1 The Creativity at the Heart of Your Research

Chloe was frustrated. She had spent the last week staring at a computer screen making absolutely no progress. At this point, her team had a contract with a publisher, chapter outlines, and were long past the brainstorming stage. The project was moving slower than expected. One coauthor was derailed by a family emergency, and the other was struggling to fit their work in between administrative duties and teaching, so Chloe was picking up the slack. But Chloe felt like an impostor writing about a field she didn't know as well as her coauthors, and she was entirely unsure how to get from the muck she and her team were stuck in to a finished book manuscript. She had solved many other problems through sheer force of will, and she desperately hoped she would be able to do the same with this one.

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Alexander had spent the last few months alternating between being excited and overwhelmed. He was in the second semester of his PhD and had so many ideas for his dissertation work. Every time he attended a seminar or read a paper, it sparked a dozen new potential topics. While having all these new ideas was exhilarating, it was also exhausting. Whenever Alexander's advisor asked for his thoughts on research topics, he floundered – he really didn't know how to prioritize among his many ideas and thus would answer with a simple, "I'm not sure yet; I'm still exploring." For all his ideas, it felt like he was making no progress at all.

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Paloma was a talented amateur painter who had even sold a few of her paintings in a local gallery. She had spent so many years experimenting with color on canvas that when she was painting, time seemed to

disappear. She somehow simply knew what needed to happen next to create surprising new depictions of familiar locations in the city. When it came to her graduate work, however, she was a very analytical scholar, approaching her research on human–computer interaction methodically and afraid to do anything that had not been done before. Paloma kept bringing her advisor data she had analyzed, but she didn't know how to fix it when he looked at her attempts at analysis and kept pushing her to think bigger and break new ground as she considered how the variables might be related.

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Eric had been hired into a tenure-track job based on his award-winning history dissertation. He loved the process of archival research: the pursuit of rare documents in the archives, the intellectual quest of telling a coherent story about the past based on often fragmented evidence, and the process of building an argument that took into account others' research and theories. The only trouble was, he was now responsible for teaching five courses a year, was traveling regularly for conferences, and was directing his department's undergraduate degree. All this, combined with a two-year-old daughter at home, meant that the amount of quiet time Eric had to think had essentially disappeared. He no longer felt like he had the space to produce quality history.

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Each of these scholars faced a different challenge, but they actually needed the same tool: greater awareness of their creative research process. This book is a practical guide for researchers who want to apply creativity more effectively to the challenge of performing scholarly research.

Creative thinking provides a way to explore ambiguous, messy problems and find ways to resolve them. At its core, creativity is a problem-solving tool demonstrated countless times, from ancient humans creating early devices to harvest and hunt, to medieval artists expressing their artistic vision in cathedrals, to modern entrepreneurs

developing groundbreaking technologies. In research, many times the big goal is clear: Earn the PhD, write a winning grant, finish the master's thesis, reach tenure, think up the next big thing in your field. But knowing which direction to go or how to move concretely toward that big goal is often not clear. This book is a distillation of methods you can use to build your creative competence and find effective paths toward your goals.

Each of the stories that led this chapter describes a real person sharing real concerns. All these people recognized the need for creativity in their research and sought out the classes and workshops that we've been leading for the last ten years. Our classes adapt design thinking and other approaches to building creativity to the specific needs and challenges of academic research.[1] Now, we offer the curriculum and exercises that we've developed in book form. Our students' experiences of learning to manage their creative process consciously compelled us to write this book. We provide practical guidance that combines the conversational tone of a workshop with the scholarly grounding to help you understand how these skills and techniques can be applied to your research. Whatever your background, discipline, or career stage, this book can give you concrete tools to gain clarity, be innovative, and make progress in your research journey.

THE CREATIVITY PARADOX OF MODERN RESEARCH

Creativity is the heart of research. No matter your field, scholarly work prizes novelty and innovation: identifying new problems worth solving, explaining unexplained phenomena, solving problems that haven't been solved before, producing new interpretations of important cultural or historical events, or developing new methods to study the world. While creativity is a nebulous construct (kind of a "you know it when you see it" thing), it is generally defined as the ability to produce new ideas or solutions.[2] This generation of novel ideas is the basis for innovation, so to be a truly innovative researcher, you need to be creative.[3]

In addition, scholarly research is messy, nonlinear, and ill-defined – not the clearly structured method you probably followed in high school science labs.[4] Doing research requires that you define a problem that is only partially known in advance, and you don't know whether an answer even exists until that answer is found. This means that researchers spend their days engaged in problem solving, by which we mean that they are taking a number of complex mental steps to reach solutions.[5] Every day you make small decisions, for instance whether to spend the next hour revising a manuscript, reading a paper, synthesizing a new lab sample, or getting a snack. And you make big decisions, like who to collaborate with or what topic to study for a research project. Each of these decisions forces your brain into problem-solving mode, and the same creativity skills used to generate new ideas can help you work through these decisions in a more innovative and effective way.

