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A book by The Living Lab

WAYS OF THINKING AND IMAGINING

Aphantasia (noun)

aph·an·ta·sia \ˌa-ˌfan-ˈtā-zh(ē-)ə

The inability to voluntarily conjure visual mental images in the mind's eye

"With aphantasia, his memory is a museum without paintings —all structure, no scenes."

Eric C. Anderson, *Firewatch,* 2024

Backwards Through the Mists

A Painter's Reflections on Aphantasia

Until quite recently, when people said they pictured things in their minds, I assumed they were speaking metaphorically. Certainly, I knew of people with so-called photographic memories, but they were clearly outliers. After all, my own mental imagery is a bit like a mirage or something glimpsed in peripheral vision—try to focus directly on the thing imagined, and it dissipates like mist in the sun. Consequently, I'd always assumed most people thought like I did, primarily through words and symbols.

A little aside in a news column late last year led me to the VVIQ, an interesting quiz that tests "the vividness of your visual imagination." I took it, then passed it over to my wife, just out of curiosity. Imagine my surprise to find that I—a professional visual artist of nearly twenty years—scored abysmally low, while my wife, an accomplished technology executive, got a near-perfect score!

How is it then that I came to be in a field seemingly so at odds with my natural abilities? I've puzzled on this quite a bit over the past few months. Certainly, this idea of differing degrees of visual memory or imagination has helped to explain some things. For example, I was a very weak draughtsman when I began my MFA program, and it took me an enormous amount of effort to become good at drawing. In contrast, some of my classmates were so

visually gifted that they could essentially stare hard at a scene, return to the studio, and recreate it from memory. It sometimes felt as if I was a person with no legs who decided to become a mountain climber. Perhaps the feeling of accomplishment is greater when coming from a deficit, or maybe I've simply persisted out of some kind of legendary bullheadedness!

Now at least I better understand why, as I've persisted in this odd choice of vocation, I've found that the work has naturally moved away from representation toward an ever more tactile abstraction. I make the paintings now by a long process of layering, removing, and building up again—a very physical, centering, and perceptual experience. Learning about aphantasia through my work with the Living Lab has helped to better understand why the work seems to want to develop as it has. I simply cannot envision what a painting might look like when I begin. I've never been able to plan—and I need no longer feel shame about that. In a way, I just didn't come equipped with that ability. I've found various workarounds over the years, of course, but now I feel immensely more open to the understanding that I simply don't need to; I can just approach each piece I'm making on its own terms, one brush stroke, one layer, one movement through space and temporal reality at a time. Each painting can reveal itself to me; moment by moment, emerging backward through the mists before me.

Eric C. Anderson

Dedicated to the Voices from the Columbia University Community

This book is dedicated to the individuals who generously responded to our questionnaire—Columbia University students, faculty, alumni, and staff whose insights, stories, and reflections shaped every page that follows. It is also dedicated to everyone living with aphantasia and other neurodevelopmental conditions. Your experiences remind us that minds work in beautifully diverse ways, and that our work in the laboratory—though often difficult, especially when resources are scarce—is deeply meaningful and worth pursuing.

Following Eric's artwork, we invite readers to pause and consider the many voices that helped bring this project to life. On page 33, you'll find a guide on how to read this book—a resource to help navigate its layered stories and themes. But first, we begin with the people who inspired it. Their contributions are rich and revealing, and we highly recommend reading them.

The Living Lab

Foreword

Do we really need another book about visual mental imagery?

By the time you finish reading this one, I hope you'll agree: yes, we absolutely do.

There are wonderful books out there already—Adam Zeman's "*The Shape of Things Unseen*" and Ned Block's "*The Border Between Seeing and Thinking*" come to mind—that share scientific knowledge about visual imagery, perception, and the like with the general public. More recommended books can be found in the "What To Read Next" section at the end of this book. Those books are important. They translate science, and I highly recommend reading them.

This book does something else.

It offers narratives. First-person experiences. Perspectives that aren't smoothed out into averages or wrapped up in synthetic (as in *synthesis*) definitions of normal and abnormal imagination. It gives voice to the complexity. To the diversity. And to the Columbia students, researchers, and community members who helped us write it by taking their time to complete our survey. And this book would not exist without their stories and narratives.

I knew that writing a book with your lab was—rare while—possible. But that *I* would one day write one *with my lab*, so *early* in my career? I never really imagined it. And yet, here we are. The process wasn't always easy—balancing voices, shaping structure, and stepping away from the idea of a single author - but we kept going at it week after week after week, and with the right consistency and determination, it felt absolutely natural. We were helped enormously by the fact that many of the authors are undergraduates or post-bac students, coming from a wide range of backgrounds—neuroscience, cognitive science, creative writing, philosophy, and psychology. Not all of us are at the same stage in our careers; I'm a PhD, and others are just beginning their academic journeys. But it was exactly this mix of perspectives, experiences, and voices that made the process so rich. It shaped not only what we wrote, but how we wrote it - collaboratively, creatively, and with a shared sense of purpose.

Another key fact in the history of this book is that it is connected to an event (see more below), and that deadline gave us just enough structure to stay on track and actually finish it.

The result is a well-conceived book, structured, written, edited, rewritten, and re-imagined by all the authors in a virtuous cycle of collaboration that left me, quite honestly, wordless. This cycle lasted about one year. What emerged is a living, breathing project

that reflects who we are in The Living Lab - a space I first imagined (pun very much intended) having a three-pronged mission:

1. Train bright new minds in psychology and neuroscience.

2. Advance scientific knowledge through research and publication.

3. Engage the public by sharing what we learn, and how we learn it.

This book does all three of those things at once.

Instead of asking what visual mental imagery is, this book asks: What does it feel like? What do people do with it? What do they see, feel, and think when they imagine? This book won't tell you a lot about what the scientific community agrees (or disagrees with) about what mental imagery *looks like* (in the brain, or in the stats of an excel spreadsheet). But if you read it, you will hear from a multitude of people and their stories about how they go by when someone asks them to *rotate a molecule in their mind*.

This book is a teaching tool, a research product, and a public offering—free, accessible, and open to anyone who wants insight about how we imagine. It's a milestone in my own career, not because I wrote it (I didn't), but because it captures everything I care about in science: curiosity, collaboration, clarity, and care.

If you're wondering where to begin, you could start with the reflections on aphantasia and hyperphantasia, or the stories that

touch on language, memory, and creativity. I'm especially excited about the pieces that question what it means to "see" in your mind at all—because they don't just describe; they challenge my scientific investigation to embrace a broader perspective.

This book was made possible thanks to the generous support of Columbia University *"Diversity Matters Grant"* awarded to the lab in 2024. We will present this book during a special event (link) hosted at the Zuckerman Institute on April 9th 2025, called *Imagine This,* and co-sponsored by the Zuckerman Institute, the Presidential Scholars in Society and Neuroscience, and with help from the Wallach Art Gallery at Columbia University.

To all the contributors, to the readers, and to the thinkers who keep us moving forward—thank you.

To Anna, my newborn niece, born today, April 8th 2025, marking an incredible coincidence where personal and professional paths beautifully intersect.

To Emaad, M, Kezia, Jess, Ellie, and to *The Living Lab*. Never stop dreaming, and always believe in the power of those dreams.

And as I like to say: Onward!

Alfredo

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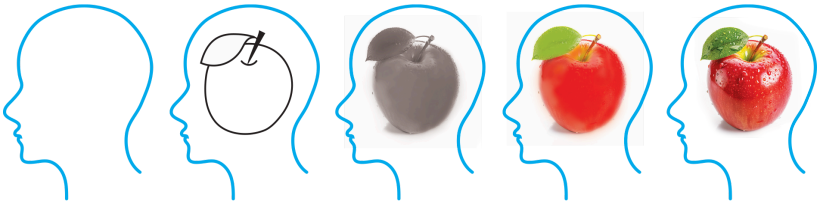
Introduction

There exists a facet of the mind that many individuals effortlessly engage—a realm where thoughts, memories, and imagination manifest as vivid, dynamic mental images (Zeman, 2024). Now, imagine lacking this capacity entirely. Closed eyes are met with impenetrable darkness. This was my startling discovery—a revelation that led me to understand the unique condition of aphantasia where the mind's eye is blind (Zeman et al., 2015).

My realization began with a tweet. It invited readers to close their eyes and envision a red apple. (Try it yourself!) The tweet showcased a series of five images where a brilliantly red apple became a fuzzy shape and progressively transformed into a black square. I thought the replies claiming vivid, clear pictures were part of an elaborate internet joke. But when my friend casually responded that she could conjure an almost lifelike image, I was stunned. It felt as though everyone around me possessed an incredible superpower I had lacked my entire life—they could see with their minds.



The realization was a sledgehammer, sudden and shattering. I had always believed "daydreaming" and "visualization" were merely metaphors for contemplating concepts. My memories were only words, not vivid replays of past events. I felt as if I was missing out on a fundamental aspect of human experience. The depth of this absence was profound; most people's minds lived in a world painted in expressive colors while mine wasn't even grayscale—it was pitch black.

Curiosity became my lifeline. I needed to understand how other minds worked. I interrogated everyone—friends, family, classmates—about their mental imagery. If they could truly see pictures in their minds, where was it in relation to their perceptual view? Could they make the apple green? Turn it upside down? Could they imagine a third person perspective of themselves reading this book? (Many reported they could but have never tried such a thing before.) My academic struggles, especially in subjects like physics where visualizing objects interact was crucial, suddenly made sense. While studying organic chemistry, my friends could simply visualize molecular mechanisms and interactions, while I was stuck with words. My brain operated differently, relying heavily on verbal and semantic encoding rather than visuals.

My relentless questioning led me to Dr. Alfredo Spagna, a pioneering researcher in mental imagery. With his guidance, I immersed myself in the enthralling world of cognitive

neuroscience at Columbia University—turning research into *me*-search. My previous study in biology taught me the mechanisms of life, but psychology and neuroscience opened up new domains for questioning. I've become deeply intrigued in how unique cognitive styles shape how we think, perceive, learn, understand, and remember. I have an insatiable curiosity for the role imagination has in everyday tasks and academic settings. In The Living Lab, we focus on cognitive processes that interact with, and sometimes rely on, mental imagery such as attention, introspection, and language (Spagna et al., 2024). My research specifically focuses on how mental imagery (or the lack thereof) affects problem solving and learning, which was inspired by my challenges in visuospatial subjects (e.g. physics).

It wasn't until recently that I realized I experience the world differently from most people. The journey to accepting my aphantasia has not been easy and I wonder if it will ever reach its destination. I used to grapple with a deep sense of loss and the feeling of missing out on imaginative, voluntary daydreams and vivid personal memories (most of which I've forgotten). But I realized that, even if I do not remember them, the person I am today is still the sum of all my lived experiences. Through the struggle, I discovered strengths I never knew to appreciate. I recognized my ability to convey complex ideas through precise language and vivid analogies, making abstract concepts clear and

accessible. Throughout this book, I hope you will enjoy hearing from a diverse range of individuals and experiences.

Here, I hope to bridge the gap between personal experience and scientific investigation. Aphantasia was my personal diving board, and I hope this book will demonstrate to you the vast ocean of cognitive diversity. Through the combination of personal accounts and insights from pioneering studies, I seek to elucidate the beauty and complexity of the human mind. But this isn't just my story—it's a collective celebration of the countless ways we experience the world.

