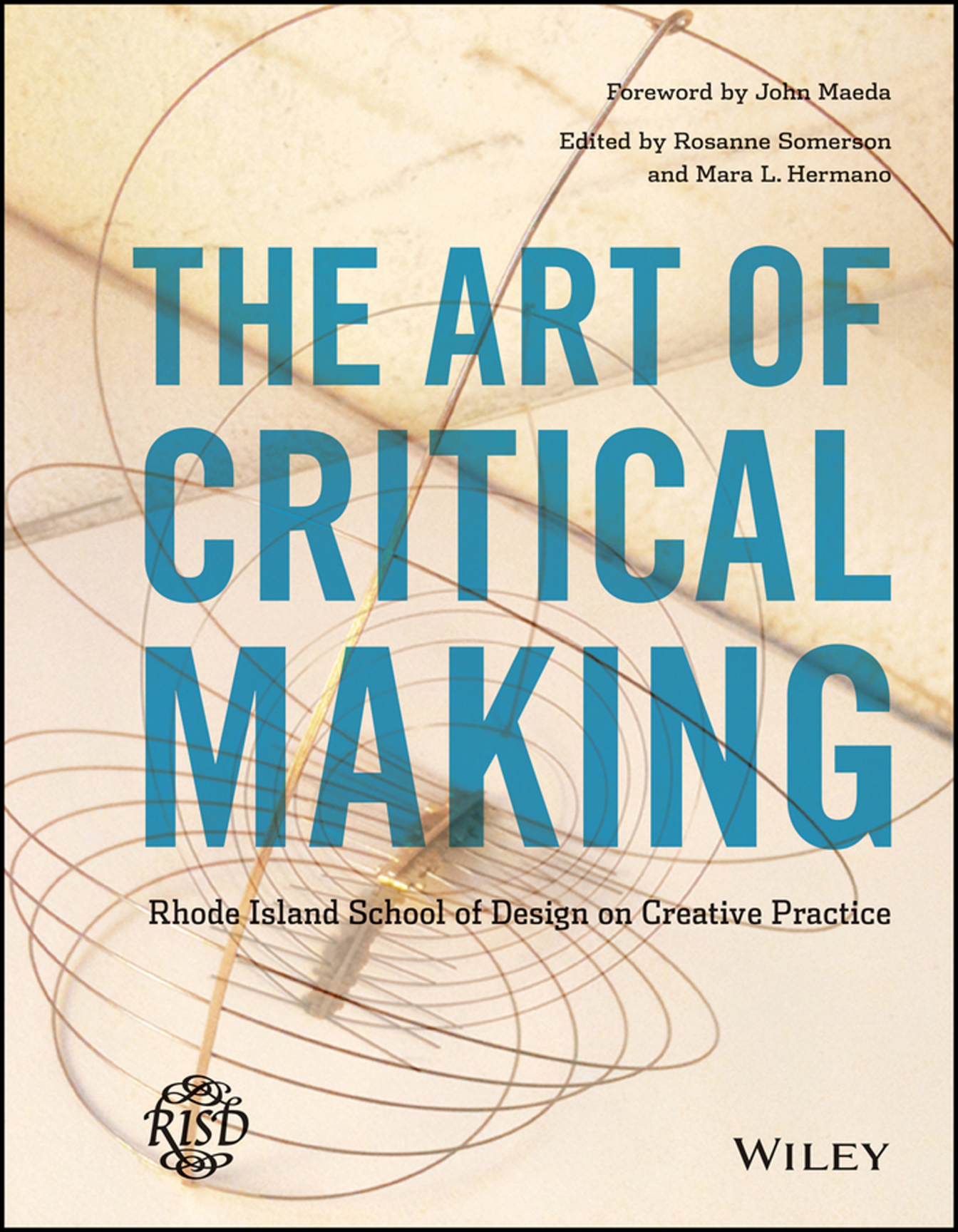

Foreword by John Maeda

Edited by Rosanne Somerson
and Mara L. Hermano

THE ART OF CRITICAL MAKING

Rhode Island School of Design on Creative Practice

RISD

WILEY

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Cover images: Elish Warlop (MFA 2013 Furniture Design), studies for *Rings of Fire* and *Hoop Skirts* lighting, 2013, steel and brass, each 4 × 4 in.
Publication design: Julie Fry

This book is printed on acid-free paper.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.
Published simultaneously in Canada.