Unfortunately, though, modern research conditions don't support optimal creativity, so many scholars are not achieving their full creative potential.

First, many researchers are never explicitly taught how to be creative, which means that most learn about creativity by trial and error. Graduate students don't tend to receive instruction in creativity as part of their training. A lucky few PhD students might learn the skills to manage creativity from mentors; a few exceptional courses also cover these skills. Some scholars with hobbies or previous careers in "creative" fields like music, fiction writing, software design, or printmaking may bring those lessons to their research. But these are the exceptions, rather than the rule. The majority are self-taught creative scholars: Over multiple years and multiple projects, researchers develop an appreciation for creativity and tailor their own techniques. Most of the time, this learning is left to the learner to figure out, meaning it becomes more sporadic, difficult, and stressful than it has to be. Developing creative skills or strategies from scratch – under pressure because you need them – is about as fun and useful as reinventing a wheel because you are stuck

somewhere without transportation. You get yourself wherever you need to go, which is the immediate goal, but perhaps you later realize that you could have done it with a bit less effort.

Second, academic life in the twenty-first century is not structured to foster creativity. Compare a day in your life to one of Charles Darwin's. When he wasn't sailing around the world in HMS *Beagle*, Darwin spent only a few hours in dedicated work. The bulk of his day was spent writing letters, going on walks, resting on the sofa, or eating with his family.[6] This is exactly the setup that people who study creativity would espouse: leaving plenty of downtime for reflection and an idle mind. Part of generating novel ideas is absorbing information and then coming up with new associations between things you have assimilated.[7] Activities where your mind isn't focused on a particular task, like going on a walk or daydreaming, help shift your mind into an idle state where generating and associating ideas is easier.[8] In fact, you can even distract your conscious mind with easy tasks like brushing your teeth – which probably explains why so many people say they have great ideas in the shower!

But if you're like most modern scholars, your daily reality is not creative idle time, but being busy. In an industry that was once considered relatively low-stress, surveys of academics point to increasing levels of stress, "identifying both mounting workload and an increasing pressure both to publish and acquire external research funding as significant contributory factors to academic distress."[9] It is increasingly hard to land a full-time job after completing the PhD, pressuring graduate students to come up with stellar research questions, publish a lot, and become well-known scholars just to land a job.[10] Successfully doing this requires significantly different abilities than succeeding in coursework (where a problem is handed to students).[11] The emotional investments are potentially greater, too, given the passions that lead many students to pursue a PhD in the first place. And once you do find that coveted job, if you are one of the lucky ones,

surveys suggest that it's more difficult to obtain tenure now than it was ten years ago.[12] This leads to an unhealthy "publish or perish" mindset – especially among pre-tenure faculty.[13]

What this adds up to is a focus on productivity and outcomes. Open any publication or blog providing advice for academics and you'll find guidance on how to write regularly, manage your time better, or work more efficiently so you can produce more and/or maintain work–life balance. But rarely do you see advice telling academics to slow down and revisit how they are doing their research.[14]

The result is tragic but all too common: Just like Chloe and the others from the introduction, many researchers are frantically trying to produce as much innovative research as possible without doing the things that science suggests lead to optimal creativity. In other words, they are focusing on outputs without paying attention to the process by which their research happens or developing awareness of the conditions in which their creativity flourishes.

GUIDANCE FOR YOUR CREATIVE PROCESS

What if you could be more intentional about being creative? That's where this book comes in. Our team's goal is to save you and/or your students from the need to reinvent creative wheels.