You are cordially invited to explore the dimensions of the mind with us. Whether you can close your eyes and conjure vivid scenes, see sounds, think in complex patterns, or process information in unique ways, we hope you will see yourself in our words. Together, we'll unravel the mysteries of cognition and commemorate the incredible diversity of human thought.

By gaining insights into how our minds work, we can encourage more inclusive workspaces and welcoming classrooms, develop better pedagogical strategies, and appreciate the uniqueness that lies within human brains. This book will provide you with not only empirical findings but also practical advice rooted in science and a deeper understanding of your own cognitive processes.

I must admit that none of this would have been possible without the support of those around me. To my co-authors and fellow

members of The Living Lab, your insights and fervor brought this project to life. Alfredo, your mentorship has not only shaped this book but transformed how I approach science. To my family, thank you for your unwavering support.

Wendy—through every late night, every rewrite, every setback, and every small win, you've been by my side. Even in a mind without pictures, you've brought warmth, depth, and color.

And to you, dear reader, I hope you enjoy reading this book *half as much* as we enjoyed writing it for you—because we had a blast.

Emaad

Chapter 1 **Cognitive Diversity and Aphantasia**

"I paint my own reality."
–Frida Kahlo

Rundown

In this chapter, we will describe what we know (and don't know) about aphantasia and cognitive diversity. Unfortunately, scientific literature is often inaccessible due to overly technical jargon and paywalls. This book aims to dismantle this barrier and distill important insights, making discoveries accessible to everyone.

The Palette of the Mind

Cognitive diversity encompasses the various styles in which people think, learn, and process information (Shinn & Ofiesh, 2012). Much like an artist, each of us is equipped with a set of tools to uniquely perceive and process the world. These tools—our cognitive styles—are as varied as painters' palettes.

Many investigations show that embracing cognitive diversity promotes creativity, innovation, and more flexible problem solving in educational, workplace, and community settings (Thuo et al., 2024; Hundschell et al., 2021). Unlike physical traits that are easily observed, cognitive differences lie beneath the surface, influencing how we interact with the world and each other in profound ways.

Mental Imagery

The topic of mental imagery has intrigued scientists since Sir Francis Galton's pioneering work in the late 19th century. Galton asked individuals to visualize their morning's "breakfast table" and describe what was in front of them. He noted wide variations in the clarity and vividness of these internal pictures (Galton, 1880). This was perhaps the first documented discovery of the variability of mental pictures.

To many, mental imagery is a fundamental part of everyday life—often used unconsciously and sometimes even when it is not necessary (Pearson, 2019). However, the capacity for mental imagery exists on a spectrum. While some individuals have no capacity for mental imagery (aphantasia, Zeman, 2015), most have an intermediate-level capacity and describe their mental images as moderately realistic and vivid. Others report an exceptional capacity, known as hyperphantasia, where the subjective quality of their mental images rival real-life perception (Zeman, 2024). There remains much discourse on how mental imagery should be defined.

Here is a working definition for voluntary visual mental imagery that we invite you to refer back to as needed.

Voluntary Visual Mental Imagery: The ability to (1) initiate, (2) sustain and manipulate, and (3) extinguish the (4) content of (5) visual perceptual experiences without external stimulation (Razzak & Spagna, 2024).

Our definition is broken down into five components. Each one is crucial to our understanding of visual mental imagery.

1. **Initiation:** The ability to voluntarily create a specific image in the mind. This step results in awareness of the visual experience.
2. **Sustaining and Manipulating:** Sustaining the image involves effortful maintenance of the visual experience over time. Manipulating the image includes the capacity to alter its features, like changing its size, color, or perspective.
3. **Extinguishing:** The ability to voluntarily clear your mind of a mental image. This step results in awareness of the termination of the visual experience.
4. **Content:** The substance of the mental image, which can range from simple shapes and colors to complex scenes and objects.
5. **Visual Perceptual Experiences:** Primarily involving the sense of sight, visual mental imagery can also be shaped by other senses and by the ways people recall experiences.

Understanding these components helps us appreciate the full spectrum of mental imagery capabilities and explains why mental imagery is not a one-size-fits-all phenomenon. Individual abilities

may vary across any one of these distinct components, making each person's subjective imagery experience unique. By recognizing this diversity, we can better understand how different individuals navigate the world and leverage their strengths.

How do you use mental imagery in your daily life? Let's consider the everyday implications of living without mental imagery. The inability to picture how pieces of furniture fit together or to visualize the end product of an art piece is the reality for an estimated 1-4% of the population (Zeman, 2024; Dance et al., 2022). Yet, this lack of visual imagery does not necessarily diminish one's capacity for spatial reasoning, short-term memory, or simply enjoying a good book (despite typical imagers reporting a "movie" in their head as they read) (Dawes et al., 2022; Knight et al., 2022; Speed et al., 2024; Williams & Suggate, 2024). Like many forms of cognitive diversity, those with aphantasia simply use alternative strategies to circumvent the absence of visual imagery, such as through enhanced verbal or logical reasoning (Kay et al., 2024).

Cognitive Diversity

There are a myriad of ways individuals approach thinking, learning, and interacting with their environment. Here, we use 'Cognitive diversity' as a general term indicating individual differences in cognitive style. Specifically, this concept is constructed from the following two concepts:

Cognitive Style: A person's characteristic manner of perceiving, thinking, remembering, and problem solving. Cognitive styles might differ in preferred approaches or activities, such as group work versus working individually or more structured versus less defined activities (APA, 2023). It influences how we learn, solve problems, and interact with the world. For example, some might excel in analytical thinking, while others are more intuitive/gut-feeling-based (Riding & Cheema, 1991).

Neurodiversity: The unique way that each person's brain develops. This concept includes variation in neurological conditions such as autism, ADHD, or dyslexia. We advocate viewing these conditions not as deficits but as differences that contribute to the richness of human capabilities and experiences; there is no single definition of "normal" for how the human brain operates (Cleveland Clinic, 2022).

One of the central claims of this book is that acknowledging these differences is necessary for creating inclusive environments.

In the Classroom

Recognizing and valuing cognitive diversity is essential for ensuring all students have the opportunity to learn and grow, regardless of cognitive style and ability. When teachers adapt their

instructional methods to address differential learning preferences—through a mix of visual aids, verbal instructions, collaborative exercises, and hands-on tasks—students are more likely to remain engaged and retain information (Tomlinson, et al. 2003; Pozas et al., 2021; Moallemi, 2023). Individuals with aphantasia tend to rely on logic, external visuals, and descriptive language (Kay et al., 2024; Liu & Bartolomeo, 2023). Providing these resources or extra time to complete mental-imagery based tasks could be particularly helpful. Such inclusive approaches ensure no single learning style is privileged over another.

In the Workplace

Understanding cognitive diversity can also enhance team dynamics and productivity. Teams composed of individuals with varied cognitive strengths are often more innovative, more adaptable, and better at attacking complex problems by doing so from multiple angles (Page, 2007).

To illustrate this, consider a team designing a mobile app. A designer who may have strong visual imagery can intuitively map the interface's layout and aesthetics of how users will navigate the app. Meanwhile, a colleague with minimal mental imagery capacity but strong analytical and verbal reasoning skills may evaluate the logical structure to ensure clarity and functionality. By combining their strengths, the output is a more user-friendly and effective product. Indeed, there is a documented correlation between

imagery strength and profession of choice; individuals with aphantasia are over-represented in mathematical, computational, and scientific sectors while those with hyperphantasia have greater prevalence in the visual arts (Zeman, 2024).

Chapter 1 Summary

- Cognitive diversity includes the various ways people think, learn, and solve problems. It deserves celebration for the inclusivity, creativity, and innovation it fosters. Such inclusive approaches ensure no single learning style is privileged over another.
- Visual Mental Imagery allows individuals to create, control, modify, and extinguish internal pictures of objects and scenes that are not currently in front of them.
- Aphantasia does not indicate a "broken" imagination: it's one end of the mental imagery spectrum—a lack of voluntary visualization. It can encourage other thinking styles (i.e. strong verbal or analytical reasoning) and is over-represented in mathematical, computational, and scientific roles.
- Hyperphantasia sits on the opposite extreme: mental images feel as clear as actual perception, and is often elevated among people in visually creative fields.

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Chapter 2 **Daily Life**

"Normality is a paved road. It's comfortable to walk, but no flowers grow on it."
— Vincent Van Gogh

Rundown

In this chapter, we'll discuss how cognitive diversity shapes our daily lives. Through personal narratives and scientific insights, we uncover the nuances of imagination and cognitive processes to reveal their profound influence on tasks as ordinary as parking a car or as complex as solving multidimensional problems in the physics classroom. Personal experiences shared by members of the Columbia University Community enrich this section, blending relatable stories with scientific depth to illustrate how these differences manifest in everyday scenarios.

Underlying Cognitive Processes

Consider the process of packing a suitcase for an upcoming trip—a task so simple that we often take its inherent complexity for granted. Some of us gather all the items around the suitcase before placing them inside. Perhaps this process involves a mental checklist or a physical list. But, of course, you can't just stuff everything in the suitcase, sit on it, and hope the zipper doesn't burst! Instead, you might quickly plan where items will go: socks

in that corner, blouses in the bottom left, and those shoes are pretty bulky so they'll have to go on their side in their own corner.

Each mental step—selecting items from your closet, mentally picturing the layout, and strategizing around spatial constraints—is evidence of intricate cognitive machinery engaging many different cognitive processes:

- **Future Planning:** Anticipating future needs of the trip involves considering the weather, planned activities, and duration.
- **Mental Imagery:** Visualizing the items going in the suitcase and their specific orientation.
- **Working Memory:** Holding onto information about what you need to pack, where you have mentally placed it, and continuously updating this information.
- **Problem Solving:** Considering the constraint of limited space, prioritizing items you need the most, and choosing the best way to compress clothing (rolling, folding, or stuffing!)
- **Organization:** Grouping similar items together so they're easy to find and to unpack once at your destination.

Strategies for accomplishing such a task often vary across individuals. Someone with aphantasia may rely on physical lists, or trial-and-error when packing while a typical imager might mentally map out the suitcase before ever touching a zipper.

