Learning to Imagine
To Carina
I can’t imagine a better sister
Contents

1 Our Unimaginative Imagination 1

PART I: Expanding Imagination by Example 23

2 Testimony 25
3 Tools 50
4 Anomalies 74

PART II: Expanding Imagination by Principle 97

5 Science 99
6 Mathematics 120
7 Ethics 144

PART III: Expanding Imagination by Model 167

8 Pretense 169
9 Fiction 193
10 Religion 220
11 Reimagining Imagination 245
Learning to Imagine
Our Unimaginative Imagination

In *The Little Prince*, the narrator recounts a time in his youth when he drew a picture of a boa constrictor that had eaten an elephant. He proudly showed it to the grownups around him and asked if they were frightened, but they didn’t understand why they should be frightened of a hat. Frustrated by the grownups’ lack of imagination, he drew a picture of the boa as if it had been x-rayed so the elephant could be seen more plainly, but the grownups’ response was that he should put his drawings aside and pursue more useful skills like arithmetic and grammar.

When the narrator grew up, he kept his first drawing and used it as a litmus test to see who might view it properly, as an elephant-engorged boa. But his fellow grownups always described it as a hat, and when they did, he resolved never talk to them about snakes or forests or stars. “I would bring myself down to his level,” explains the narrator. “I would talk to him about bridge, and golf, and politics, and neckties. And the grownup would be greatly pleased to have met such a sensible man.”

The idea that children are imaginative but adults are not is a common theme in popular fiction. In *Peter Pan*, only children can go to Neverland and meet the fairies, pirates, and mermaids who live there. Grownups cannot “because they are no longer gay and innocent and heartless. It is only the gay and innocent and heartless who
can fly.”² In *Charlie and the Chocolate Factory*, only children are able to wrap their minds around Willy Wonka’s amazing inventions. Wonka is intent on leaving his factory to a child, rather than a grownup, because “a grown-up won’t listen . . . he won’t learn.”³ In *Mary Poppins*, only children are able to hear what the trees and the birds say, and only children are able to understand the language of the sun and the stars. “Do you really mean we won’t be able to hear that when we’re older?” asks one of the children. “You’ll hear all right,” explains Mary Poppins, “but you won’t understand.”⁴

In these stories, children are open to possibilities that elude the adult mind. They grasp extraordinary ideas that adults cannot fathom and have clever insights that adults do not appreciate. It’s a theme that resonates with everyday observation of children’s imaginative activities. Children play elaborate make-believe games with their toys and role-playing games with their peers. They build forts, assemble costumes, bake mud pies, and construct block towers. They create imaginary friends and chart imaginary worlds. They believe in fantastical beings, like Santa Claus and the Tooth Fairy, and they are convinced that magic is real. They are ardently curious about the way things work and keenly inventive in explaining why.

On closer inspection, though, many of these activities are more mundane than they first appear. Children spend most of their pretend play doing realistic things, like cooking and cleaning, and they eagerly abandon pretend play if allowed to do those things for real.⁵ Their homespun creations—forts, costumes, and the like—are usually replicas of adult artifacts, created to imitate the adult world rather than depart from it.

In fact, children prefer imitation to innovation in general. When playing games, they stick closely to the rules and are offended by anyone who might attempt to change them.⁶ When drawing pictures, they focus on ordinary objects and are baffled by the request to draw something that doesn’t exist.⁷ Some children do invent imaginary friends and imaginary worlds, but they are imaginary
in the sense that they don’t exist, not that they couldn’t. Imaginary friends behave a lot like real friends, and imaginary worlds are as rule-bound as the real world.⁸

Although children do believe in fantasy characters like Santa Claus and the Tooth Fairy, these beliefs are not spontaneous inventions; society colludes to convince children they are real.⁹ In the absence of such collusion, children are highly skeptical of extraordinary ideas. They claim that events that violate their expectations cannot happen in the real world, whether those events are magical or merely improbable.¹⁰ They deny, for instance, that a person could own a lion for a pet or wear shoes in the bathtub. Prompting children to imagine these events in their mind does not increase their willingness to accept them as possible, nor does providing children with an explanation for how the events might occur.¹¹ When children say that magic is real, it’s not because they think nothing is truly impossible; rather, it’s because many of the events they thought were impossible turn out to be real.¹²

And yes, children are curious, but they are most curious about things they largely understand. They explore the world in ways intended to confirm their expectations, not challenge them. When exploring a new object or situation, they repeat what they see others do, failing to discover anything they did not expect to discover.¹³ If they do discover something unexpected, such as a surprising feature of a tool or a surprising consequence of an action, they often ignore the discovery or write it off as unimportant.¹⁴ In the rare instance that children attend to an unexpected discovery, they may explain it in a creative fashion, but creative in the sense of unusual rather than insightful.¹⁵ Children rarely intuit novel causal principles on their own.¹⁶

Forty years of research on how people reason about novel possibilities reveals that the glorification of children’s imagination is misguided. Children are no more imaginative than adults. Quite often, they are less imaginative. Children have the capacity to contemplate hypothetical ideas and counterfactual events, but they do
not have the knowledge or expertise to use that capacity as effectively as adults.

The problem is that our imaginations are firmly anchored in the status quo. People of all ages, adults included, have difficulty contemplating alternatives to reality that differ by more than a few details. If, for instance, we are asked to draw an imaginary animal, we usually draw a real animal and then add an extra feature, like an extra eye or an extra limb. If asked to finish a fictional story, we default to commonplace endings and ignore more creative options.18

We struggle to apply familiar tools to novel problems, fixating on what we know the tools are for, and we struggle to apply novel tools to familiar problems, overlooking their relevant affordances.19 We rarely see how a problem-solving strategy illustrated in one context could be of use in any other.20 We stick with hypotheses for why something happened even after they’ve been refuted, and we have difficulty entertaining more than one hypothesis at a time.21

New technologies are dismissed as unsafe, and new scientific discoveries are dismissed as unreliable.22 We fail to discern better ways of making a calculation if we have a method that suffices.23 And we fail to appreciate ethical or legal principles that challenge our understanding of everyday morality.24

There is room for innovation in everything we do—cooking, cleaning, writing, drawing, navigating, negotiating—but we rarely innovate. We stick with what we know, making small adjustments to fit the situation but no revolutionary changes. Such changes require sustained effort and reflection. We have to acquire the right knowledge and cultivate the right habits of mind. Imagination, like any other faculty, can be developed and refined, and this book tells the story of how.

Imagination’s Purpose

What is imagination? What is it for? Our stereotype of imagination is well captured by a 2020 commercial for Adobe software. The
commercial showcases Adobe’s image-editing features by cycling through a series of eye-popping pictures, including a mermaid hugging a teddy bear, a child riding a cloud, a whale swimming over a sunken city, and an astronaut discovering a flower on a distant planet. The pictures blend into one another with splashes of color and shifts of perspective, keeping beat with the song “Pure Imagination” from the movie *Charlie and the Chocolate Factory* (1971). “Come with me, and you’ll be in a world of pure imagination,” goes the song. “We’ll begin with a spin, traveling in the world of my creation. What we’ll see will defy explanation.”

This commercial implies that imagination is for creating rule-bending, mind-blowing ideas. But is that what imagination is really for? Did imagination evolve so we could paint pictures of
mermaids hugging teddy bears and write stories about children riding clouds?

Certainly not. Imagination evolved for planning and predicting, not innovating. Every time we entertain a thought that transcends what we are currently perceiving, we are using imagination. Thinking of mermaids requires imagination but so does thinking of past vacations, distant friends, or future meetings. Almost all mental life requires traveling beyond the here and now to contemplate what was, what will be, what might be, what should be, and what could have been. Planning your day requires imagination, as does planning your route, retracing your steps, deciding what to wear, rehearsing what to say, anticipating a response, estimating a value, remembering a joke, telling a story, telling a lie, or daydreaming.

Life is a series of problems—what to eat? where to go? who to ask?—and solving those problems requires entertaining multiple possibilities and then selecting the best option among them. The possibilities we entertain are inherently constrained by those we have already encountered. What we imagine ourselves doing in the future is usually some permutation of what we have done in the past.

The connection between remembering the past and forecasting the future runs deep, both developmentally and neurologically. Children who accurately remember what they did yesterday are more accurate at predicting what they will do tomorrow. Children who accurately recall how they performed a task in the past are better at predicting how they will perform that same task in the future under different circumstances. Thinking about the future recruits regions of the brain that are also involved in thinking about the past, such as the hippocampus. If those regions are damaged by an accident or a stroke, the result is not only amnesia for past events but also difficulty contemplating future events.

Contemplating future events is a prerequisite for intelligent, flexible behavior. It is a hallmark of human thought—but is not
exclusive to humans. It also characterizes the thought of other intelligent animals, such as scrub jays. Scrub jays are part of the corvid family, which includes crows, ravens, and rooks. When foraging, they hide excess food to retrieve at a later date. Scrub jays have excellent memories not only for where they have hidden their food but also for what they hid and when. They are particularly fond of worms, but these delicacies perish fast, so when scrub jays hide both worms and nuts, they return for the worms first. And if the first worm they retrieve has decayed, then they assume all the worms they’ve hidden have decayed and switch to retrieving nuts instead.

Imagination thus affords mental time travel. It allows us to move forward in time or backward in time or jump to another time line altogether. We can contemplate events that have happened, will happen, or did not happen but might have if the circumstances had been different. The latter are known as counterfactuals: the events that underlie our regret for lost opportunities, our relief at avoiding misfortune, and our surprise that events turned out one way rather than another. We contemplate counterfactuals not just because we enjoy exploring alternative time lines but because they help us learn more about our current time line so we might steer ourselves toward future successes and away from future failures.

Take, for instance, the goal of cooking a successful meal. When we discover that a meal we’ve cooked is not a success, we could throw up our hands and hope for the best next time, or we could do something more proactive: we could retrace our steps in the kitchen and attempt to pinpoint what went wrong. Were the ingredients fresh? Were they combined in the right order? