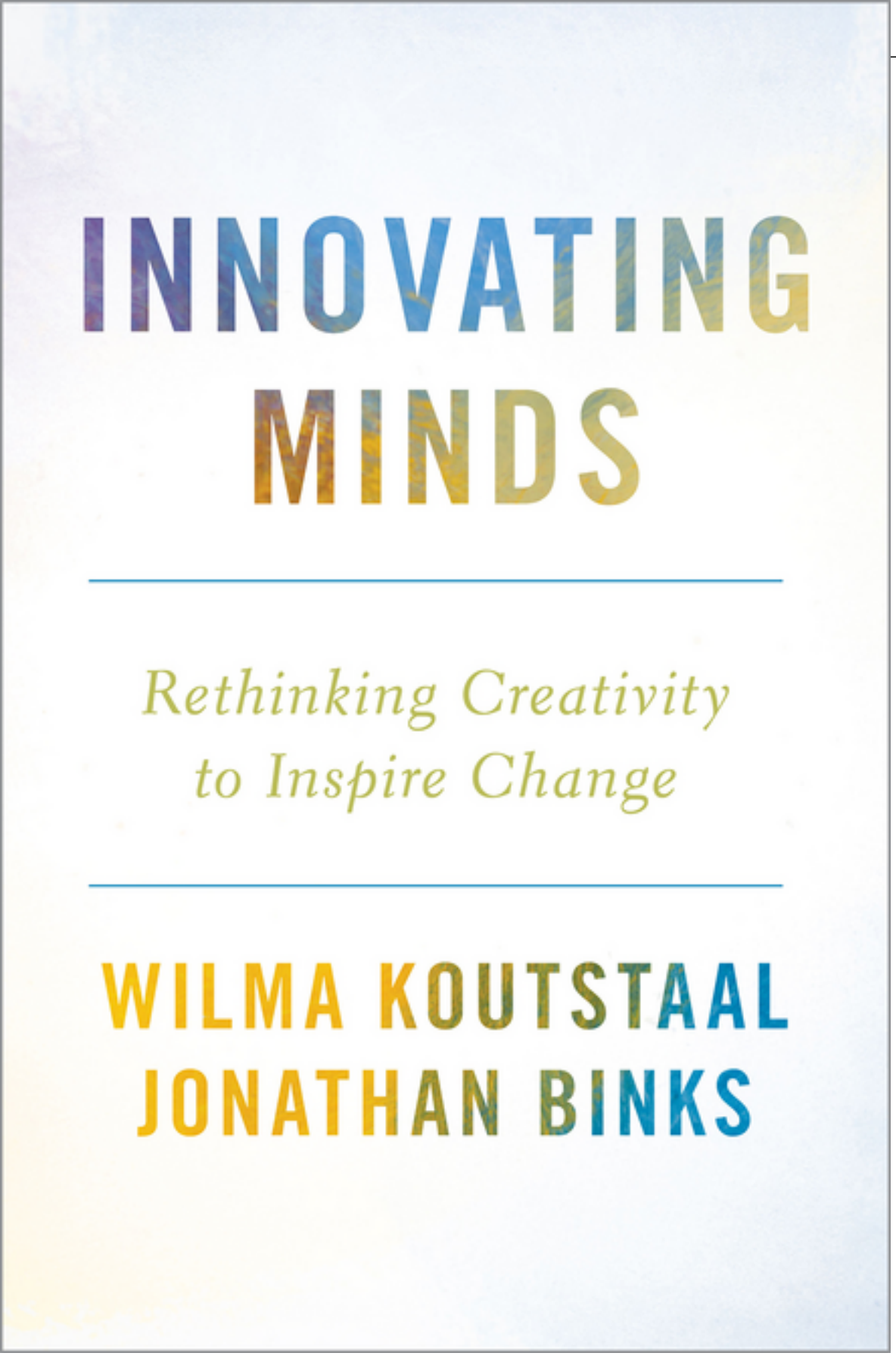
INNOVATING MINDS
Rethinking Creativity to Inspire Change
WILMA KOUTSTAAL
JONATHAN BINKS

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AND

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This book is dedicated to the memory of
Cyril Binks, a consummate craftsman, and to
Willemina Koutstaal, a noticer par excellence.

CONTENTS

ABOUT THIS BOOK

This book invites us to discover how we can all become more creative thinkers and doers. A central question at the heart of this book is: How can we more flexibly and responsively bring about positive change in our world and in ourselves?

We will ask you to actively work through ideas as, together, we explore a new way of understanding our own and others' thinking. The science-based "thinking framework" that we will learn can help each of us—as individuals and as groups, teams, or organizations—to be more creative, innovative, and mentally agile.

A primary message of this book is that positive change and creativity can be encouraged through gaining a better understanding of the ways in which our thinking *really* works. Thinking emerges not just from our brains, our minds, or our environments in isolation but from an ongoing dynamic interaction of brain, mind, and environment. By gaining a better understanding of our thinking (our own and that of others across time) we can optimize our "innovating minds"—minds that continually creatively adapt themselves, flexibly building on what they have learned, helping others to do so, and shaping environments that sustain and spur further innovation.

We will learn about the processes of generating and testing ideas and how ideas lead to yet other ideas. We will see that there is not as sharp a divide as might be supposed between thinking and action or between creating and innovating but that these cycle together, each informing the other. Creativity and innovation—changing the ways in which we and other people think about, listen to, look at, or do things and helping to solve problems (large or small)—rarely happen in a single step or a single moment.

In creativity, our actions bootstrap our thinking and our thinking bootstraps our actions. We perceive, act, and perceive again. This is what we

call *making* and *finding*. In our efforts to discover and create we repeatedly alternate between making (guided by what we intend) and finding (responding to what emerges as a consequence of our intentions). Although many propose distinctions between creativity and innovation, such as suggesting that creativity involves the generation of ideas and that innovation involves the application or realization of ideas (including also adapting ideas in use elsewhere), the view of creativity that we develop throughout this book does not propose such a sharp distinction. Making and finding and the perception-action cycle apply to both creativity and innovation.

The thinking framework that we introduce in this book asks us to approach creativity and change—whether as individuals, teams, or organizations—through a unique combination of five questions. First: What ideas are competing for your attention and awareness, and how are you helping to form and *re*-form them? Second: Should you be zooming out to a bigger picture, a more abstract perspective, or zooming in to a more detailed and specific view? Adjusting where we should be in our level of abstraction (what we refer to as *detail stepping*) is an often overlooked but pervasive contributor to creativity. Third: Are you allowing sufficient room for both spontaneity and deliberateness in your creative process? Do you know when to trust your routines? Fourth: Are you receptive to the interplay of motivation, emotions, and perception in your thinking? How are you choosing your goals and keeping them in mind? Fifth: How are your physical, symbolic, and social thinking spaces (including your working tools) spurring or spurning creative insights?

Our science-based thinking framework is rooted in research from many different fields that share an interest in achieving a better understanding of how we newly imagine and work through opportunities and problems. We traverse research findings from neuronal ensembles and brain networks to individuals in interacting groups and to organizations that span continents. We explore the science of thinking in our minds and brains in ongoing dynamic interaction with our richly symbolic social and physical environments. We scout a rich world of research that illuminates the real-world creative challenges of people in all walks of life. We meet architects, choreographers, composers, and musicians and learn of their creative obstacles and opportunities. We encounter, too, the innovative struggles and successes of dancers, designers, engineers, film crews, nurses, and physicians. We gain insight into the creative realizations of manufacturers, teams of scientists, software developers, and theater companies. We chart change and innovation in a variety of organizations, from design companies to hospitals to nonprofits dedicated to preserving and protecting our environment.

We discover early that innovative ideas are not only about "concepts" and are not just "in our heads." Ideas are in our minds but are also deeply intertwined with motivation and emotion, perception and action, and in continual interplay with our environments in all their physical, social, and symbolic complexities. We soon discover, too, that creativity and innovation are profoundly iterative. Bursts of creativity involve much more than sudden insight and often emerge from acting on and in the world in an ongoing interchange of making, finding, and making once more.

Our thinking framework provides a widely integrative perspective that asks us to always see ourselves and others as in a changing "idea landscape" in which thoughts and possibilities are continually forming, emerging, disappearing, and resurfacing into our awareness. Although we sometimes deliberately evoke ideas, at other times thoughts arise more spontaneously or even automatically. It is our ability to aptly modulate between these processes of cognitive control that offers us the greatest opportunities for mental agility and creative change.

Ideas crucially differ, too, in their degree of abstractness or specificity. We gain the most power and reach from our experiences when we can aptly and effectively move up and down in our level of detail. Sometimes we need to delve deeply into concrete particulars, with all their rich specificity and context. At other times, it is essential that we nimbly climb up and across those rich particulars, using abstractions that select, summarize, generalize, or extract some features of our experiences and set aside others. We need to be able to draw on modes of thinking that are closely tied to our immediate experiences but also on those modes that provide us with distance and perspective.

There are six main parts to this book. These are interlocking and mutually reinforcing. To highlight overarching themes, each part begins with a set of brief "thinking prompts." Each part closes with a series of more personally directed "cross checks and queries" designed to encourage your reflection and suggest various connections to your own work and practice. Throughout we use diagrams and schematic illustrations to convey key concepts. Many parts also include separate "research highlights" and "thought boxes" that selectively extend ideas introduced in the main text. Words or phrases placed in boldface italics are further explained at the end of the book, in our "Concepts Guide."

In Part 1 we invite you to think about what an idea is. We introduce what we call "idea landscapes" as a way of helping you to think about when and how ideas come to mind and the pivotal role of our environments in prompting or precluding good ideas. We outline our science-based thinking

framework—the integrated Controlled-Automatic, Specific-Abstract framework (iCASA)—for mental agility and creativity. We also introduce the importance of goals, especially open goals, in sculpting and shaping our idea landscapes.

Parts 2 and 3 develop the core ideas of what we call *detail stepping* (modulating our level of abstraction) and *control dialing* (varying our degree of cognitive control). Detail stepping and control dialing are metaphorical expressions coined to more tangibly and easily convey two central aspects of our thinking. Detail stepping refers to the level of abstractness of the content of our thinking, or *what* we are thinking about, and our ability to move up or down in levels of detail. Control dialing refers to the degree of cognitive control we are experiencing in the process of our thinking—the *how* of our thinking—and our ability to increase or decrease our degree of control. In Part 2, we illustrate the many ways in which we can capture and express our ideas at differing levels of abstraction. We explore how our environments and actions change our level of detail and impact our creative directions. Part 3 looks at how differing degrees of cognitive control shape creativity. At different times and in different ways we can benefit from varying our degrees of cognitive control—being more defocused or focused, more spontaneous or more deliberate.

In Part 4 we concentrate on the cyclical contributions of perception and action to innovative thinking and doing in our making-finding processes. We explore how constraints are both made and found, how we can introduce novelty into our worlds by learning to vary, and how we improvise collectively.

Part 5 expands our consideration of idea landscapes to groups and organizations. We underscore the importance not only of seeking novelty but also of recognizing when to wisely rely on already tested and proven approaches. We introduce the creatively significant concepts of adaptive expertise and of absorptive capacity for organizations in facilitating innovation and change.

In Part 6, the final part, we emphasize the temporal dimensions of organizational change and creativity in both the longer and the shorter term. We draw cross connections between autobiographical memory and organizational memory and knowledge. We walk through the key components of goal tuning—crucial for selecting and updating our goals and having them come to mind in our idea landscapes when and if we need them. This concluding part focuses again on the surprising ways in which our environments and shared idea landscapes may foster our efforts to initiate positive change and carry forward our creative ideals. We close by weaving together broader

themes of the book with the five "thinking framework" questions, inviting you to draw further connections going forward—as together we rethink creativity to inspire change.

Our own generative and making/finding processes in researching and writing have been creatively cued by the generosity of readers of varying drafts of the manuscript. Joan Bossert, our editor at Oxford University Press, has been an ever-thoughtful and stalwart champion of the ideas behind and for the book from the beginning and has deftly guided us in ways large and small; for responsively and adeptly shepherding the manuscript process at OUP we thank Louis Gulino. Ben Denkinger and Shane Hoversten were receptive and envisioning readers, recognizing strengths and aptly calling for further strengths; John Kruse, of 3M user experience and product design, offered multiple insights and an expert practitioner's perspective; Chip Pitts offered bolstering words and valuable leads to sources we might otherwise have overlooked; our anonymous reviewers gave us incisive pointers and inspiring support. We thank our copyeditor Heidi Thaens for her watchful eye and attentive ear.