ISBN 978-1-118-51786-4 (cloth); ISBN 978-1-118-76395-7 (ebk);
ISBN 978-1-118-76403-9 (ebk)

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

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Foreword

John Maeda

I spent a large part of the '90s getting a PhD at Tsukuba University Institute of Art and Design, a largely closed-off, pristine educational enclave of Japanese master makers and thinkers. There were no computers to speak of, and the web hadn't really happened yet. It was a happy time, unfettered by the e-mails and other e-disruptions that fill all of our days today. I often found myself in the library—intently learning about the history of design through old publications from Ulm (a kind of post-Bauhaus school) and of course the Bauhaus itself.

Conversely, I had spent the decade prior affixed to a computer, at MIT. The '80s was the time when the first "undo" action was invented. Imagine a world without undo; I remember after I began studying at Tsukuba, I was in an ink-drawing class where I noticed that whenever I made an error, my hand would reach for command-Z on an invisible keyboard in my mind. I had to "unlearn" being digital. In doing so, I learned to truly appreciate the advantages of being a student—to get the chance to unlearn what I knew, in order to learn anew. This wonderful educational experience inspired me to become a teacher myself. I returned to MIT as a junior professor at the Media Lab, where I could bring some of my art and design education to bear.

While I was cloistered in Japan, the computer really started to take off. It was fast. And it kept getting faster, cheaper, and better. Digital art and design were largely panned by the art and design establishment because of their "lack of the human hand." In retrospect, I can see that this was a normal reaction to a dehumanizing technology going mainstream—much the same as John Ruskin's and William Morris's proud questioning of the Industrial Revolution. What I could see upon my return from Japan, having been traditionally educated in Bauhaus-style thinking, was that there was opportunity in this new medium, which, like others before it, could help harness unbelievable amounts of expressive power and creative energy. I felt that the tool—in this case the computer—had to be mastered for it to do the biddings of the artist and designer's hand, head, and heart.

As an advocate in the late '90s for artists and designers writing their own computer programs, I often got a lot of flack. The prevailing sentiment was, "Why should artists learn to code when there are tools like Photoshop?" My goal was to simply follow what I learned from my materials-based education at Tsukuba—that we needed to treat the computer as a new kind of material, and to master it deeply. This interest led me to develop a variety of systems for teaching computer programming to artists and designers, culminating in the Design by Numbers system in 1999. My graduate students Ben Fry and Casey Reas then built an even better system called Processing, which has vastly eclipsed my own work—suitably and proudly so. Today there are thousands of artists and designers programming with Processing to advance their ideas computationally.

And so, after twelve years teaching at MIT, my post as the 16th President of Rhode Island School of Design has been a homecoming back to the world of rigorous art and design. This book is all about the kinds of things I learned at Tsukuba, and frankly way, way more. Having stood in the same ultra-hot studios of our Glass department where alumnus and teacher Dale Chihuly forged his first physical thoughts, which would come to define evanescence, and in the same drawing studio where alumnus Gus Van Sant came as a RISD freshman, later making major movies like *Good Will Hunting* and *Milk*, I know I stand on the hallowed grounds of a kind of creative education "dojo" unlike any other place on earth.

At RISD, the integrity of the work comes from a place of criticality *and* materiality. Why does it exist? What existed before? What has influenced it? How is it made? Can it be made? Can we will it to be made? I find that the process of making work at RISD involves a kind of questioning that rivals a grand jury combined with a six-sigma manufacturing audit. Every stone, speck of dirt, and atom of oxygen must be turned over and examined in the light of the day in its present, past, and future. It is this kind of intensity that makes our unique brand of "critical making" so relevant to this day and age. We are all hungry for authenticity—the studied touch of a human hand, the

thoughtfulness of a brilliant human mind, and a heart replenished with the warmth of another human heart.