By shifting from a focus purely on *content* and paying conscious attention to the creative *process* of research, you can create conditions that lead you toward the innovative outputs you ultimately desire. We want to highlight our use of the terms "content" and "process," as this is a key distinction we will make throughout the book. "Content" refers to the substance of research, such as finding a research question, figuring out which analytical technique to use, or deciding how to structure an argument in a manuscript. "Process" refers to the ways you move through your research, such as addressing writer's block, deciding when to ask a colleague for input on a draft paper, or deciding how to communicate a research idea in a way that excites your coauthor or PhD advisor. While content and process are closely intertwined, we'll encourage you to be conscious about the distinction

and to practice designing creativity in both. Ultimately, a focus on creative process can yield more creative research content, making you more productive.

How do we do this? We give you tools and exercises to practice specific skills employed by creative scholars. There are plenty of books about how to be creative written by choreographers, writers, animators, designers, and other creative professionals.[15] But their examples and advice require translation to apply them to scholarly research. We as an author team have explored many of the mindsets, abilities, and tools that people in creative professions use and spent a decade applying, testing, and iterating them in the specific context of research.

First, this book explores four foundational abilities that reflect things that creative people do: being aware of your thoughts and behaviors, understanding and using emotions, making sure that you solve the right problem, and learning through iteration and experimentation. Second, we dive into three additional abilities that help create the conditions for creative thinking; we call these support structures. The support structures are using language and stories to generate the creative behaviors and identity you want to adopt, managing your energy to create motivation, and using input from other people to amplify your creativity. Together, these seven abilities (Figure 1.1) provide different cognitive, emotional, and behavioral lenses through which to operationalize creativity.

(Our framework is not the only one available for understanding the mental abilities that contribute to creativity and creative problem solving. We have focused on the abilities we believe to be most relevant in the research context. But if you'd like to explore how other scholars describe the mental attitudes underlying creativity, in the Appendix we have mapped the abilities we use to those that appear in other frameworks in the literature.)

For each ability, we provide guidance on what it is and how it works, as well as exercises for you to practice using it in your research. You might think of your research endeavors like a sport,
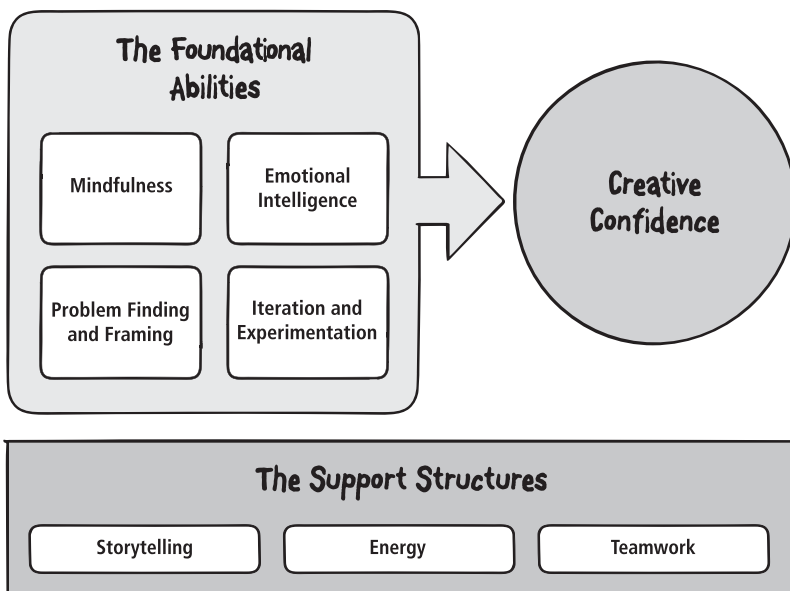
FIGURE 1.1 The creative abilities

where you need endurance, strength, flexibility, and balance to perform effectively. You do different exercises to develop these distinct skills, allowing you to combine them seamlessly when you perform during a competition. By practicing each of the creative abilities, you can increase your facility with generating novel ideas and solving problems – skills that will contribute to your overall creative research practice.

DEFINING CREATIVITY

What exactly do we mean when we say creativity? Is it about being imaginative? About being skilled at artistic endeavors? About generating new ideas or solutions?

A number of scholars who study creativity emphasize the final point – that creativity is about creating something new, whether that something is an idea or a product.[16] However, what counts as novel depends on whether you adopt what's called a "little-c" or "big-C" view of creativity.[17] According to big-C Creativity, the novel thing

also has to be deemed "appropriate, useful, or valuable by a suitably knowledgeable social group."[18] In other words, a scientific idea or a work of art is deemed creative only if it is also judged to be creative by other people. In contrast, the little-c creativity also requires novelty, but not social recognition. In little-c creativity, a teacher figuring out a new way to encourage a shy student to engage in class would count as creativity, as would figuring out a way to repair a piece of broken lab equipment. Everything that is big-C Creative is also little-c creative, but not vice versa.