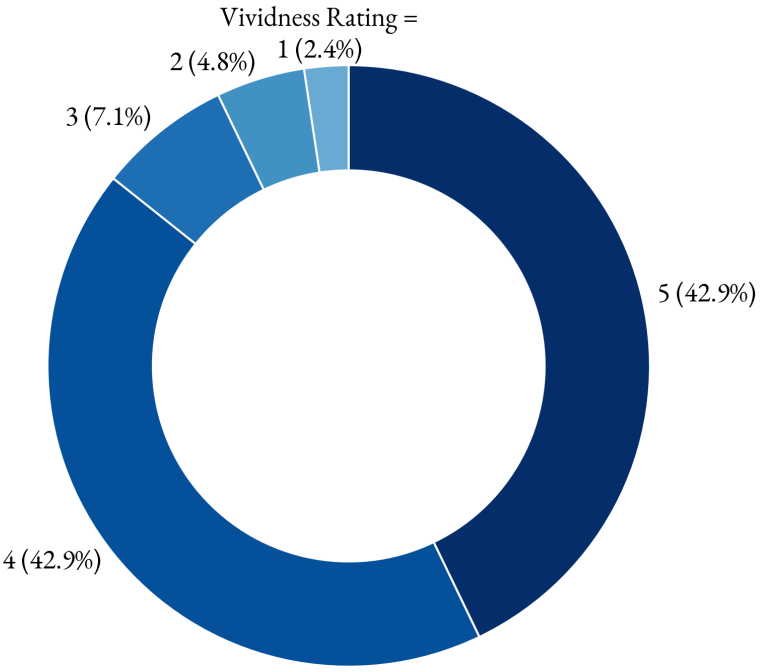
Voices from the Columbia University Community

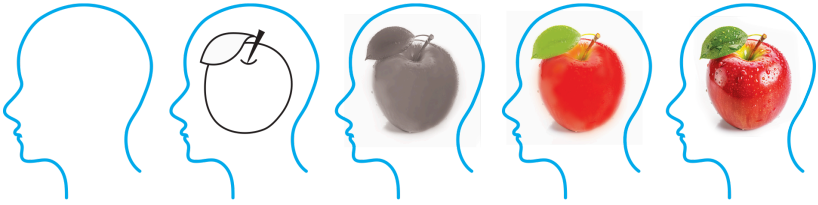
Imagery experiences are so diverse that they can best be understood by hearing directly from individuals. This is why we asked members of the Columbia Community to freely share their experiences with mental imagery and cognitive preferences in their daily life.

To preserve anonymity, the initials for each respondent are fictitious, but they remain consistent throughout the book. This allows you to follow along with individuals whose stories resonate with your own experiences. However, not all respondents have answered every question, and we have selected responses to encapsulate a wide range of perspectives and minimize repetition.

We wanted to first get a sense of the imagery capacities for our respondents based on the apple rating. The proportion of ratings are included in the following graphic:

Please close your eyes and imagine a red apple.
Consider the image that appears before your mind's eye.
Please select the corresponding option that applies.

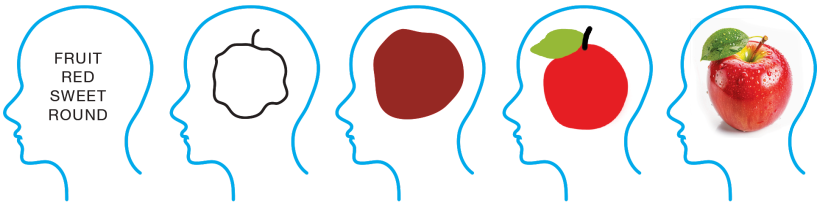




As expected, the majority of respondents report vividness ratings of “4” or “5” with moderate to strong subjective imagery experiences with a low proportion reporting “1” to indicate no image at all.

Versions of the subjective scale shown above have become quite popular; they all mimic that of the Visual Vividness of Imagery Questionnaire (VVIQ). It prompts respondents through 16 scenarios such as “Visualise a rising sun. Consider carefully the picture that comes before your mind’s eye. The sun rising above the horizon into a hazy sky.” (Marks, 1973). Individuals must rate their subjective imagery experience on a scale from 1 to 5, much like the popular image shown above. However, many of our respondents have indicated that almost all aspects of their imagery experience might decline with lower vividness.

As you can see in the above image, the shape and features of the apple appear to be intact despite decreasing vividness with the exception of color saturation. To better represent the overall decline of the image, we have created the following image, that we hope better reflects the variability in clarity, vividness, and features that are experienced across the imagery spectrum:



Perhaps for some of us, the apple has a more fuzzy or wobbly outline. For others, the apple may start to take shape but is less colorful. And for our readers with aphantasia, we hope and believe the semantic representation of an apple aligns more closely with your subjective experience.

We then prompted respondents to define imagination in their own words. Their responses reveal the incredible diversity in how people experience mental images.

"How would you define imagination? Please share what it's like for you."

DT: "Imagination is very *verbal* for me – I have a constant conversation in my head and am able to come up with extravagant stories and dreams for myself."

ES: "The *dark space* in my mind that generates all kinds of things, not consciously or unconsciously, but in a space in-between the waking and the dreaming."

GM: "Imagination is the ability to think about concepts without them being in front of you. It's *purely semantic* for me."

IL: "The ability to consider the internal *logic* of a hypothetical reality."

KR: "The ability to let your mind *think* of, see, and explore ideas that may be different than the ones presented to you often"

OS: "*Thinking* of anything ever."

These responses demonstrate the multitude of ways in which imagination can manifest including verbal, visual, or conceptual abstractions (emphasized by our italics).

Evidently, imagination is not always synonymous with visual mental imagery. **DT** and **GM** interpret imagination as a verbal experience, perhaps involving an inner dialogue or linguistic creativity. Scientific insights corroborate this point: imagination taps into multiple cognitive systems, including the default mode network, which supports self-generated thought, and the prefrontal cortex, involved in goal-directed cognition (Spreng et al., 2010).

In contrast, individuals like **ES** and **KR** find imagination to be more visual, abstract, or experiential, operating at the boundary of

conscious thought and unconscious creativity. These diverse experiences highlight an important distinction: there is no singular way in which imagination operates.

Adapting and Thriving with Mental Imagery Differences

Elucidating the various modes of imagination provides insight to how individuals approach learning, problem solving, and creativity.

"How do you leverage visualization in problem solving, or what strategies do you use to compensate if you lack mental imagery? Please share example(s) of ways you use visual imagination (or compensatory strategies) to tackle problems in the classroom."

GM: "I explain things in words/break them down into concepts that I can understand."

HT: "Although I can visualize concepts, it doesn't mean that I am constantly visualizing everything. If given a task to imagine something, I am able to do that. But when I am problem solving, I don't sit there visualizing things. I just think about the problems unless I specifically need to visualize for the task or need to recall information that I remember visually."

LM: "I rely on [visual imagination] to figure out what to do next, or compensate for verbal problems by creating diagrams or holding images in my mind to follow."

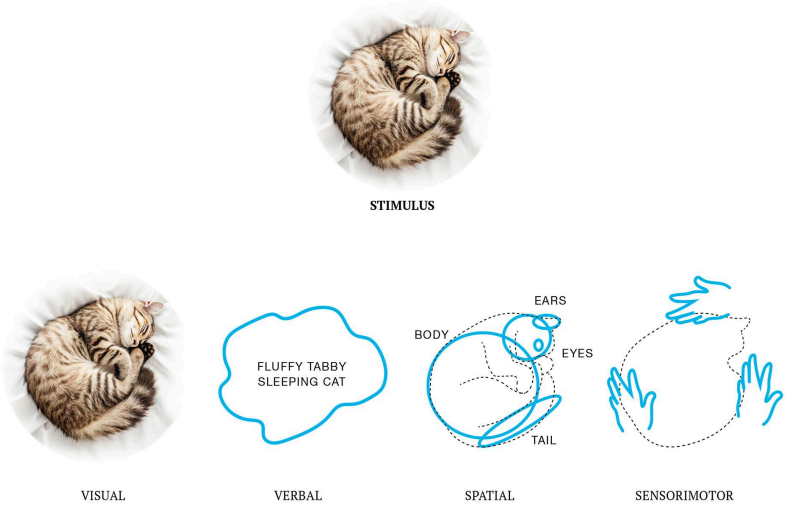
MN: "To compensate for my lack of mental imagery, I try to have a general understanding of the topics in my classroom and if I need more specific details I refer back to notes (that I take meticulously). My main compensation is through note taking, because even if I am not able to understand what is being said in class, I can still write it down and review it later. Often I will also make mnemonics to help me remember specific information."

Scientists have designed a number of problem-solving experiments to understand differences in the cognitive strategies individuals use. Much like the suitcase example, in these studies, participants could be prompted to mentally manipulate objects (e.g. rotation), navigate a new space (e.g. solving a maze), or hold items in short-term memory (e.g. memorizing numbers in an array) (Bocchi et al., 2017; De Vito et al., 2014; Shepard & Metzler, 1971). Results show that individuals use one of two main strategies: commonly referred to as visual and verbal.

Visual techniques often utilize mental imagery: individuals construct an internal picture of objects/scenes that are relevant to the task and then manipulate the image as needed. Alternatively,

semantic approaches emphasize deductive reasoning or analytic processes rather than mental imagery (Saunders & Quaiser-Pohl, 2020; Schultz, 1991). Indeed, an individual's subjective mental imagery experience has an impact: typical imagers favor visual strategies in mental rotation tasks whereas weak imagers prefer verbal strategies (Kay et al., 2024).

However, scientists are now gaining a more nuanced understanding of how individuals tackle visuospatial tasks. For instance, some simulate body movements related to the stimulus (sensorimotor) while others consider the relative locations of different components (Reeder et al., 2024). This sparked our curiosity for the specific strategies individuals use to understand, retain, and recall information in heavily visual subjects.



Adapted from "Non-visual spatial strategies are effective for maintaining precise information in visual working memory, Reeder et al. 2024. Cognition, Volume 251, October 2024, Article 105907. DOI: https://doi.org/10.1016/j.cognition.2024.105907"

Everyday Tasks

How do we navigate an unfamiliar city, decide which route to take home, or remember where we left our keys? One method of navigation may rely on landmarks for directional cues. But someone who utilizes vivid mental maps might picture a route from a bird's-eye view, rotating the path in their head. Someone else might rely on GPS, methodically following step-by-step instructions or memorizing street names. Or perhaps utilizing the more understudied motor imagery, one might imagine themselves walking and turning in their mind. These different ways of thinking can be especially noticeable in:

- **Memory and Recall:** Although many of us recall autobiographical events through the first person point of view, this is distinct to imagers. Individuals with aphantasia instead rely on factual information that resides as semantic (meaning-based) information in their mind.
- **Creativity and Hobbies:** Visual thinkers may easily imagine a finished painting or sculpture before starting or use a mental reference during the creative process. Michelangelo mused, "I saw the angel in the marble and carved until I set him free." (a quote that might be recontextualized for those with aphantasia). Verbal

thinkers may instead brainstorm ideas by talking, writing, or sketching them out.

- **Social Interactions:** Face recognition and social cues may rely on mental images as well. Visualizing what someone looks like may serve as a good reference when trying to pick them out from a crowd. For an individual with aphantasia, remembering someone's hair color or searching for the red of their favorite coat may be more helpful.

Despite these differences, however, individuals often adapt without consciously realizing they are leveraging the strength of their own cognitive style. These strategies are not simply "workarounds," they are unique expressions of human cognition.

Chapter 2 Summary

- Ordinary tasks (such as packing a suitcase or navigating a city) involve a range of cognitive processes that we often perform without conscious awareness. How these processes unfold depends on one's mental imagery capacity and cognitive style.
- Individuals can interpret and utilize imagination in different ways—some focus on the meaning of words while others use visuals to represent concepts internally.
- Research shows that these strategies are more nuanced than previously thought. Sensorimotor, spatial, verbal, and visual strategies can be used for the same stimulus or task.

- Cognitive diversity influences how we recall information, form mental schema, engage in creative work, and interact with others.