In this digital age, there is a renewed curiosity about humanity, materiality, and all things physical, simply because much of the world has lost sight of them. You see little bits of this in the incongruity of putting faux wood-grain digital veneers on software apps. We are still in the very early days of art, design, and the computer—we have yet to have that "aha" moment when the physical world and the virtual world truly click together. For now, I see tremendous opportunity in studying and understanding traditional media—for in these materials is the root of all that we know and can truly believe.

At the same time, I know that a deeper understanding of computer code and computer-aided design and fabrication is also important. At RISD we have those efforts underway, led by Provost Rosanne Somerson and her advanced critical making initiatives. I'm not surprised by the number of corporations that have begun to knock on our door to ask for what a business or technology school can no longer do for them—which is to help them envision the future by engaging with some of the most creative thinkers and makers of our times.

After a life spent traversing the fields of technology, art, and design, my foremost conclusion is that there is great power in both fields taken separately, and in both fields put together. Reading this book, you will see why RISD is a symbol for art, design, and creativity the world over, and as such, can play a role as their advocate on national and international stages. That is why we have taken a leadership role in the movement to turn STEM (Science, Technology, Engineering, and Math) into STEAM in the United States by adding the "Arts," broadly defined. STEAM advocates for the federal government to integrate art and design with its growing emphasis on STEM education and research. By doing so, we will develop the creativity needed to drive our innovation economy forward and keep America competitive throughout this century. The critical making we teach here at RISD is

what enables designers and artists to create objects, devices, and services that are more engaging, more efficient, and more human.

So, STEAM is embodied naturally at RISD. Nowhere is this more evident than at the 75-year-old Edna Lawrence Nature Lab. Filled with more than 80,000 samples of animal, plant, and mineral materials, it's a beautiful repository of everything from a taxidermied turkey to Brazilian butterflies to human bones. At RISD we teach students to understand humanity and nature from the core essence and architecture of life—by observing it and reproducing it on paper or in clay. Science is taught the way it was taught centuries ago, when artists and scientists were often the same person.

We have all seen that in the battle over education funding, the arts have been cut to make way for STEM education in public schools. As a lifelong STEM student, I know the possibilities inherent to those disciplines, but I also know that the way they are taught doesn't always lead to creative thinking, nor do they enable vitality and humanity to shine through. STEAM got on the federal government's radar when Rhode Island Congressman James Langevin introduced a House Resolution in 2011 in support of STEAM research and education. Around the same time, a Conference Board study was released, which said that nearly all employers view creativity as increasing in importance in the workplace, yet 85 percent say they can't find the creative applicants they seek. Leaders in both business and policy circles have begun to recognize the criticality of integrating the arts and design with the STEM fields.

Since then, pardon the expression, the movement picked up steam and has found its place on Sesame Street, at South by Southwest, and on the agendas of the National Science Foundation and the National Endowment for the Arts. Please visit http://stemtosteam.org to learn more about how you can be a part of this important effort to reveal the importance of art and design. I am proud to lead an institution that knows that art isn't just a "nice to have," but a "need to have."

I believe that art and design have critical roles to play in innovation in this next century, much like science and technology did in the last. The very methods revealed in this book will drive the new ideas, movements, and solutions to help us tackle the complex problems of our day. RISD students understand this: 71 percent of students surveyed from the RISD Class of 2011 responded that they are or want to be entrepreneurs; they are pioneering a new kind of "artrepreneurship" for our country.