This book primarily adopts the little-c perspective. We are giving you the tools to solve familiar and unfamiliar problems in new ways and generate new ideas in your research process and outcomes. Some of these new ideas might reach the standard necessary for big-C Creative acclaim (which would be great for your research, career, and field!), but even if they don't there is much benefit to be gained from applying creative practices to your everyday research life.

Practicing the creative abilities will help you develop or strengthen a capacity called *creative confidence* (also known as creative self-efficacy): "a person's belief in their own ability or personal power to successfully create or produce desired change and envisioned outcomes," where the desired outcome is creating a novel or useful outcome.[19] We focus on creative confidence because it helps you act in a more creative way. Studies of creativity in the workplace have repeatedly shown that creative confidence correlates with innovative behavior and idea generation at both the individual and team level.[20] Essentially, if you know that you have the tools to solve problems creatively, logic suggests that you are more likely to both succeed in solving problems and in producing more innovative ideas.

Creative confidence relates to Albert Bandura's concept of self-efficacy and Carol Dweck's conception of a growth mindset. Self-efficacy refers to "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Self-efficacy beliefs determine how people feel,

think, motivate themselves and behave."[21] A growth mindset refers to the belief that human abilities are things that one can cultivate; someone who possesses a growth mindset recognizes that their interests, strengths, and weaknesses can change as they have new experiences and gain new skills.[22] People who adopt a growth mindset are usually able to persevere in the face of the inevitable challenges that arise when they learn something new, helping them stay motivated and work toward mastery.[23] In contrast, holding a fixed mindset, wherein a person believes that individuals are born with certain traits (e.g., "I'm good at writing, but not good at math"), limits one's potential. These mindsets carry over to creativity: If you believe that some people are inherently creative and others aren't, it reduces your chances of ever becoming more creative.[24] A creative growth mindset, paired with a self-efficacious attitude, means that you believe you are capable of learning creativity. If you believe you can become more creative, you set yourself up to become so.

ON THE RELATIONSHIP BETWEEN CREATIVE AND ANALYTIC THOUGHT IN RESEARCH

"But wait!" you might say. "Doesn't doing good research require a rigorous, objective analytical process?" Yes . . . and it takes creativity too.

In the mid-twentieth century, Nobel Prize–winning biologist Peter Medawar wrote *Pluto's Republic*, a treatise on the scientific endeavor. In it, he argued that science is both ideas ("imaginative and exploratory . . . a great intellectual adventure") and critique ("a critical and analytical activity").[25] In other words, you have to have a great idea and then actually implement that idea. Research is both intuitive and analytical. This same pattern was shown in interviews of innovative scholars from diverse fields at Stanford University. When asked how they develop research projects, they emphasized the interplay between the imaginative, lateral thinking that goes into developing a good research question and the rigorous analysis necessary to test that question.[26]

Indeed, the interaction between idea generation and critique extends beyond research into other creative domains. Brain imaging

shows that when you come up with creative ideas, you activate areas of your brain linked to associative, lateral thinking and areas associated with control and inhibition.[27] This highlights the continual interplay between creative and analytical thinking: Creative ideas are more likely to arise when the mind has been prepared by deep analytical thinking about a subject. The more you know, the more you have read, the more data you have worked with, and the more you have prepared the groundwork, the more fertile space there is for the generation of spontaneous connections. This link was recognized by the ancient Greeks, who used the same root word for "inventory" (i.e., the things you know) and "invention" (i.e., the things you create with what you know).[28]

In this book, we don't focus on analytical skills in the traditional sense, since there is already plenty written about how to do rigorous spectroscopy, or historiography, or radio telemetry, or grounded theory, or whatever particular methods your field uses. We offer guidance for cultivating creative research practice, which ultimately requires judgment about when to cast a wide net and when to pull it in.

WHO WE ARE, AND WHY WE'RE WRITING THIS BOOK

This book is the collective effort of a team of researchers and educators – Nicola, Amanda, Anja, Sebastian, and Adam – who came together at Stanford University with a common interest in creativity training for researchers.

We met at Stanford University's Hasso Plattner Institute for Design ("the d.school"), an institute focused on teaching innovative and creative problem solving through design. This approach includes *design thinking*, a creative problem-solving methodology that is inherently focused on addressing human needs.[29] As taught at Stanford, design thinking combines a defined innovation process with a set of mindsets and techniques for solving ill-defined problems. It emphasizes that innovation is a learnable process, not an event or an innate personality characteristic.[30] When the d.school exposes students to design thinking, its instructors aim to nurture creative confidence by

teaching a set of abilities that are useful for creative work in any field. While design thinking initially grew out of product design and mechanical engineering, it has more recently been applied to solving challenges in a range of fields such as K–12 education,[31] medicine,[32] and international development.[33]

When we each converged on the d.school, it was focused on building the creative confidence and creative abilities of Stanford students through solving external problems like alleviating poverty and improving healthcare. While research students participating in these courses might gain important innovation and collaboration skills that complemented their domain expertise, for many of them, it was hard to translate those skills to their scholarly research. This is where we saw an opportunity. Because design thinking offers a learnable, repeatable method to address fundamental creative problem-solving challenges, why couldn't it be adapted for the numerous researchers at Stanford who faced creative challenges in their academic work on a daily basis? Thus, the Research as Design project – RAD for short – was born in 2010.

This book draws on our experience teaching the RAD curriculum and getting extensive iterative feedback from our students (primarily graduate students and postdocs, with occasional faculty and research staff participants) as well as from faculty colleagues in diverse disciplines and other teachers of design thinking. Beginning with our initial pilot with six students (read: "arm-twisted friends") in March 2011, we've taught RAD classes and workshops at universities and conferences on five continents. The format has varied from two-hour taster workshops to more traditional multi-week classes.

As we've taught, we've been engaged in continual evaluation of the curriculum using a technique called *design-based research* (DBR).[34] We actively observe our students and their interactions with the material, capturing real-time observations of their questions and behavior. After classes and workshops, we also obtain student feedback and capture records of the impacts of the course, through interviews, surveys, and student debriefs. This book draws on the

knowledge gained through this experiential research. Throughout the text, we provide stories of scholars we have known and taught. We describe the challenges these researchers faced and how they applied the skills we've taught to develop their creative practice and bring greater ease to their work. The names and details of these stories (e.g., research field or dissertation topic) have been changed to protect anonymity, but they are based on real people. While the stories represent a handful of the hundreds of students we've worked with all over the world, we have selected them as representative of our students' common challenges and solutions. (If you're interested in a more formal evaluation of our curriculum, see the article we wrote in 2014.)[35]

Our curriculum began as a direct adaptation of the d.school's pedagogy and design thinking process to the challenges of research. Over the years that we have been teaching and investigating the creative practices of researchers, our approach has evolved in response to student feedback and our learning from our design-based research observations. Initially, we were focused almost exclusively on creative confidence as a means to greater productivity and innovative outputs. We still see this as a key benefit of creativity training for scholars. But we also found that focusing on the process of research and one's own creativity had an emotional impact on how our students approached research. We observed the same shift in ourselves as our team practiced these techniques over the years since we began working on this project. Greater facility with designing one's research process seemed to translate into less stress, greater self-efficacy, a greater sense of control, and ultimately being a happier as well as more creatively productive researcher. This link between attention to one's creative process and emotional empowerment was the most surprising outcome for us. Perhaps research doesn't have to be as painful or stressful as many PhD students and Principal Investigators seem to consider the norm.

WHO THE BOOK IS FOR

This book is written for anyone interested in creativity in research, regardless of career stage or discipline. We lay out strategies for

building creativity but encourage each of you to incorporate them into your own unique practice.

Both early and established researchers should find inspiration in the book. For graduate students and postdocs, the abilities provide a concrete roadmap of what to do when feeling "stuck," thereby empowering you as a scholar and minimizing the need for protracted learning by trial and error. For more experienced researchers, the book will help develop conscious recognition of the successful strategies you already use, which can increase your ability to mentor creativity for your students. Experienced faculty may also find new techniques to try in your own research practice. Throughout the text, we provide stories of people across career stages. And in the final section, we provide chapters targeted at the types of challenges typically faced by emerging (Chapter 9) and senior scholars (Chapter 10).