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Chapter 3 **Learning**

"There are no rules of architecture
For a castle in the clouds."
— G.K. Chesterton

Rundown

We believe learning is synonymous with growth. It's a never-ending cycle of inquiry and discovery, and each one of us has our own process. For many, mental imagery can be extremely helpful when learning abstract concepts—turning them into tangible representations. In this chapter, we explore the interplay between mental imagery and other modes of reasoning to understand how we navigate the learning landscape.

The Power and Limits of Mental Imagery

Mental imagery can play an important role in conceptualizing and retaining new information (Marre et al., 2021). For instance, the ability to visualize a right triangle for the Pythagorean Theorem, forces acting on an object in motion, the phospholipid bilayer of a cell, may be extremely helpful when being exposed to these topics for the first time or even when recalling them (Nelson et al., 1976).

However, as our respondents' experiences demonstrate, learning is not exclusively visual. While many individuals rely on internal pictures, others may use verbal reasoning, logical steps, or abstract

constructs. “Seeing” something in the mind’s eye is just one of many methods for comprehension.

“Please share how your ability to visualize or not visualize affects your learning process.”

ES: “Unless the material is visual in a 3D way, I hardly ever bother to picture what I'm learning, though stories can generate images.”

FZ: “When I am able to picture something in my mind, or to create a diagram I feel more certain about what I am learning.”

GM: “My inability to visualize forces me to adopt alternative strategies for learning. When I want to learn or understand something, I need to break it down into conceivable steps/smaller processes. I think the best way for me to learn something is to have it logically explained.”

HT: “[The] ability to visualize helps me when I am trying to comprehend a complex problem. By visualizing the details, I can understand the material.”

IL: “I don't feel confident that I've learned a concept until I'm able to visualize it comprehensively from memory.”

LM: "I use it heavily to learn. Sometimes I need to translate words into a visual in my mind to understand something."

These personal accounts highlight the role of a well-known psychological construct: the "visuospatial sketchpad," a component that allows processing and manipulating visual and spatial information (Bruyer & Scailquin, 1998). For those who naturally use it, mental imagery can bolster clarity and confidence: "seeing" a concept may help internalize it, as noted by **IL, FZ,** and **LM**. In these narrative reports, we can see how mental imagery can play a significant role in the process of learning: many individuals don't even feel confident in the material unless they can visualize it!

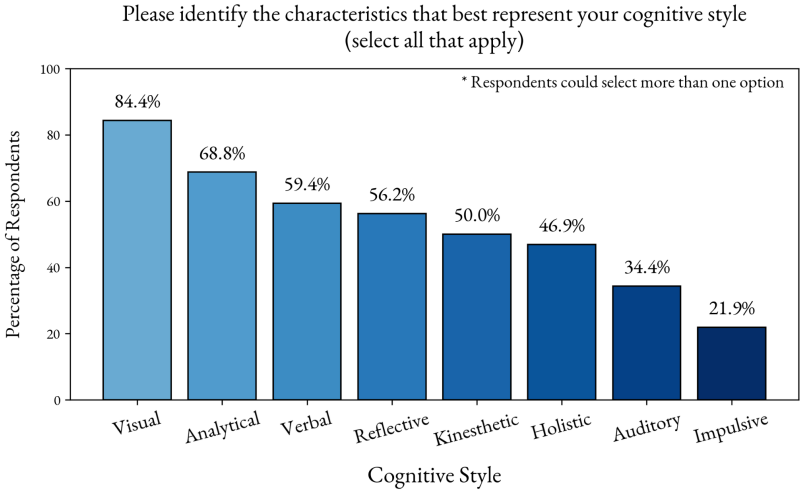
Learning Styles: Beyond VAK

Surely you've been asked before whether you're a visual, auditory, or kinesthetic learner (commonly referred to as "VAK"). Many traditional models of learning styles categorize students as such, but modern pedagogical research suggests these styles are more nuanced and individualized (Pashler et al., 2008). Cognitive diversity extends well beyond these broad categories, encompassing differences in mental imagery, semantic reasoning, working memory capacity, and even attentional focus.

Educators have begun adopting a Universal Design for Learning framework, which provides multiple ways for students to

demonstrate their understanding of course material by encouraging a multi-format presentation of information (Rose, 2001; Rose & Meyer, 2002). This allows varied cognitive profiles—including individuals with aphantasia or hyperphantasia, ADHD, dyslexia, or other conditions—to thrive in a more inclusive classroom.

When asked to describe themselves, individuals revealed adopting hybrid approaches to learning:



As shown above, individuals rarely fit neatly into a single learning style. Some combine **Visual** strategies with strong **Verbal** reasoning. Others prefer a **Reflective** approach in some scenarios (linking new material to past experiences) and are **Impulsive** (action-oriented) in others. Multiple individuals also reported both **Holistic** and **Analytical** learning styles, which suggests a

preference for understanding the big picture, while at the same time enjoying detailed breakdowns. Recognizing these layered styles allows educators to tailor their information to a wider audience and simultaneously encourages students to identify strategies that they may capitalize on as a strength.

Challenges in the Classroom

Despite increasing awareness of differential learning styles, academic settings often default to a "one-size-fits-all" approach, typically lecture-based with slide presentations. This poses challenges for those whose cognitive styles clash with traditional instruction.

"Can you think of a situation where your cognitive style presented challenges in your learning?"

OX: "I don't like big lectures where someone just talks at you for a long time. That makes it hard for any info to sink in for me."

DT: "Organic chemistry was the class that made me realize I will never be able to grasp certain topics because of my lack of mental imagery... I had never struggled with topics that require mental imagery, like physics and geometry, because I had teachers that miraculously taught to my cognitive style."

FZ: "In front of a lecturer using mostly if not only a verbal strategy, it is hard for me to follow without spending most of the time writing notes."

LM: "School is mostly verbal and auditory, and those are the styles I struggle the most with. I have trouble holding onto information in class."

MN: "Many professors teach in lecture format. I feel like I have to work much harder to understand the topics."

These experiences zero in on a crucial point and huge challenge for instructors: no single style or instructional method can serve everyone equally well. Whether the content is presented in a spatial format like organic chemistry reactions or a lecture-heavy format, mismatches between an instructor's approach and a learner's style inevitably lead to frustration, anxiety, or the need for extra effort to succeed.

Overcoming Obstacles

Despite these hurdles, respondents showcased incredible resilience by experimenting with techniques through trial-and-error. After all, learning is about discovering what uniquely works for you.

"How have you adapted your learning strategies to fit your needs?"

Repeating themes include the below points:

- **Disability services:** Accessing accommodations including extended test time, note-taking assistance, or alternative exam formats.
- **Capitalizing on productive periods:** Some recognized that focus ebbs and flows throughout the day. They intentionally schedule challenging tasks for peak concentration times.
- **Verbal reasoning:** Utilizing well-structured explanations or typed out concepts in lieu of mental imagery.
- **Meticulous organization:** Using a digital agenda to track deadlines, plan study sessions, and incorporate to-do lists to stay on top of workload.
- **Noise-cancelling headphones:** Minimizing sensory overload in large lectures or busy cafes.
- **Physical sketches and mnemonics:** Drawing diagrams or utilizing memory devices can provide essential scaffolding.

One respondent (**MN**) frankly noted, "I haven't [adapted]. I don't know how to change and make it better, and I know it's not sustainable but I don't know how to change it." This perspective highlights an important truth: not everyone has found the perfect strategy yet. Some learners may benefit from guidance, formal assessments, or a supportive community to discover what works

best. We hope that readers benefit from some of the tools and strategies shared in this book.

The Influence of Self-Knowing

"(For individuals who identify as neurodiverse,) did your approach to learning and studying change after you became aware of your neurodiversity? How so?"

DT: "My learning style has changed after self-diagnosis... I am more gentle with myself and in touch with my nervous system."

ES: "Yes, I was better about being nice to myself. Though for a while I excused myself too much."

GM: "Not really. It's how it's always been."

LM: "I got disability accommodations. Otherwise, no."

YU: "No, but I gave myself more grace for struggling to uphold my system sometimes."

Acknowledging one's own learning style—whether through self-diagnosis or professional evaluation—may not instantly resolve difficulties but can encourage empowerment and self-compassion. Many of us have developed coping strategies even before discovering the terms to describe our conditions. But

increasing understanding of one's own cognitive style often reduces stress and guilt, enabling us to explore methods that genuinely align with what makes us unique. It allows us to understand our behaviors and methods through a clear lens.

Summary of Chapter 3

- While many learners rely on mental imagery to grasp new concepts, others may depend on verbal reasoning, abstract constructs, or a blend of methods.
- Learning styles are much more varied than Visual, Auditory, Kinesthetic (VAK). Instead, aspects of impulsivity, detail, and groundedness in real life can influence preferences in unique ways.
- Traditional lecture-based teaching may disadvantage learners due to a unidirectional approach to instruction.
- Learners in the Columbia Community demonstrate remarkable tenacity in addressing these mismatched learning environments: adopting new learning strategies, requesting disability accommodations, and tailoring methods to one's cognitive style.
- Realizing one's neurodiversity may foster self-compassion and encourage experimentation with new study approaches—though not everyone is able to reconfigure their methods overnight.
- Education should meet learners where they are.

- Ultimately, learning is a journey of constant experimentation. What works for our peers may not work for us and what has worked in the past may not be suitable for present challenges.
- The stories in this chapter show us that adaptation, collaboration, and a dash of self-compassion can make all the difference in turning challenges into opportunities.

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Chapter 4 **Creativity & Problem Solving**

"Make visible what, without you, might perhaps never have been seen."
— Oprah Winfrey

Rundown

Imagination allows us to conceptualize novel solutions, map out complex possibilities, and approach challenges with flexible thinking. In this chapter, we'll examine the many ways imagination drives creativity and problem solving ranging from the arts and sciences to everyday life. We also consider how personal differences in cognitive functioning expand our understanding of the problem-solving repertoire—there is no single "right" way to imagine or create.

People develop strategies, prefer different modalities (e.g. visual vs. verbal), and manage time-sensitive or complex tasks during problem-solving. Weaker mental imagery can be offset by compensatory strategies such as strong verbal or logical reasoning and the use of external resources (i.e. grocery shopping with a written list or a molecular model kit in organic chemistry class) (Zhang, 1997).

Imagination (visual or not) is the driving force behind creativity—it allows us to conjure entirely new perspectives,

possibilities, and ideas. A pivotal insight from creativity research is that flexible adaptation of strategies often matters more than any single "correct" method (Wallas, 1926). This chapter explores the role of imagination across several domains, draws on personal narratives, and examines how diverse cognitive styles can lead to personalized problem-solving approaches.

Imagination, Learning, and Challenge

As discussed in earlier chapters, imagination can be especially helpful in learning. While some prefer using mental pictures, others excel at abstract or verbal reasoning. This variability often translates directly into how people tackle creative and problem-solving tasks.

Many of the same hurdles that impede classroom learning, such as lecture-heavy instruction, time-sensitive tasks, or purely verbal transmission of ideas can also affect problem-solving approaches:

LM: "School is mostly verbal and auditory and those are the styles I struggle the most with... I especially put in a lot of effort to get my writing and communication skills to acceptable levels, and it's still an incredible source of stress for me."

DT: "Organic chemistry... I began to wonder how I could be expected to comprehend atoms connecting in a 3D plane that does not exist in my mind."