It's heartening to watch our students and graduates rise to this challenge and to witness the ever-growing stream of visitors on campus who recognize that artists and designers will be the next change agents. We have greatly broadened the kind of employers that come to RISD now from our home base of creative industries to include technology companies, financial services, healthcare solutions providers, and even venture capital firms looking for artists and designers to propel new ideas. In 2012, we launched the inaugural class of Maharam STEAM Fellows in Applied Art and Design, which funds RISD students to pursue internships in the public and nonprofit sectors. Michael Maharam, the company's CEO, himself a visionary in the broader cultural implications of design, expressed it well when he said, "Maharam believes that creativity demonstrated through the arts and design will play an increasingly critical role in America's ongoing efforts to remain a dominant global force through both culture and commerce."

So much of RISD's inspiration and humanity fill these pages—but words pale in comparison to what we experience every day on our campus. So in closing, I invite you to take a train, car, or plane to visit us here in Providence, Rhode Island. If you are a lifelong creative person—knowing that you are if you've read this far—you will feel like you are truly at home. It's my honor to get to see that satisfaction every day in our students' faces, here at RISD.

Preface

Frank R. Wilson

All humans are born biologically gifted learners—recipients of a host of inheritances from ancestors we will never meet. This claim is not one of those plastic verbal posies tossed lightly from a Preface writer to inspiration-hungry readers. It is a straightforward fact about the strength of every person's connection to genetic heritage, and the reason for our astonishing capacity to acquire skill, knowledge, and understanding through physical experience, fulfilling the deepest instinctive intentions of the human mind itself. No matter who our forebears were or where they lived as individuals, as a group they learned to see beneath surfaces, to read meaning into the unfamiliar, and to adapt and survive not simply as a species, but as living individuals, in a future than could not be foreseen. But how did they do it?

The sources of our readiness are unimaginably remote, as the roots of human physical skill and intelligence extend into the past by millions of years. It seems likely that widespread climate and vegetation changes in Africa at the end of the Miocene epoch, more than 5 million years ago, increasingly forced tree-dwelling apes there to take their chances as bipedal ground dwellers. When this happened, the hand and the brain that we inherit were not what they are today. Much of what we know about the evolution of the human wrist and hand we owe to Lucy, who lived in the Afar region of Ethiopia 3¼ million years ago.[1] A chimpanzee-size ape whose existence became known because her fossilized skeletal remains were discovered by anthropologist Donald Johanson in November 1974, Lucy the matriarch together with the species named after her, *Australopithecus afarensis*, stand very near the dawn of human evolution.[2]

As chimp-like as she may have looked, Lucy was structurally very unlike the chimp in ways that offer major clues to the early stages of human evolution. The most obvious structural difference was in the design of her pelvis and the bones of her lower extremities, which marked her as a habitual upright walker, or bipedal. Not quite so obvious at first were the un-apelike anatomic features of her hand. An increase in the length of the thumb compared to the fingers and the ability to rotate the index and middle fingers on

their long axis gave her the biomechanics needed for a variety of new grips and hand movements. For example, the "3-jaw chuck" is a grip that permits an irregularly shaped object (such as a stone) to be held securely between the thumb, index, and middle fingers. This grip is identical to that used by a baseball pitcher for an overarm pitch, and would have been extremely useful if the skill of throwing could be mastered for purposes of hunting or defense.

Lucy's longer thumb retained the muscle and tendon features of the ape hand, allowing enhanced independence of thumb movement. The addition of new rotational movements of the index and middle finger that were absent in the ape hand show Lucy's hand to have put her descendants—our ancestors—solidly on the path toward the functionally far more versatile grasping and handling organ that became the modern human hand. Subsequent structural changes, mainly on the side of the hand opposite the thumb, allowed improved finger-to-finger contact and a greatly expanded range of grips and movements—in effect, the biomechanical platform that paved the way for us to become adept and highly skilled users of an open-ended set of objects and tools.

The hand of tree-living apes who lived millions of years before Lucy was itself highly specialized, but mainly for supporting and transporting the weight of the suspended body, for grooming and fighting, and for handling food and small objects available in the environment. Over time, minor anatomic changes produced a hand whose functions were being radically transformed; it was a hand that traded some of the raw power of the ape hand for a movement profile emphasizing independence of the thumb and greatly increased control of precision finger movements. The other major change (the oblique squeeze grip, which came after Lucy's time) compensated for power loss by increasing the effective power and accuracy that could be delivered by objects securely held and precisely controlled in the hand.