The techniques presented in the book should also be useful to scientists, scholars, and academic researchers across disciplines and settings: from the physical and social sciences, to engineering, to the humanities, and including those working in universities, government, and private industry. The research process looks very different across disciplines, whether you do experiments, work in archives, or observe people or places in the field. However, because we focus on the process (of research and of solving problems), the abilities we teach work across fields: for instance, everyone has to manage relationships, develop research questions, and translate research findings into written text. Our classes have been attended by a diverse array of scholars, and we've seen the exercises work for theoretical physicists, legal scholars, chemists, and critical literary theorists, among many others.

Finally, while the book is written mostly for people actively engaged in research, Chapters 11 and 12 provide ideas for how you might use the book as a mentor, administrator, or someone otherwise engaged in helping other people (whether students, postdocs, or faculty) develop creative confidence. If you are responsible for mentoring

emerging scholars, you might find the book useful as the basis for research methods courses, lab group meetings, and individualized advising or coaching.

HOW TO USE THE BOOK: TEXT, EXERCISES, AND REFLECTION

When we teach in person, we ask our students to dive into hands-on activities before we provide time for analytic thinking about what they are doing. From a pedagogical perspective, our curriculum is designed with nested cycles of experiential learning,[36] guided self-reflection on what was just experienced,[37] and brief presentations of scholarly information and stories about others' experiences that help participants develop a mental framework for understanding what they are doing and feeling. This book is organized to replicate this experience as much as possible for you, given that you do not have the interactive experience of an in-person instructor guiding you. Most chapters include text (establishing what the ability is and how it works), exercises for you to experiment with the approach, and guided questions to help you reflect on your current approaches and what you're learning. Engaging in each of these activities – reading, doing, and reflecting – can help you cultivate the cognitive, behavioral, and emotional abilities that optimize your creativity.

We recommend two possible approaches to read the book. One is to read the book chapters in order and experiment with the exercises in each chapter as you go. The second approach is to skip directly to Chapter 11 and begin the thirty-day learning progression that incorporates all the material in the book. Following this approach, you'll have the opportunity to apply the skills to your ongoing research and read each of the chapters in the context of this experimentation.

Whichever approach you choose, we encourage you to take the exercises seriously. This means not just reading the chapters, but actually trying some of the activities we suggest and then reflecting on what you learned. When you learn something new (start a new

language, try a new hobby, etc.), your brain is initially challenged and you pick up the new skill rapidly. Eventually, though, you reach a cognitive plateau, where your brain shifts to autopilot because it considers the activity you're doing to be familiar and easy. However, reaching this plateau does not mean you've mastered everything you could learn about a subject. To make sure that you keep learning, you need to challenge your brain continually to overcome plateaus by being deliberate with your practice.[38] Like the sport analogy mentioned earlier, practice and game time do not necessarily contribute equally to learning; improvement will likely be much quicker with dedicated time spent practicing particular skills.

In research, PhD students are challenged by the unfamiliarity of doing things for the first time and therefore learn rapidly about the process of doing research. But for junior and senior scholars alike, as you become more familiar with research, you tend to enter autopilot regarding your research practice. If you want to learn new habits, you need intentionally to make the process of doing research new and challenging again. So, we encourage you to step out of your normal routine and try some of the activities we propose in each chapter.

A second key component of our pedagogy is reflection. Educational psychologist John Dewey defined reflection in 1938 as mental "reconstruction and reorganization which adds meaning to [one's] experience."[39] According to Donald Schön, another foundational scholar of reflective practice, professional competence is developed through a continual, dynamic process of addressing a situation based on prior experience, consciously considering how the present situation is different from previous situations, and then making sense of an event after it happened.[40] By noticing your research process, trying exercises that ask you to do research in a new way, and then reflecting on them, you build metacognition (the ability to think about your thinking) about your research process.[41] This lays a mental framework where you can store new information as you learn it. Then, as you continually do and reflect, you'll incorporate new experiences into

this framework, helping you to remember new skills and apply them in the future.[42]

There are many ways to build your mental competency through reflection, but we suggest journaling, drawing, and/or discussion. The introduction to Section II provides guidance on how to use each approach and more detail about their benefits. Additionally, each chapter's exercises include a *Reflect* subsection with suggested questions to help you become aware of your assumptions, your feelings, and your reactions to the concepts and exercises.