IL: "I'm challenged by time-sensitive math tests. I feel the urge to fully visualize the question and my solution before moving on."

OS: "When people are talking in lectures, I become anxious and cannot focus."

FJ: Problems involving a lot of numerical information and computations might be tricky to easily visualize."

UA: "It's difficult for me to hash out complete ideas in my head. So if I am building something for a project or class, I need a piece of paper or something to visualize it externally rather than picture it all internally."

In spite of these challenges, evidence from creativity research demonstrates the adaptability of problem solving (Polland, 1996). An individual who struggles with conjuring mental images might develop powerful logical strategies, while a visual thinker can be quick to form a 3D simulation in their mind. Everyone has a unique blend of strategies they may use, and each strategy is, of course, context-dependent.

Different Styles, Different Solutions

In creativity research, a number of "styles" are frequently described—some center around strong internal visualization, while

others rely on language or interactive experimentation (Finke, Ward, & Smith, 1992). Furthermore, creativity can be driven by distinct preferential strategies (e.g. mental simulation) or a hybrid approach that combines visual and conceptual thinking. Below, we examine how respondents leverage their unique capacities to generate solutions and ideas.

Vivid Visualizers

OS: "I can see the molecule in my head...which allows for determination of whether molecules are chiral or achiral. Other students use molecular model kits to physically see the molecule, but I can simply make the model kit in my head."

FJ: "I spend a lot of time during study just sitting back and trying to visualize what I'm trying to learn."

YU: "[Imagery] helps with mathematical and logical concepts, since I picture numbers or other components fitting together like a puzzle."

Conceptual/Verbal Thinkers

DT: "I have a strong conversation with myself in my head, rewording the lessons to fit my cognitive style."

PW: "If something is too complicated...it helps a lot to have a whiteboard...mapping out ideas to figure out how to connect them."

LY: "I write things out/break problems into smaller parts in outline form."

Hybrid Styles

XK: "To [supplement] mental imagery, I usually rely on writing. For example, if I can't imagine a physics concept, I physically write it out and break it down with either drawings, mind maps, or both."

KA: "I can still use visual imagination but my problem-solving approach isn't dependent on visuals, that is only part of it, and more focused on recognizing patterns and internalizing general shapes of things."

All of these styles emphasize a synergy between imagination, functional approaches, and the individual's unique preferences. Some share that they have no difficulty visualizing even complex 3D structures (think organic chemistry), whereas others rely on external tools (charts, diagrams, and physical models). According to dual-coding theory (Paivio, 1971), these mixed strategies can boost memory and facilitate problem-solving but as we've seen are also highly customizable and distinct across individuals.

Many respondents also identified differences in how they retain or recall information compared to peers (such as those in a study group):

WR: "I need to spend more time thinking about and fully grasping new ideas before I can actively engage with it (e.g. participant in discussions)... others may be able to engage with course material more quickly."

RR: "I have noticed that I need to physically write down content and have it broken down into smaller parts in order for it to be retained. Typing notes down doesn't help as much."

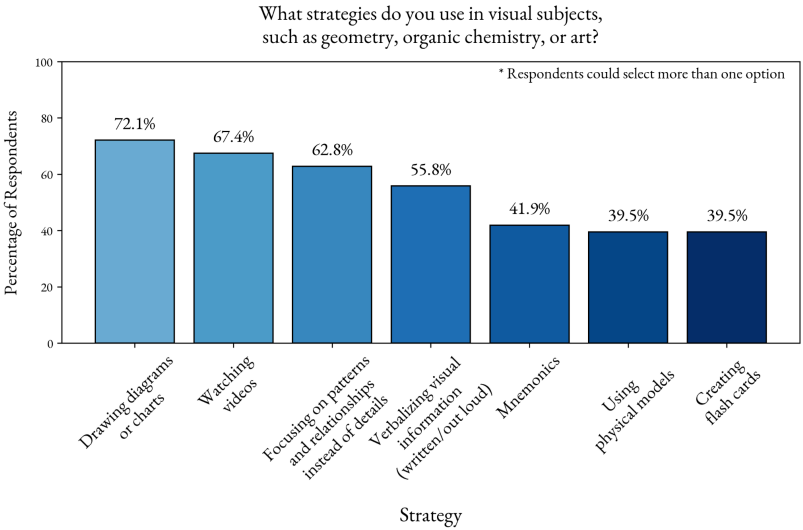
JJ: "I am able to retain information to a lesser degree than my peers."

LY: "We all have different methods of memorizing information or ensuring things are retained for certain amounts of time."

ZG: "I'm a lot more visual/imaginative than most of my peers..."

CN: "My approach to study is much more language and sound based than many of my peers. I like to remember ideas in rhymes or short sayings..."

Some respondents feel they are able to retain knowledge better in a visual format, while others need more study time than their peers. Others prefer language-based cues like rhymes or mnemonic devices. We asked participants to select strategies that apply to how they approach visual subjects, such as geometry, organic chemistry, or art. Their responses are encapsulated in the bar graph below.



An overwhelming majority of participants mention the use of drawing diagrams or charts as a core strategy, followed by mnemonics, watching videos, and verbalizing information. Physical models appear especially common in these spatial subjects such as organic chemistry (e.g. stereochemistry). This finding aligns with prior research showing that externalizing information—such as in drawings, physical manipulatives, or even gestures—reduces working memory load and often results in a deeper understanding of course material (Karlsson Wirebring et

al., 2015; Goldin-Meadow, 2001). Instead of having to retain spatial information in your head, having an external model offloads that cognitive strain (Holmes, 2013).

Creativity in Action

We asked respondents to describe their creative processes and perhaps share an instance where their unique cognitive style led to creative solutions. The answers reveal a multitude of approaches.

PW: "I prefer to map/plan out a lot in advance as I need a somewhat concrete idea before continuing."

MN: "I usually try to get inspiration from photographs or other art when I want to make something creative."

FJ: "I start with rough sketches of what I imagine the final product to look like."

IO: "I feel that my mental imagery has helped me in my creative writing endeavors. I enjoy writing short stories related to science fiction, and through imagining many crazy scenarios in my head, I can write quickly and describe made-up scenes with an elevated degree of vividness."

GM: "I like brainstorming with others and bouncing ideas. Sometimes they just appear in my mind."

XK: "To prepare for a test, I would make mind maps and then make videos where I go over the mind maps and rewatch those videos constantly so the information sticks."

KA: "My creative process often involves me diving straight into things... I love just going in and being immersed for some period of time, and then coming out of it with a new, fresh perspective—I don't like planning too much at the start."

RR: "I usually start with a bullet point list, preferably written. Then I like to expand on my favorite ideas and see whether I can connect them into a more expansive idea. I also like to do this in a space I usually am not in, which means removing myself off of campus and more into the city. Once I have a solid foundation for an idea, I like to have a mini peer review of 1-2 other people hearing my idea and suggesting feedback. I then go back to the drawing board and reassess ways in which I could improve."

AV: "I usually take patterns and then extrapolate them."

Here, an interesting dichotomy emerges: though some prefer "jumping right in" or are inspired by a "spontaneous burst," others tend to take a structured approach of writing things out or creating a bullet pointed list. This systematic outline or initial sketch of ideas may align with those who tend to follow a logical or

analytical flow. Others immerse themselves in a problem or gather external inspiration. Many mention building on references (visual or conceptual), brainstorming/free writing, or physically working through a project. Our exploration supports the insights from Finke, Ward, & Smith (1992): creativity can arise from a combination of domain knowledge, environmental scaffolds, and internal imagination. But as we saw, even formal reasoning through "logical" or "pattern-based" approaches can be utilized to reach creative solutions (Holyoak & Thagard, 1997).

Chapter 4 Summary

- Imagination allows us to generate new solutions, see complex possibilities, and drive creativity.
- Although there appear to be distinct strategies in the creative or problem-solving process, many individuals utilize hybrid styles that can integrate a multitude of approaches.
- Lecture-heavy and fast-paced classrooms can affect those who need more time or prefer interactive tools. Many individuals find ways to adapt to their needs.
- Physical manipulatives, collaborative brainstorming sessions, diagrams, and instructional videos can also spark creative insights or help cement information.
- There is no universal formula for creativity and problem solving. Understanding and levering your unique cognitive preferences can enhance your learning and creative input.

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Chapter 5 The Impact of Cognitive Diversity on Education

"The world is going to need all of the different kinds of minds to work together."
— Temple Grandin

Rundown

Everyone navigates the education system in their own way—shaped by who they are, what they need, and how they learn. Although schools and universities strive to standardize how knowledge is delivered to students, we must work toward a model that is more inclusive. No two people in a classroom will have the same cognitive profiles. Indeed, the concept of neurodiversity reminds us that such differences are not mere obstacles; they can be opportunities to build richer classroom dynamics (Armstrong 2012). The challenge for educators and educational systems lies in how they respond to and accommodate these differences.

This chapter highlights case studies and personal narratives from respondents who identify as neurodiverse, exploring how these differences have shaped their educational experiences, and suggest practical ways to make teaching more inclusive.

Experiences & Challenges in the Classroom

Many of our respondents spoke about how their neurodiversity manifests in classroom life—both the frustrations, and some unexpected advantages.

LM: "Not taking notes, inability to stay focused, keep up, or maintain progress. I get overwhelmed and frustrated, I can't sleep... I have dissociated in class and during presentations. I have also failed or withdrawn from all classes when I get too overwhelmed."

MN: "I find group projects particularly difficult because I don't have good connections with those in my class... I also find participation without raising hands to be difficult because I don't understand when people want to initiate... nor how I can interject."

QP: "When I try to focus on something, the stimuli around it become clearer than what I am trying to focus on... When I am stressed and taking an exam, it sometimes causes me to skip over important words like 'NOT'."

OS: "In middle school I had to leave the classroom a few times a week due to panic attacks. In college, people talking in lectures, especially behind me, leads to serious panic attacks."

TC: "Lack of confidence is the biggest distractor."

One respondent (**GF**) noted that they had been "illiterate and performed in the 1st percentiles in STEM until around age 11 or 12," demonstrating that developmental timelines can dramatically vary (i.e., the development of some cognitive domains may be delayed compared to others) but that low scores at one point in time don't necessarily predict later performance (Meyer, Rose, & Gordon, 2014). Another respondent talked about their struggles in a "high pressure and competitive environment," sharing how they needed "constant breaks, extra time, and plenty of space to plan ahead"—resources that are rarely accommodated in fast-paced higher education.

Such testimonies point to two primary challenges for neurodiverse students. First, many individuals may struggle with executive-function (e.g., focus, time management, and emotional regulation), which can become barriers to academic performance when unsupported (Barkley, 2012). Second, social and cognitive factors such as anxiety related to group discussions, background chatter, or unclear instructions—can add an extra layer of stress, and overshadow a student's actual cognitive potential (Rainey et al., 2024). For one student, however, "if anything, [my neurodiversity] has helped."

Adapting Learning Strategies

When faced with the obstacles listed above, many respondents describe workarounds or personalized strategies that they have developed. Yet others acknowledged feeling stuck or uncertain.

"How have you adapted your learning strategies to fit your needs?"

MN: "I haven't, I don't know how to change and make it better... it's not sustainable but I don't know how to change it."