No one knows how much aggressive or defensive overarm throwing the *Australopithecines* actually did, nor do we know exactly when subsequent changes in the anatomy of the hand occurred or how they may have been

exploited by Lucy's descendants, but we do know that over the span of several million years, those of Lucy's descendants who learned to take advantage of the hand came to dominate the bipedal world of the hominids and eventually outlasted all their competitors. When our ancestors came down from the trees, in other words, an upright walking posture had not merely relieved the forelimbs of their primary role in locomotion but had opened the door to a completely novel domain of perception, action, and *interaction* based in the hands. It was *our* ancestors who walked through that door.

The extremely long span of time from the earliest manufacture of stone tools until more complex objects appeared at habitation sites has been puzzling to some experts, but during that time there may have been little need for a more advanced tool "technology," and a significant portion of that time may have passed as the brain was altering its own operations to allow more complex movements of the hand and arm to be added to the already impressive repertoire of skilled upper limb movements that existed in chimpanzees. This is because the brain would not have been capable of controlling the complex movements of the evolving hominid hand *before* the hand itself was physically capable of varying the hand grips and individual finger movements which are now part of our repertoire.

Neural adaptation to a hand whose inner mechanics were in transition must have been extremely complicated for two other reasons: first, significant changes in hand function would have required an open-ended repertoire of adaptive body movements to make hand use effective and dependable—think of a carpenter hammering on a roof, a tennis player running toward the net, a short-order cook juggling pots and skillets on a stove. Second, as pointed out by anthropologist Peter C. Reynolds, human tool use eventually acquired a critical social dimension. As he says: "The essence of human technical activity is anticipation of the action of the other person and the performance of an action complementary to it, such that the two people together produce physical results that could not be produced by the two actions done in series by one person."[3]

There will always be room for debate about critical events in early human evolution, but it is widely conjectured by anthropologists, archeologists, and cognitive scientists alike that the biologic success of humans has largely been due to evolving hands, an increasing reliance on tools, and a host of behavioral changes associated with a complex communal and material culture. Given all of this, from a neurologic and evolutionary perspective, the conservative position on hand-brain co-evolution must be that the brain developed its enormously enhanced hand control capabilities very gradually and modified them over time as experience defined the long-term role of the hand in hominid survival. Genetic change at the species level assured that each new member of our species would arrive with an inborn potential for skilled hand use, activated by an early-life urge to take things apart and put them back together again, and to gain membership in a team in the process.

So what does Lucy's story have to do with the hands-on critical making at the core of art and design education at RISD? To answer that we must consider the current educational alternative. We live in an age of remarkable technological advances. Yet with all the good technology has done to add to the general prosperity of society, the as-yet-unmeasured cost of our acceptance of these advances in educational settings seems fundamentally at odds with the physicality of human perception, thought, and action. Computer and communications technologies have arrived in classrooms at every level, but the spectacular advances in student achievement widely anticipated from the digital revolution simply have not been realized.[4] As a society we have not learned how to use powerful new technologies in ways that do not paradoxically subvert the innate power of students to examine and learn that will lead them toward mastery on their own terms. The danger is that today's students, equipped with technologies they did not themselves create and which yield them experiences they are not prepared for or temptations they cannot resist, are at the mercy of the inevitably self-assertive tendencies of

technologies.[5] Considering our hopes for them, and the inestimable power of resources already provided them by virtue of biological heritage, this seems not merely a tragic but an entirely needless outcome.

There is no such thing as just saying no to technology—there really never was. Lucy and the *Australopithecines* were a species on a very specific path, with a new arm, a new hand, and a brain capable of turning simple stones into a powerful hunting and self-defense technology. But Lucy also put her descendants on a path toward a unique kind of individual intelligence: a marriage of brain, body, and objects waiting to be turned into something better than what was already there. And that was not all: Objects brought to life by a maker return the favor, not only by fostering confidence and vitality but by sharpening personal identity and adding meaning to the experience of consciousness.