OVERVIEW OF THE CHAPTERS

The process of creative problem solving in diverse fields including research shares fundamental similarities in the underlying mental challenges one must meet. Chapters 2 through 8, which form the heart of the book, are devoted to the seven abilities essential to innovative research. Each of these chapters includes an overview of scholarly research on how the ability works, stories that illustrate how approaching research with the ability can transform your relationship to research, and concrete techniques to practice developing it in your life.

Chapter 2 focuses on mindfulness. Researchers tend to be busy, rarely stopping to take the time to notice how they go about their research and why. This chapter argues that you can be more productive if you pay explicit attention to the behaviors, thoughts, and attitudes that comprise your research practice. By developing the ability to notice and accept what is happening, you can develop the ability to act more intentionally.

Chapter 3 discusses the role of emotions and emotional intelligence in research. While there has been increasing recognition that emotions can affect researchers' productivity, emotions are often framed as a problem to be solved. But your desires, fears, and subtle motivations can also become a source of intelligence and insight for your research. This chapter explores ways to use emotional self-awareness, self-compassion,

and empathy for your colleagues and research subjects as a means to diagnose and prevent problems.

Chapter 4 focuses on making sure that you're solving the right problem. While researchers have sophisticated analytic strategies for solving problems, research can stall because you are unclear what problem needs to be solved or are trying to solve the wrong problem. This chapter explores tools for identifying and framing tractable problems. It also discusses how you can become more comfortable with ambiguity, i.e., not knowing how you'll move forward in a given situation.

Chapter 5 frames research as a continual process of experimentation and iteration. While it can be tempting to focus on finding the "right" answer in the face of challenges, moving forward in the face of a sticky research challenge often requires an iterative process of trial and error. We explore the role of divergent and convergent thinking – times when you deliberately generate numerous options or ideas, and times when you refine toward a single option – and present a variety of ways to use experimental learning to move your research forward incrementally.

Chapter 6 emphasizes how language reflects and shapes your understanding of the world. It provides guidance on ways to become aware of the language you use and the stories you tell about your research, in order to gain insight about assumptions you hold about research. Noticing these patterns provides the opportunity to craft new stories that reinforce your use of the creative abilities and your identity as a creative scholar.

Chapter 7 explores the role of human energy in creative research practice. Researchers don't necessarily work in ways that reflect or enhance available energy. In this chapter, we discuss ways to become more aware of your energy, including becoming cognizant of different types of energy and of trends in your energy over time, and provide guidance on ways to use that knowledge to work smarter. Working with your energy can also help you boost your creative abilities, by helping you cultivate the mental and emotional states that best

support the types of thinking needed to be emotionally intelligent, to find and frame problems, and to ideate and experiment.

Chapter 8 focuses on finding diverse sources of feedback on your work. Researchers tend to work either independently or in project-focused teams. As a result, they may rarely get input on early ideas or interact with people in fields outside their own. This chapter highlights the benefits that diverse input can provide, including providing you with surprising insights you would not otherwise encounter, helping you develop a deeper understanding of your research process, and enabling you to see your challenges in light of others' common struggles. We present strategies for understanding your various types of feedback needs and for building a diverse support network that meets those needs.

The final section of the book is designed to help you bring the individual abilities together into a cohesive process for doing research. First, to see these skills in action, Chapters 9 and 10 apply the abilities to common research challenges, describing potential approaches to integrating the abilities to solve each challenge. Chapter 9 uses the examples of choosing a dissertation topic, cultivating your relationship with your advisor, and managing time efficiently; Chapter 10 focuses on the challenges of writing a paper, developing a team project, and designing a class.

Chapters 11 and 12 then provide suggestions for using the book (as an individual, small group, mentor/supervisor, or course designer). Chapter 11 presents a thirty-day learning progression for an individual or small group to practice with the techniques in the book; it also provides suggestions for how a faculty member or administrator might modify the curriculum to emphasize different learning objectives like productivity or emotional resilience. Chapter 12 discusses ways to use the book and the techniques it provides to mentor creative confidence in others.

The book concludes with a short reflection on our own process and suggests ideas for you to continue learning and experimenting with creativity.

ONWARD TO CREATIVITY

Hopefully, we've convinced you that cultivating creativity is worthwhile for researchers and that you can build or enhance your creative research proficiency. Now, we invite you to use this book to explore. Dig into the text, try some of the exercises, and reflect on what you already understand about your practice and what you're learning. Find the approaches that resonate with you and find the approaches that you really don't like – both contain important information about the process that works best for you.