YU: "I have become extremely organized and always on top of time management. I meticulously keep track of deadlines and have become very aware of when my attention starts to drift."

WR: "I am still in the process of figuring this out, but... I require longer periods of rest and sensory isolation so that I am able to function [on] school days... I try to prepare well beforehand so that I minimize the potential of having to think quickly on the spot, which is very difficult for me."

VE: "So many ways! I don't mind adapting though, I see it as an exciting challenge."

HO: "I try to incorporate multi-modal stimuli when learning. For example, reading out loud and hearing my own voice helps me remember things."

OS: "Noise cancelling headphones."

For some respondents, another major hurdle is the unpredictability of social demands and the environment's sensory overload (e.g. loud rooms, fluorescent lighting, or constant group collaboration). Yet, some report responding to those challenges with a renewed interest to reframe them as opportunities for development.

Understanding vs. Resistance

An important element in shaping a student's academic experience is how educators and the institution respond to their needs. Some individuals have had wonderful interactions with understanding faculty members and disability offices, while others have had less positive experiences that left them feeling unsupported.

"How have your educators responded to your needs?"

WR: "Some of my professors understand, and once they take the pressure off me, I am able to relax and really succeed. Others, however, refuse to accept any sort of requests for accommodation, and in these cases I have really struggled."

BB: "Generally they've been pretty nice and understanding, but many don't know."

GF: "I had to transfer to a school with teachers trained to guide dyslexic students."

VE: "Some [are] better than others. The wiser ones have fed my curiosity and encouraged my enthusiasm and creativity. I like that."

Research on inclusive education emphasizes the fact that consistent, institutional support and faculty training can mitigate these difficulties (Armstrong, 2012). The onus, however, often remains on the student to self-advocate, which can sometimes be a significant barrier for individuals who already feel overwhelmed. Even a single supportive educator who acknowledges the legitimacy of one's requests (e.g. extended time, alternative exam formats, or noise-free workspaces) can serve as the launchpad for a student's educational success (O' Connor, 2008).

But in what ways can educators and institutions account for the different needs of their students? We asked "How can your ideal classroom accommodate your neurodiversity?"

By providing options for respondents to select, three recurring themes emerged:

1. **Reduction of overwhelming sensory inputs:** Quieter study areas, fewer auditory distractions, or the option of noise-canceling headphones.
2. **Flexible, self-paced options:** Asynchronous or extended deadlines, multiple ways to complete tasks, and structured time for work or reflection.
3. **Assistive tools & interactive elements:** Text-to-speech tools, visual diagrams, and carefully moderated peer collaboration to prevent chaotic interactions.

These responses align closely with the principles outlined in the Universal Design for Learning:

- The ideal classroom provides multiple ways of representing class material (e.g. diagrams, written notes, and spoken content)
- Additionally, inclusive classes allow students to participate in the modality that is most comfortable to them, whether through writing, speaking, or other alternatives.
- Last, the more engaging the classroom environment is, the more students will feel welcome.

Recommendations for Inclusive Teaching

Bringing together these narratives and scientific insights, we summarize responses into the following suggestions.

- **Proactive Accommodations:** instead of reacting to students' requests, educators can provide alternative assignment formats, flexible deadlines, or quiet corners.
- **Sensory and Social Considerations:** discouraging disruptive background noise, allowing for small group discussion, and clarifying interaction expectations (e.g. how to initiate or interject during discussions) can alleviate anxiety for students that struggle with sensory overload or social cues.
- **Transparent Communication and Collaboration:** clear deadlines, detailed instructions, and explanations of why tasks matter can encourage deployment of executive function.
- **Assistive Technology and Multi-Modal Instruction:** allowing students to select and use what aid can help them, whether note-taking apps, speech-to-text conversion tools, or visually enhanced presentations, can lower cognitive strain and ensure the accessibility of content.
- **Cultivating Empathy and Trust:** simple interpersonal gestures—like acknowledging a student's anxiety in group discussions—can bolster confidence and motivation. For many learners, a teacher's willingness to accommodate can be the deciding factor in whether they persist or withdraw.

For more in-depth information, please feel free to explore the following resources from Columbia University Center for Teaching and Learning:

- Accessibility in Teaching and Learning
- Creating a High Trust, Low Stress Class Environment
- Teaching in All Modalities

Chapter 5 Summary

- Inclusive education should go beyond providing accommodations to students with special needs. Instead, educators should have the resources to anticipate potential differences and harness the strengths/creativity that comes from diverse ways of thinking.
- Individual experiences and struggles with education can vary significantly. Therefore, standardized teaching strategies may disadvantage some students.
- A common thread is clear: responsiveness and adaptability on the part of educators can transform an otherwise stressful, disengaging classroom into a welcoming environment where anyone can excel.
- This focus on cognitive diversity benefits everyone—when a classroom is designed with a multitude of access points, all learners feel empowered to find ways to make learning easier for them.
- Genuine inclusivity in education begins with embracing and understanding cognitive diversity. When we recognize

and value the wide range of ways people think and learn, we encourage broader systemic shifts, such as reimagining classroom structures and transforming how educators communicate. These changes don't just remove barriers for some; they improve learning outcomes for everyone.

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Chapter 6 Accommodations and Columbia University Support Channels

"I come as one, but I stand as ten thousand."
— Maya Angelou

Rundown

When students enter a learning environment, they bring a unique set of cognitive strengths, challenges, and personal experiences. For neurodiverse individuals, the ability to navigate campus life can heavily depend on the availability and effectiveness of support channels, which range from formal support to peer-based communities. Empirical research emphasizes how accessible, well-publicized accommodations significantly enhance academic outcomes for students with learning and attention differences (Tarconish et al., 2023). In this chapter, we explore the specific accommodations and campus resources that have helped respondents thrive on the Columbia University campus.

Social Scaffolding

In many cases, discovering a welcoming student club or organization can be a turning point for neurodiverse learners. Clubs offer social connection, practical resources, and a sense of belonging (Tinto, 1993). Respondents mentioned several groups:

LM: "Neurodivergent at Columbia."

MN: "I have found the Columbia Ballroom Team helpful because they accept me and my excitability over dance, wholeheartedly."

BB: "Columbia Recovery Coalition & Active Minds."

WR: "Artistic endeavors such as dance teams or social groups like Greek life."

Even clubs that are not explicitly labeled as neurodiversity-related can be incredibly helpful. Indeed, any welcoming space can be a supportive environment when a student's passion or personality is encouraged! Furthermore, activities from clubs that offer broad mental health advocacy and peer support, such as Active Minds and Columbia Recovery Coalition, align with research on how student-led communities can reduce stigma and promote academic engagement (Reis et al., 2022).

Why Peer Support Works

Social support is highly effective at buffering stress and building academic resilience. In particular, a sense of belonging has been linked to both increased self-efficacy and motivation—two key predictors of persistence in higher education (Walton & Cohen, 2011). Research further indicates that students who engage in peer mentoring or student organizations show higher retention rates (number of students who continue their studies at a school from

one year to the next) and degree completion (Boutakidis et al., 2024). In this sense, clubs and communities are a lot more than a mere social outlet; they are informal scaffolding for academic and emotional well-being!

Some respondents mentioned that they prefer to connect directly with mentors and professors. This is an important point: while clubs can be transformative, an inclusive campus also depends on faculty approachability and departmental networks (Heiman & Kariv, 2004).

Support Systems & Resources

When we asked about neurodiverse respondents about the resources and individuals they rely on, they mentioned everything from mental health professionals to understanding friends and family:

MN: "I have specifically relied on a Psychiatric Occupational Therapist and having neurodiverse friends."

OS: "[I] relied on community mostly."

TC: "I rely on loving and kind souls in communities that I can find."

TH: "Most of my family and close friends."

LY: "I don't tend to tell people but...I've relied on my medication and conversations with my doctor."

For some, professional support (e.g. occupational therapy for sensory or executive-function challenges) can be crucial. Others rely on grassroots networks—fellow students, friends, or online communities. This resonates with research on informal social capital, which suggests that supportive relationships can mitigate academic stress and improve mental health (McPherson et al., 2014).

Mental Health Services & Accessibility

A robust institutional infrastructure is essential to address mental health—especially because neurodiverse individuals may experience higher rates of anxiety or depression (Otu & Sefotho, 2024; Eisenberg et al., 2009). However, studies also reveal that the top two persistent barriers for college students are difficulty accessing services and lack of time to seek treatment (Weissinger et al., 2022). It is important that academic institutions adopt proactive strategies, such as anti-stigma campaigns, well-advertised counseling hours, and screening programs can lead to more equitable access (Eisenberg et al., 2012). Institutions with streamlined processes for referring students to disability support or counseling services observe higher rates of sustained enrollment and academic success among students with learning or mental

health challenges (Kutscher & Tuckwiller, 2019). These students benefit from the legal protections of accommodations but also from a campus climate that normalizes help-seeking and fosters early intervention for new college students.

High-Impact Accommodations

When asked which accommodations have made the biggest difference, respondents consistently reported:

- Testing Accommodations (extended time or private rooms)
- Note-taking Accommodations (recorded lectures or a designated note-taker)
- Assistive Technology (screen readers or speech-to-text)
- Housing Accommodations (quiet dorm floors or single rooms)
- Learning Specialists (coaching for organizational/academic strategies)
- Foreign Language Substitution or modification

There is an extensive body of work demonstrating that simple accommodations such as extended test time, note-taking services, or alternative-format materials can bolster outcomes for students with diverse learning needs (Troiano et al., 2010). Executive-function coaching and focused tutoring are linked with higher GPAs and lower dropout rates among college students diagnosed with ADHD (Lefler, Sacchetti, & Del Carlo, 2016).

Assistive technology (e.g. text-to-speech) has demonstrated measurable improvements in reading comprehension for students with dyslexia (Floyd & Judge, 2012). It quickly becomes clear that accommodations work when they are thoughtfully implemented and easily accessible to students. Empirical findings further emphasize the importance of reducing stigma and simplifying the process: when students realize that accommodations are a natural extension of learning support, they will be more likely to seek them out.

A Systemic Focus

Many universities, such as Columbia, are realizing that a genuine commitment to inclusivity requires active support and prioritizing initiatives that address the needs of a diverse student body. Below are some ideas informed by student responses and literature:

- Accessible Course Development
    - Revamping course materials in alignment with the Universal Design for Learning (Meyer et al., 2014). This could involve integrating captions for all videos, providing outlines in advance, or using interactive online modules.
- Assistive Technology Loan Program
    - Providing free, short-term access to devices like smart pens, noise-canceling headphones, and text-to-speech software for students.
- Peer Mentorship & Advising Workshops

    - Supporting student organizations that train neurodiverse mentors to guide incoming freshmen through the campus environment—helping them navigate everything from finding quiet study nooks to understanding how to register for accommodations.
- Faculty Training
    - Workshops on disability awareness, mental health first aid, and strategies to make synchronous online learning accessible can help accommodate a wide range of learners. Offering these opportunities for development can enable faculty to adopt these inclusive techniques.

Empowering the Neurodiverse Student

Accommodations can act as a powerful bridge between potential and performance for many students. As respondents' stories demonstrate, even a single resource—like note-taking assistance—can transform academic trajectories.