That for humans there should be an essential reciprocity between action and identity, mediated by the hand, is neither modern nor merely an interesting idea—it is a signature motif found over and over in the work of late Renaissance artists, elevated to the status of religious iconography in Michelangelo's *The Creation of Adam*. My own relation to this idea grew over many years working as a neurologist with musicians at virtually all stages of their education and their careers, an experience that led me to believe that the desire to achieve an artistic goal is invariably strengthened when the body itself is both the instrument and the focus of the work. There must be many reasons why this is so, but one that should stand out for readers of this book is that when physical skill supports and enlivens the creative process, memories of place, object, movement, and companions will always make their way into the fabric of achievements.

We are now well into the computer revolution and the information age, living with changes in virtually every aspect of ordinary and professional life. The way bankers handle money, armies fight wars, writers get their books published, politicians get elected—everything has changed. Well, almost everything: gymnasts still balance on narrow beams and risk injury from

falling; violinists still perform on violins whose design has been stable for centuries; cowboys still ride real horses; hairdressers still use scissors to cut hair; potters still throw pots on a rotating wheel. What about architects and engineers? What about designers and doctors? What about you and me? No matter what computers do for us, gaining mastery of the body and deploying it as an agent of the mind may be the only way for us as individuals to continue to find the distinctive and emotionally rich forms of creative expression that embodied learning makes possible, and to retain control of the idiosyncratic, mysterious self that came along with the rest of the package.

Notes

1. We also owe a great deal to anthropologist Mary Marzke at Arizona State University, whose contributions to our understanding of the evolution of modern hand function are grounded in her landmark research on Lucy and on the evolution of hand and wrist morphology in relation to hand use and the manufacture of stone tools. See Mary Marzke, "Who Made Stone Tools?" in *Stone Knapping: The Necessary Conditions for a Uniquely Hominid Behavior*, McDonald Institute Monographs, Valentine Roux and Blandine Bril, eds. (Cambridge, UK: Oxbow Books, 2005).

2. The discovery of Lucy and the aftermath of the find are described in Donald Johanson and Maitland Edey's *Lucy: The Beginnings of Humankind* (New York: Simon & Schuster, 1981).

3. Peter C. Reynolds, "The Complementation Theory of Language and Tool Use," in *Tools, Language, and Cognition in Human Evolution*, Kathleen R. Gibson and Tim Ingold, eds. (Cambridge, UK: Cambridge University Press, 1993), 412.

4. It has probably been a full decade since one could have anything approaching a clear idea about the direction and influence of computers and the media on education. The years surrounding the millennium were a time of lively and confident writing on the subject: Stephen Talbott's *The Future Does Not Compute: Transcending the Machines in Our Midst* (Sebastopol, CA: O'Reilly & Associates, Inc., 1995); Jane M. Healy's *Failure*

to Connect: How Computers Affect Our Children's Minds—for Better and Worse (New York: Simon & Schuster, 1998); Alison Armstrong and Charles Casement, *The Child and the Machine: Why Computers May Put Our Children's Education at Risk* (Toronto: Key Porter Books, 1998); C. A. Bowers, *Let Them Eat Data: How Computers Affect Education, Cultural Diversity, and the Prospects for Ecological Sustainability* (Athens, GA: University of Georgia Press, 2000). 2000 was also the year *U.S. News and World Report* featured a young girl on its cover, seated rather improbably on a lawn, intently gazing at the screen of a portable computer, next to the title "Why Computers Fail as Teachers: Too Much Screen Time Can Harm Your Child's Development" (September 25, 2000). Probably the last serious book in this genre was Todd Oppenheimer's *The Flickering Mind: The False Promise of Technology in the Classroom and How Learning Can Be Saved* (New York: Random House, 2003). A decade later you know who won the epic battle from today's book titles. From Sherry Turkle, MIT's Professor of the Social Studies of Science and Technology, we have a blunt description of our new way of living: *Alone Together: Why We Expect More from Technology and Less from Each Other* (New York: Basic Books, 2011); and from Kevin Kelly, co-founder and Executive Editor of *Wired* magazine, we have our marching orders: *What Technology Wants* (New York: Penguin Books, 2010). There is a consolation prize, though. Our individual minds may have become a shadow of what our parents had (or vainly thought they had), but they are connected! For a vision of how education will look when the shouting is finally over, see: *Connected Learning: An Agenda for Research and Design, a Research Synthesis of the Connected Learning Research Network* (Irvine, CA: The MacArthur Foundation on Digital Media and Learning Research Hub, January 2013).