Our colleagues and students have been a source of explicit and implicit wisdom and intellectual sustenance across many years. We are grateful to so many creative exemplars—artists, scientists, thought leaders—who daily inspire and sustain us through their dedication, perseverance, and pioneering reach for promising newness.

For specific comments relating to our discussion of their research and thinking, for reading portions of our manuscript, or for permission to cite their work that is in progress, we thank Professor Jonathan Cagan, Department of Mechanical Engineering, Carnegie Mellon University; Professors Shawn Cole, Amy Edmondson, Karim Lakhani, and Ryan Raffaelli of the Harvard Business School; Alice Foxley, landscape architect at Studio Karst, earlier with Vogt Landscape Architects; Professor Liane Gabora, Department of Psychology, University of British Columbia; Professor David Kirsh, Department of Cognitive Science, University of California, San Diego; Alex Olson, a Los Angeles–based visual artist; Dr. Alonso Vera at NASA Ames Research Center; Professor Glenn Voss, Cox School of Business; and Professor Zannie Voss, Meadows School of the Arts, Southern Methodist University.

The artwork emerging through the book's front cover, and also animating the lettering, is called *Transitions*. Painted and photographed by Jon, the book's coauthor, the work was chosen to convey a sense of the ongoing interplay of thinking and acting in our experience, with the multiple variations and gradations of color suggesting dynamic continua and change.

Innovating Minds

Innovating Minds

Part 1

What Are Ideas, and Where Do They Come From?

Thinking prompts

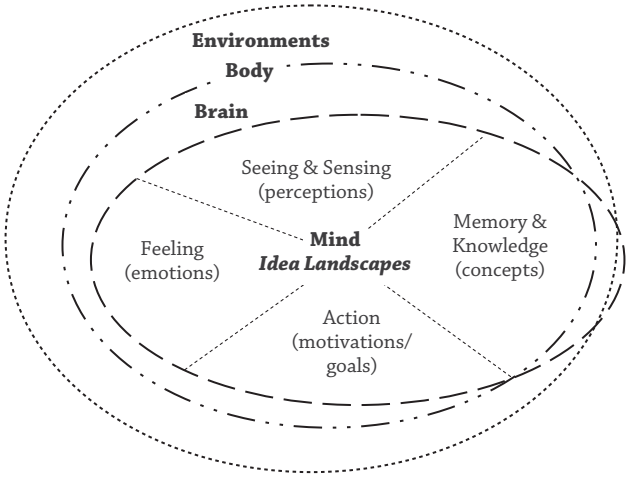
- What is an idea?
- What are "open goals" and how can they help us to be more creative?
- How do our emotions, motivations, perceptions, and concepts work together?
- How do our various environments shape and guide innovative thinking?
- What forms of experience lead to enduring newness in our brains and our worlds?

We all at various times in our lives want or need to accomplish something creative or innovative. But where do good—or potentially good—new ideas come from? How do we manage our ideas and hold on to them? How do we capture them? How do we make or recognize promising ideas and skillfully revise them to become powerfully innovative, in order to promote positive change in the world, in ourselves, and in others? How can we as individuals and as organizations be more *innovative thinkers and doers*? How can we rethink creativity to inspire change?

OUR IDEA WORLDS, OUR IDEA LANDSCAPES

At the broadest level, all of our ideas occur in a set of three entwined and continuously changing worlds: our minds, our brains, and our environments. These are our "idea worlds." The dynamic interplay of these ever-present players in our thinking is pictured in Figure 1.1.

At the center of our idea worlds are our minds. This is where we perceive, categorize, remember, imagine, and reconceptualize what we experience. In our minds, we register the effects of our actions in the world and the progress we are making in the pursuit of our individual and collective endeavors. Here we also become aware of new aspirations and potential new directions,



OUR MINDS, BRAINS, AND ENVIRONMENTS ARE EQUALLY POWERFUL AND ALWAYS PRESENT PLAYERS IN PROMOTING CREATIVE IDEAS.	OUR IDEA WORLDS. Creative ideas are generated and realized at the dynamic intersections of our mind with our brain and our environments. The dotted and dashed lines are meant to represent the many permeable and reciprocally interacting relations of our environments (physical, social, symbolic) with our brains and minds across time. Our minds and thinking encompass more than our memory and knowledge; they also include seeing and sensing, feeling, and our intentions and motivations for action; we later refer to these four constituents of our thinking as concepts, perceptions, emotions, and motivations/goals.