Chapter 6 Summary

- All students thrive when accommodations and support systems are accessible.
- Student clubs and organizations encourage belonging and support.

- Peer support boosts self-efficacy, motivation, retention, and graduation rates.
- First-hand reports and empirical research support high-impact accommodations such as note-taking, testing, and housing.
- Universities can continue incorporating accessible course development, faculty training, and workshops to create an equitable learning environment.

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Chapter 7 **Personal Discoveries and Journeys of Acceptance**

"You can't be what you can't see"
— Marian Wright Edelman

Rundown

In this chapter, we dive into the personal transformations individuals have undergone when learning about their neurodiversity. By exploring their testimonies, we can see how respondents navigate journeys of self-discovery, cope with social perceptions, and eventually forge a path toward acceptance and growth. We also see how knowledge of one's cognitive profile can impact emotional well-being, relationships, and academic identity. This chapter celebrates the milestones that have empowered our respondents, highlighting the human spirit's capacity for adaptation and hope. Finally, we include some advice that may help others on a similar journey.

Pathways to Self-Discovery

For many, understanding one's neurodiversity is not a straightforward process. Some respondents describe childhood experiences of restlessness or difficulty focusing, while others recalled social or emotional struggles that only made sense in retrospect:

MN: "I discovered my neurodiversity because my mental health was really suffering and none of the preferred treatments were helping... My friend recognized a lot of herself in me and urged me to start the ASD evaluation."

YU: "I think everyone kind of always knew. My friends always said talking to me was like talking to a dog while squirrels are running by... I only sought formal diagnosis and treatment in college."

OS: "Always knew because my brother [was] diagnosed. I don't really tell others."

VE: "I honestly don't care about my neurodiversity. I like my mind and it doesn't matter to me how it's categorized."

A few only discovered their differences after a crisis or dramatic shift in daily routine:
FT: "Formal diagnosis after an acute episode."

BB: "It was very extreme, very fast; I have a rare condition that develops within weeks to months initially. It was very obvious to everyone."

We see that "aha" moments can arise when familiar coping strategies fail or when external circumstances demand reevaluation of identity (Heiman & Kariv, 2004). In some cases, acceptance

appears to come organically—particularly for those who see neurodiversity as an intrinsic, even valuable, part of who they are. In one case, the diagnosis came during college, reinforcing the critical role that higher education can play in students' development and underscoring the need for ongoing support to the students and institutional resources.

Emotional Impact and Self-Image

A common theme is the sense of relief many respondents report feeling once they gain clarity and language to describe their experiences:

YU: "I think the confirmation of a formal diagnosis was relieving because it helped me understand that my seemingly fundamental inability to maintain executive function wasn't my fault."

WR: "It has given me the freedom to be myself. I stopped trying to fit in.. because that takes up way too much of my energy."

Yet, initial acceptance is not always smooth:

LM: "Validated, but also sad that validation only came out of diagnoses and labels that other people defined."

MN: "I grew up thinking there was something wrong with me... points where I just didn't want my life anymore because nothing

seemed to fit. The truth was that I didn't fit, but not because I was wrong."

These reflections align with findings on identity development in young adults, where naming one's differences can bolster self-esteem but also rekindle past traumas or frustrations (Rathbone et al., 2023). But by framing perceived deficits as variations in cognitive processing, many find new ways to articulate their struggles and celebrate their unique strengths in a way that does not downplay the reality of their past experiences.

Family, Friends, and Relationship Dynamics

When disclosing their neurodiversity to loved ones, respondents have experienced a range of reactions. Some note that friends and family responded with understanding or even relief:

WR: "Once I told my friends and family, they all just said it made a lot of sense."

BB: "People were much nicer than I had expected; I think they felt very bad for me."

Others, unfortunately, describe less than desirable experiences when speaking openly about their differences to friends and family. Many respondents note that this often leads to feelings of

alienation and increased "masking" where they deliberately hide their differences in order to fit in socially:

MN: "The initial reaction from almost everyone is 'you really don't seem autistic' which feels not good because I struggle in ways I have to hide."

LY: "It tends to drive me away from relationships or affect them negatively, which then affects my self-image."

These striking perspectives illustrate the potent impacts of others reactions. Some social and familial environments can either validate or invalidate an individual's identity, shaping broader emotional well-being. Conversely, without acceptance or knowledge, individuals may feel compelled to camouflage their differences, which can deplete emotional resources.

Advice from Neurodiverse Respondents

Based on their personal experiences, respondents have offered tips for others:

BB: "It's a massive challenge, but a massive gift, as it gives you skills to use your unique perspectives to help others. Also, if you believe in yourself, you can do a whole lot. Even if you have less time you can spend on work and other tasks, you can adapt and be extra efficient, and still accomplish what you need to. It's never easy, but

even when things seem hopeless and that they never will get better, they often do more than what we can possibly imagine."

MN: "Try to find people like [yourself]. Feeling different and being different is isolating, but finding people who are like you makes a world of difference."

OS: "Friends will have to be okay with the parts of you that are 'neurodiverse.' If they can't, they aren't a good friend match for you, and that's okay. It doesn't make you or them a bad person."

WR: "Don't ever compare yourself to anyone else, and don't ever feel embarrassed or ashamed for being different."

TC: "Have faith in yourself. You are stronger than you think."

VE: "Keep your mind engaged in math or books. Use the imagination so it doesn't use you."

HO: "Seek help where you think it is needed."

LY: "Outlets are important not only for academic stress but also emotional stress."

Several respondents emphasize the positive impact of finding creative outlets, coping mechanisms, or simply having a safe

community for venting frustrations. In line with research on coping mechanisms, employing consistent self-care can have a measurable impact on resilience and emotional stability, especially during high-stress academic terms (Pariat et al., 2014; Reddy et al., 2018).

Personal Milestones

Many respondents highlight meaningful personal achievements:

- Embracing uniqueness: letting go of self-blame has allowed individuals to celebrate an identity that may have once felt alien.
- Developing new strategies: discovering the techniques (e.g. scheduling apps or sensory tools) that align with one's needs can make daily life much more manageable.
- Requesting accommodations: having the courage to advocate for extra time on tests or note-taking support can transform a sense of helplessness into empowerment.
- Passing a class once thought impossible: a powerful testament to perseverance.
- Joining a community of peers: putting yourself out there can help you realize you are not alone and can ultimately lead to reduced feelings of isolation.

Journey of Acceptance

Though everyone's path is different, we asked respondents to share resources that have proven to be helpful in their journey of

self-discovery and self-acceptance. We hope that sharing these resources empowers individuals who may be currently in need of advice. Respondents mentioned books, mindfulness apps, specialized nonprofits, and even social media.

ES: "Unmasking Autism by Devon Price"

WR: "TikTok" (for community and relatable stories)

TC: "Mindfulness (MBSR, Yoga, Buddhism)"

VE: "Khan Academy... I also just read a lot and talk to smart people who can challenge me."

BB: "International OCD Foundation"

LY: "Yoga classes!... just anything to keep me active while exposing me to [being] comfortable around strangers."

The underlying theme in the above suggestions is structured support; educational tools, mental health practices, or peer community can all help dramatically reshape self-acceptance and personal growth. Learning about others with similar experiences helps reduce stigma and allows individuals to better understand and appreciate their own differences.

Chapter 7 Summary:

- Many individuals learn about their neurodiversity in response to persistent challenges or after a crisis. This realization can feel liberating, although the process of self-understanding is often emotionally complex.
- A formal diagnosis or increased self-awareness often brings relief—reframing struggles as legitimate variations in cognitive processing rather than personal failings.
- Acceptance by friends, family, educators, and peers can catalyze positive identity development, while misunderstanding or disbelief can force individuals to "mask" or suppress their authentic selves.
- Embracing one's uniqueness, developing tailored strategies, requesting accommodations, and connecting with like-minded peers can encourage resilience and confidence.
- From professional therapy to mindfulness or even finding community in digital platforms, broad access to supportive tools and networks can substantially enhance self-acceptance.

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Chapter 8 Conclusions and Future Directions

"Another world is not only possible, she is on her way.
On a quiet day, I can hear her breathing."
— Arundhati Roy

Conclusion 1: On the heterogeneity of VMI experience.
By inviting respondents to define visual mental imagery in their own words, we were able to identify striking variability in how they experience this construct. Some respondents reported having verbal, visual, or conceptual representations of the imagined content. This variability carries great implications for the *science* of visual mental imagery: when participants are asked to report on that experience in the context of a controlled, laboratory study, their responses may reflect a reality that diverges from what is expected by the experimenter. In fact, researchers have begun investigating how different strategies (e.g., visual or verbal) used when completing visual mental imagery tasks influence performance (Reeder et al., 2024).

Conclusion 2: What's next in the science of visual mental imagery?
Visual mental imagery is notoriously difficult to study. When studying other cognitive functions, researchers can tightly control the stimuli in their cleverly balanced studies and precisely measure brain and behavioral responses. On the other hand, visual mental

imagery presents a unique challenge; we must infer the content and quality of their imagery based on indirect measures like performance or self-report, which adds a layer of uncertainty that is difficult to eliminate. In the next five years, we expect significant advances in several key areas of the visual mental imagery literature:

- Improving definitions of visual mental imagery: we propose a clearer distinction between visual mental imagery as a cognitive ability and vividness as a subjective experience, challenging traditional definitions that conflate the two. This dissociation helps explain how individuals—such as those with aphantasia—can perform well on imagery tasks despite lacking vivid internal visual experiences (Razzak and Spagna, 2024).
- Characterizing the brain correlates of visual mental imagery: advances in neuroimaging techniques and advanced analytic methods, particularly those that combine high spatial and temporal resolution—will offer more precise insights into the dynamics of imagery generation, maintenance, and termination.
- Identifying imagery profiles: shifting toward more personalized models of visual mental imagery to account for the substantial variability in how people experience and report imagery (Zeman, 2024). This will likely include the development of more fine-grained imagery profiles, that

move beyond a one-size fits all *continuum* ranging from aphantasia to hyperphantasia.

- What is VMI for? Understanding the role of visual mental imagery in real-world cognition, including its function in learning and education, creativity, problem solving, social cognition, and mental health, areas where imagery is both impactful and understudied. For example, teachers, educators, and policymakers can collaborate to develop assistive and adaptive technologies (e.g., speech-to-text, mind-mapping software, and/or sensory-friendly virtual environments) that meet the needs of all students and ensure a personalized learning experience.

Conclusion 3: Cognitive differences ≠ Cognitive deficits. A central aim of this book was to reframe individual differences in visual mental imagery abilities under a positive light, to empower individuals in utilizing whatever strategies best fit their needs. We hope to have encouraged our readers to explore their unique ways of navigating the world, to embrace these differences as a vital part of what makes them who they are, and to be mindful of the diversity in thinking, perceiving and imagining.

Conclusion 4: Imagery extremes and academic outcomes. Since none of the authors are trained clinical psychologists, we deliberately refrained from taking a stance on whether aphantasia (or low mental imagery ability more broadly) should be considered

a diagnosable condition. At present, there is no established diagnostic definition of aphantasia, and it remains unclear whether such a definition is necessary. Nonetheless, it is important for educators to recognize that differences in mental imagery experience can significantly impact academic performance. Specifically, we highlighted the need to avoid relying exclusively on pedagogical strategies that depend on visualization when explaining abstract concepts.