5. For an excellent discussion on this topic, see Catherine Dowling's recent paper, "The Hand: Kinesthetic Creation and the Contemporary Classroom," *The International Journal of Learning* 8, no. 18 (2012): 51–66. See also Matthew B. Crawford, *Shop Class as Soulcraft: An Inquiry into the Value of Work* (New York: The Penguin Press, 2009), especially Chapter 6, "The Contradictions of the Cubicle"; and Richard Sennett, *The Craftsman* (New Haven, CT: Yale University Press, 2009), especially "Fractured Skills: Hand and Head Divided."

The Art of Critical Making: An Introduction

Rosanne Somerson

Walk along the riverfront in Providence, Rhode Island, at the foot of "College Hill," and you may be surprised by what you see. You might easily walk beside someone carrying a hollow six-foot shoe fabricated from woven wire, or alongside a group of students balancing their newly finished chairs on their backs and heads, or pass someone lugging a drawing portfolio so large and unwieldy that you might be tempted to stop and ask to assist. On certain days there could be fashion collections wheeled on hanger racks, or recycled industrial off-cuts of felt and cork spilling out of bags slung over shoulders, or even sculpted metal chopsticks three times the height of the woman hauling them. Someone might have laced delicate woven yarn around trees lining the river walk, preparing their branches with sweater-like covers for winter. Out of sight, inside the studios and labs, a diverse range of projects could likely be developing—investigations into sustainable systems for food transport, or objects designed for extreme climates, or a video that correlates and weaves together two events happening simultaneously in different locations.

Art schools are lively places, but few outside their walls have the opportunity to experience the kind of environment where the new is manifest every day, where paradigms are continually stretched and challenged, and where shock and beauty flourish side by side. What is the "magic" in the art and design school learning model that advances an individual from an interested student into a creative innovator? And how might the creativity and expertise that result from this form of education be accessible to others? While no single philosophy or pedagogy effectively turns developing artists and designers into creative professionals, some shared methods have proven to transform hard-working students into exceptional creative practitioners. In this book, RISD faculty and staff examine these methods to explore RISD's rationale and approach in developing and enhancing creative learning. Additionally, we explore the efficacy and the *essential need*, in contemporary times, for learning that includes hands-on practice, the processing of enhanced seeing and perception, and contextualized understanding—all elements of "critical making."

At RISD we develop curricular models through which innovation and originality are coaxed, rendered, and challenged, leading to heightened expression and new ways of thinking. We cultivate intense personal development, deep disciplinary expertise, rigorous skill-building, advanced conceptual reasoning, and attention to both process and execution. We are committed to fostering creative and critical thinkers who innovate with ease, who are not rattled by uncertainty, who move agilely from one form of output to another, and who can communicate in multiple ways with acuity and clarity. We believe that these traits are effective remedies for crumbling systems and structures that no longer work. As educational systems propel us further and further away from physical, tangible experience, how better might learning support nimble, innovative, and imaginative thinking than through models that emphasize the iterative formation of ideas through making? Contemporary times call for contemporary thinkers and makers.