Figure 1.1

and experience the diverse emotions and motivations that accompany our efforts to act, learn, and change in the world. Within our minds some ideas are always reaching awareness and others are subsiding or still being formed. We will see later that these ongoing fluctuations in our thinking and awareness—what we call our *idea landscapes*—are at the core of our creative work.

Supporting and sustaining our minds is our immensely complex and dynamically changing brain—itself in close and continual interchange with our bodies as we think and act in our environments. Just like our selves, our brains are never the same from moment to moment. Our brains are ever eager to anticipate and predict. Based on what we sense and do, earlier predictions and anticipations are constantly being updated and fine-tuned. In our brains, learning and relearning is always "on."[1]

It is sometimes said that "the mind is what the brain does." This is, in good measure, true. Our minds emerge from the activity of our brain: neurons firing, integrating information, and communicating with one another across synapses, nodes, and networks. But this simple expression doesn't convey the whole picture. Our minds are supported, too, and constantly cued and called by our physical, social, and symbolic environments: words on a page or spoken to us, visual images, numbers or formulas, sounds and signals. And our ability to produce and interpret words, visual images, or numbers is not something we entirely accomplished individually in our lifetimes. It rests on and emerges from a sociocultural and linguistic heritage and forms of social organization that extend far beyond our individual brains.

The most direct and immediate environments for our minds and brains are our bodies. It is with our bodies that we physically encounter other objects, ourselves, and each other in an ongoing cycle of perceiving and acting. Our bodies influence both how we navigate and interact with the world and how we think. Through physically reworking forms, gesturing, glancing, moving through space, and turning our heads in shared attention we bring new information into our idea worlds and use this information to act once again.

Beyond our bodies, our environments extend in both time and space, encompassing symbolic and social interactions in all their rich complexity. The things we choose to see and do, the places we go, the people we know and return to, the tools we use, what we listen and attend to, what we ignore and what we are drawn to—these all dynamically inform and form our environments. Our environments carry memory and ideas forward. Think of the jottings that we scribble in the margins of our books, or the sketches and notes on our desks or desktops, or the assorted potential ingredients that we may survey before beginning to prepare a new culinary dish. We generate creative ideas not only individually but also collectively—as teams or in

groups—based on our shared direct and indirect experiences. We elaborate on each other's ideas; one idea dovetails with another as we prompt and prod each other's thinking.

We cannot understand creativity or identify potential barriers to the generation of novel and innovative ideas and methods if we isolate our minds or brains from our environments. Our minds, brains, and environments are in perpetual interplay. It is at their intersections that new ideas emerge and can be realized.

A CREATIVE THINKING SCENARIO— TIMEKEEPING WITHOUT CLOCKS

Let's take part in a thinking exercise—drawn from the scientific research literature[2]—that will make these ideas more concrete and give us the opportunity to work through them closely. We will spend some time on this example and then revisit it in various parts of this book. We will draw on our experiences from this exercise to explore and connect the fundamental building blocks of our thinking framework.

Before we begin, please gather several sheets of blank paper and a pen or pencil so that you'll be able to capture and explain your ideas.

Imagine that you are asked to bring to mind multiple ways of keeping track of time. Your goal is to find ways of measuring out comparatively short periods of time—analogous to seconds, minutes, or hours—rather than longer periods such as days, weeks, or months.

You are by yourself, without a watch, clock, or any form of conventional timekeeping device, in a large windowless room with a 10-foot ceiling. There is a door with a doorknob and a hanging light fixture. The room also features a sink and drain with a working tap. The only other items available to you in the room are three rolls of adhesive tape and one each of the following:

A box of matches
A 1-quart plastic kitchen container (with lid)
A 1-gallon metal can of black latex paint (with lid)
A 2-inch-wide paintbrush with wooden handle
A 7-foot aluminum ladder
A 6-inch serrated hunting knife
A blue click-type ballpoint pen
A 12-inch wooden ruler
A 6-pound lead weight with hook
An 8-inch-tall candlestick with holder

A roll of twine
A thermometer
A large bottle of vodka

Your task is to think of as many different ways or processes as possible whereby you could use these materials to measure shorter periods of time. The time unit that you generate does not have to be any known unit except that it must be repeatable at a later point with a conventional clock.

Before reading further, please review the scenario above. Take about 10 minutes to try to generate some ideas for measuring the passage of short periods of time using the materials listed. For example, you might generate an idea such as lighting the candle by using one of the matches from the box of matches and then placing the thermometer a premeasured distance from the candle flame until the thermometer reached a designated temperature. Your unit of time would then be the time required for the burning candle to cause the thermometer to reach your chosen temperature.

Describe or draw your ideas on a piece of paper. Be patient and persistent. When you think that you have generated as many different ideas as you can, turn this page.

What came to your mind? What range of ideas did you explore? Did you think about counting a drip rate or the rate of flow of a liquid? Or did you consider the period of a pendulum, or the rate of an object falling freely or rolling downward owing to the force of gravity? Did you perhaps think about using your own actions in relation to one or more of the objects, such as rapidly clicking the ballpoint pen a certain number of times or rhythmically unrolling 12-inch sections of one of the rolls of adhesive tape, using the ruler as a guide?

Whatever ideas you had, where did they come from? How do possible novel approaches or actions come to mind in a situation such as this?

As you reflect on your own thinking processes, you may well find that there is no single or simple answer to these questions. Ideas may have come to you as you visualized the objects or imagined yourself handling and using them or grouping objects with each other. Or you may have remembered something from your own experiences or from something that you had read or been taught that you then connected to the task. Also, how you worked through and captured or expressed your ideas in sketches or diagrams may have prompted new ideas: the process of sketching or explaining your ideas may have automatically and with little effort "associatively cued" yet other ideas or possibilities. Perhaps you may have found yourself thinking of analogies or parallels from other situations.

The design scenario you just took part in was, in fact, actually used in a published experiment conducted with 71 senior undergraduate engineering students at Carnegie Mellon University. The study was designed to test the ways in which our creative and problem-solving goals influence how—and if—we use potentially relevant information that we may encounter in our environments. To explore this question, the published experiment included two additional twists.

The first twist was that different students were given different types of additional reading material. Some of the students were provided with detailed information about the mechanisms of various types of clocks (a grandfather clock, a windup clock, and a quartz wristwatch). Other students were, instead, given detailed information about the mechanisms and functions of various devices that were not clocks and thus only related by distant analogy to the problem (a water meter, a heart-rate monitor, and a cassette-tape recorder). The remaining students were given information that was entirely unrelated and not relevant to the problem (three current news stories or "filler material").

The second twist was that the additional information was presented at different *times* during the design task. Some of the engineering students were given additional information either before they had started working

on the timekeeping problem or later, during a break, after they had already been thinking about it and begun to generate ideas. Specifically, some students read about clocks before beginning the design task (*clocks before group*). Other students read about other devices before they encountered the scenario (*devices before group*). Still other students read about other devices during their break, after they had already begun to work on the design problem (*devices during group*). Finally, the remaining students read only filler material, both initially and during the break, providing a baseline comparison group (*control group*).

The groups and the types of reading material they encountered before beginning the design task and later during the break are summarized in Table 1.1.

Which of the four groups do you think generated ideas of the greatest variety, or the most novel ideas? In thinking about your answers, imagine yourself in the place of someone proceeding through each sequence of events. Note what that person would have read and when he or she would have read it.

Do you think that being provided with a detailed description of the mechanisms and functions of clocks *before* the design task would help or instead hinder the generation of creative ideas? One possibility is that encountering the clock descriptions at the outset would lead people to focus more narrowly on accepted mechanisms of timekeeping. Another possibility, though, is that the richly detailed characterization of the different sorts of clocks and their mechanisms or functions would help to associatively trigger useful ideas.

And for those who read about other devices—unrelated to clocks—what effects might that have had on generating alternative ways to keep time?

Table 1.1 The Procedure for the Experiment on Timekeeping Without Clocks

Group	**Initial reading**	**Begin design**	**Break reading**	**Resume design**
Clocks before	Clocks	→	Filler	→→
Devices before	Devices	→	Filler	→→
Devices during	Filler	→	Devices	→→
Control	Filler	→	Filler	→→

Students in each of the four groups proceeded through the steps as shown, starting with the initial reading and then moving into the first phase of idea generation, (Begin design), followed by a break with designated readings and then returning back to their idea generation (Resume design).[3]