Conclusion 5: Implementing small changes can lead to big outcomes. Relatedly, institutions should develop solid strategies to accommodate individuals that are neurodiverse, including interventions aimed at reducing both internal and external experiences of stigma. We believe that it is our duty to shed light on the fact that people learn differently, and small changes (such as accommodations in academic settings) make a huge impact on individual success. It is important that we address stigma and promote environments (academic, professional, and social) where differences in mental imagery, attention, or sensory processing are regarded as variations rather than deficiencies. Grassroots advocacy and larger institutional reform can encourage this cultural shift.

Conclusion 6: Connecting the Aphantasia and the Neurodiverse community. It is essential to build community and increase awareness around diversity of visual mental imagery—an often overlooked aspect of neurodiversity. By recognizing these

variations, we can foster a more inclusive learning environment that effectively serves diverse needs. As shown throughout this book, those who find supportive peers or communities often experience transformative outcomes. Future efforts should focus on creating and encouraging these widespread networks, whether online or offline, to connect individuals who share similar cognitive profiles. Such communities allow for safe spaces for exchanging personal wisdom, celebrating achievements, and advocating for broader policy changes.

Continue the Conversation

Acknowledging and understanding cognitive diversity should be an ongoing, dynamic process—one we hope extends far beyond the pages of this book. Whether you are an educator interested in designing inclusive curricula, a student currently experiencing challenges, or simply a curious reader inspired by these stories, there is always room to expand your understanding and contribute to a more inclusive society.

- Keep Asking Questions: No single framework can ever capture the full complexity of human cognition. Continuous inquiry, open dialogues, and new research avenues are necessary to advance our understanding of how we learn, think, and thrive.
- Cultivate Empathy: Advocacy begins with empathy. By listening to others' experiences—especially those different from our own—we can create a culture of mutual respect

and genuine inclusion. We hope that hearing perspectives in this book has bolstered understanding of those who experience the world differently. Small acts, like encouraging a friend to seek accommodations or joining a student advocacy group, often have a ripple effect, inspiring others to take similar actions.

- Support Institutional Change: Effective change will require shifting both practice and policy. Push for Universal Design in classrooms, flexible academic requirements, and intentional practices that invest in real, meaningful support for neurodiverse communities.
- Embrace Lifelong Learning: Cognitive diversity does not simply vanish outside education. Keep exploring how your mind words, remain open to others' perspectives, and adapt your strategies as life evolves. Each new environment—job, country, relationship—might demand novel approaches to self-advocacy and problem solving. If something isn't working, try something else!

A Hopeful Finale:

This final chapter should not be an endpoint, but a springboard—sending you forth to question old assumptions, challenge exclusionary practices, and champion a future where cognitive diversity is celebrated as an essential aspect of our shared humanity.

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At Columbia's Zuckerman Institute, *Public Programs* foster meaningful engagement between science and the community. Many of our initiatives emerge from close collaborations with community partners and are shaped by their input. These programs translate the Institute's cutting-edge research into creative, hands-on experiences for diverse audiences, including school children, families, after-school groups, and adults. Through the Education Lab at the Jerome L. Greene Science Center, we offer a wide range of brain science activities designed to inspire and inform.

We are deeply grateful to Jozef Sulik, Assistant Director of the Center for Science and Society and Presidential Scholars in Society and Neuroscience program, for his support throughout this project. Founded in 2014 by President Lee C. Bollinger as a Columbia University Presidential initiative, the *Presidential*

Scholars in Society and Neuroscience (PSSN) program facilitates cross-disciplinary, collaborative research to advance our understanding of mind, brain, and behavior. Bringing together talented early career scholars from a variety of fields with faculty experts in neuroscience, and in the humanities, arts, and social sciences, PSSN is creating a new paradigm for original, integrative research and training.

About The Living Lab

The Living Lab explores the dynamic interplay between attention, perception, and imagination in both controlled laboratory settings and real-world environments. Our multimodal approach to neuroimaging combines behavioral testing, eye tracking, and brain imaging techniques including magnetoencephalography, functional Magnetic Resonance Imaging, stereotactic and mobile EEG. We focus on how neural signatures of conscious experience vary across individuals, with special attention to conditions like aphantasia and other forms of cognitive diversity. In particular, we examine how frontoparietal networks interact with ventrotemporal regions to support voluntary imagination. Our lab collaborates internationally with leading scientists in cognitive neuroscience and psychology, and we are committed to mentoring the next generation of researchers through hands-on training and inclusive, curiosity-driven science.

Dr. Alfredo Spagna is a trained Cognitive Neuroscientist. His research focuses on the cognitive and neural mechanisms underlying human attention and imagination, particularly examining the interplay between frontoparietal networks and high-level visual regions. As the founder and director of The Living Lab, he fosters interdisciplinary collaborations that result in unconventional research projects and public events, aiming to bridge the gap between psychology, neuroscience, and real-world applications.

Emaad Razzak is an emerging neuroscience researcher investigating how individual-level variations in mental imagery inform problem-solving performance and strategies. Driven by his personal experience with aphantasia, he developed a profound commitment to understanding cognitive diversity after grappling with challenges in autobiographical memory and visually demanding domains. Harnessing psychophysiological indices, Emaad's work uncovers the intricate dance between mental imagery and working memory, revealing their impact on problem solving across diverse cognitive profiles. He has presented these insights at the annual meeting of the Association for the Scientific Study of Consciousness in Tokyo and, in a recent publication, has shed light on how subjective experiences can influence objective metrics. Through his research, Emaad champions more inclusive frameworks in both scientific inquiry and education, ensuring that a wide spectrum of cognitive styles is recognized and supported.

M Crouse At the time of this writing, M Crouse is set to graduate from Columbia University with a double major in Creative Writing and Psychology. From learning to cultivate indoor fruit trees to helping The Living Lab write Ways of Thinking and Imagining, they believe the most beautiful art is the kind sculpted by evidence. M plans to pursue a Master's Degree in Social Work or Family Therapy after graduation.

Kezia Chuaqui holds a BA in philosophy from UC Berkeley and an MA in philosophy from Princeton University. Currently, she's a post-baccalaureate student at Columbia University, researching the relationship between individual trait variation (e.g., mental imagery ability) and hallucination in both clinical and non-clinical contexts. Her secondary interests include the measurement of subjective experience and the nuances of neuroscientific terminology. Diagnosed with autism as an adult, Kezia is a proud member of the neurodivergent community. Her work is deeply influenced by her lived experience, motivating her to advocate for greater awareness of cognitive diversity and explore how we might better accommodate the vast spectrum of ways people perceive and interact with the world. When she's not exposing participants to flickering light stimulation to induce pseudo-hallucinations, she's indulging in her special interests: fine fragrance, vegan cooking, David Lynch films, elaborate beauty routines, and the brutal challenge of Dark Souls games.

Jessica Reschny is a Neuroscience and Behavior student at Barnard College, planning to pursue graduate studies and research on subjective mental processes, particularly hallucinatory experiences. Her involvement in The Living Lab is inspired by her personal journey of adapting her own education to accommodate aphantasia—a condition she discovered only after discussing mental imagery with peers. Jess is passionate about developing educational approaches that recognize and support the full

spectrum of cognitive diversity, a goal she believes begins with open and thorough conversations about how people process the world differently. She deeply aspires to become an educator to ensure that students of all cognitive profiles have equitable opportunities to learn and thrive.

Ellie Aghayeva (she/her) is pursuing a degree in Neuroscience and Political Science at Columbia University, motivated by a deep interest in how neurological processes shape political behaviors, ideologies, and international conflict. Through her interdisciplinary lens, she explores the impact of cognitive biases and neural mechanisms on global politics. At The Living Lab, she employs advanced eye-tracking methods to investigate how concurrent demands on visual mental imagery and working memory affect cognitive performance. Committed to inclusive education, Ellie founded a digital platform offering accessible, specialized academic resources to thousands of students globally. Her advocacy for equitable learning opportunities inspired her to join this neurodiversity-focused book project, where she aims to promote greater understanding and acceptance of diverse cognitive experiences across educational and societal contexts.

What to Read Next

Alan Kendle
Aphantasia: Experiences, Perceptions, and Insights.
Dark River, 2017.

"Close your eyes and picture a sunrise. For the majority of people, the ability to visualize images – such as a sunrise – seems straightforward, and can be accomplished 'on demand'. But, for potentially some 2% of the population, conjuring up an image in one's mind's eye is not possible; attempts to visualize images just bring up darkness.
Although identified back in the 19th century, Aphantasia remained under the radar for more than a century, and it was not until recently that it has been rediscovered and re-examined. It has become clear that Aphantasia is a fascinating and often idiosyncratic condition, and typically more complex than the simple absence of an ability to visualize. People with the condition – Aphants – commonly report effects upon their abilities to recreate sounds, smells and touches as well; many also struggle with facial recognition. Paradoxically, many Aphants report that when they sleep, their dreams incorporate colour images, sound, and the other senses.
Put together by lead author Alan Kendle – who discovered his Aphantasia in 2016 – this title is a collection of insights from contributors across the world detailing their lives with the condition. It offers rich, diverse, and often amusing insights and experiences into Aphantasia's effects. For anyone who wishes to understand this most intriguing condition better, the book provides a wonderful and succinct starting point."

Ned Block

The border between seeing and thinking.

Oxford University Press, 2024.

“Philosopher Ned Block argues in this book that there is a "joint in nature" between perception and cognition and that by exploring the nature of that joint, one can solve mysteries of the mind. The first half of the book introduces a methodology for discovering what the fundamental differences are between cognition and perception and then applies that methodology to isolate how perception and cognition differ in format and content. The second half draws consequences for theories of consciousness, using results of the first half to argue against cognitive theories of consciousness that focus on prefrontal cortex. Along the way, Block tackles questions such as: Is perception conceptual and propositional? Is perception iconic or more akin to language in being discursive? What is the difference between the format and content of perception, and do perception and cognition have different formats? Is perception probabilistic, and if so, why are we not normally aware of this probabilistic nature of perception? Are the basic features of mind known as "core cognition" a third category in between perception and cognition? This book explores these questions not by appeals to "intuitions," as is common in philosophy, but to empirical evidence, including experiments in neuroscience and psychology.”

Adam Zeman

The Shape of Things Unseen: A New Science of Imagination.

Bloomsbury Publishing, 2025.

“A compelling insight into how our imagination works, based on the latest scientific research. People often think of imagination as something used only in creative endeavours. In fact, we use imagination constantly as we reminisce, anticipate, plan, daydream, read, create imagined worlds.”

Temple Grandin

Visual thinking: The hidden gifts of people who think in pictures, patterns, and abstractions.

Penguin, 2023.

"Do you think in pictures, patterns or words?
In a world engineered for the verbal thinker, those of us with a visual brain can often be overlooked and underestimated. In this landmark book, international bestselling author and activist Temple Grandin transforms our understanding of how our brains are wired differently.
Bringing together cutting-edge research and her own experience as a visual thinker, Grandin reveals a ground-breaking new approach to revolutionizing modern structures such as education, health and media so that they equally serve people with all kinds of minds. Visual Thinking is a perspective shifting book that will open our eyes to the value of a life in picture."