Through these pages, we invite you to enter with us into a world of creative energy and rigorous investigation. Who might benefit from a "peek through the keyhole" into the multifaceted characteristics of RISD's educational practice? This book will certainly be useful to those who are directly pursuing an art and design education. Prospective students will gather deep insights into their potential futures. Parents who may be skeptical about the benefits of supporting such a path at a time when it seems that key opportunities point toward other areas of study—business, technology, scientific research, entertainment, medicine, and marketing—may be surprised to learn that RISD alumni have succeeded at high levels in remarkable ways in all of these fields. A RISD alumna who later became an attorney still cites her RISD education as the formative basis for complex problem solving required in her law practice; a product designer demonstrates that his education in design process helped him to create one of the most successful online businesses in existence; some of the region's best restaurants famous for their remarkably innovative cuisine boast RISD alumni as chefs and owners. Our alumni are successful recording artists, medical device inventors, and social

visionaries who have changed and improved lives around the world. And of course the list of distinguished alumni artists and designers representing every form of creative practice is the source of great pride. RISD graduates have made Oscar-winning films (and even hosted the Oscars), popular book and television series, and significant public programming. The number of alumni who have been awarded MacArthur "genius" Fellowships and Fulbrights is unmatched by any other art school. Look at the "Gallery Guide" in any city, attend any global art fair, or visit any of the top design, architecture, fashion, or textile firms, and you will likely find numerous RISD alumni at work. In short, extraordinary results have emerged from the RISD educational experience as it has evolved over some 135 years.

In addition to aspiring young artists and designers and their parents, many others will find this book enlightening and supportive. Many corporations recognize how much more inventive they can be when they apply principles like those framed in our curricula, paying close attention to how they activate innovation and advance opportunity. Businesses of all sorts looking for ways to rethink long-held assumptions and to build greater creativity into their process and outcomes will find illuminating and expansive approaches to familiar questions, which may well generate innovation and new achievement. Practitioners early in their careers looking for ways to build their own strong creative practices will benefit from the insights of the experienced educators who have contributed to this book, gaining deeper understanding of high-level creative learning. Even other systems of education can benefit from echoing the curricular approaches and processes of an art and design institution such as RISD. Indeed, so much about art and design education can benefit a broad audience.

The writers who have contributed to this book—like all of our faculty, staff, and librarians—lead in their disciplines through engaged and ongoing professional practice. These writers do not attempt here to define art or design.

They do not offer a prescription for creative innovation. Instead, they offer observations and examples from direct experience that make up the substance and distinction of a RISD education, untangling the territory of art education, which remains largely unknown outside of arts institutions. Through our contributors' careful telling, RISD's remarkably effective methodologies and tools for transformative education can be accessed by any curious reader.

In the Preface, neurologist, author, and researcher Frank Wilson—the only writer in this book who is not a faculty or staff member at RISD (though he is a frequent RISD visitor and lecturer)—describes the biologic science of the co-evolution of the hand and the brain, and proposes the resulting neurological precedents to thinking and making as collaborators in both human and educational development. He sets the stage for the other contributors, who echo how the artistic mind relies on "making" as a critical activity, one that informs a particular kind of deep intelligence that cannot be learned without real material manipulation and sensory, embodied experience.

Leslie Hirst, Foundation Studies faculty member, presents the "groundwork" of preparing students to become immersive learners in our common undergraduate first year, literally laying the foundation for the commitment it takes to succeed as a creative professional. The first-year experience for freshmen, and, in different ways, for graduate students, is about learning how to reset expectations, to find new ways to begin, and to develop the conceptual and making tools necessary to create works that are significant in composition, presentation, function, or solution. The first year is about devising individual systems for making and breaking one's own rules. As Hirst notes, it is also about learning to live comfortably in uncertainty so as to take new risks and forge new directions, and to push harder through personal limitations than ever imagined. These fundamental and formative experiences contribute to building the experience and bodies of knowledge that shape an artist or designer.

The creative process cannot live independently from the contexts that inform the maker. In his essay, Dean of Liberal Arts Daniel Cavicchi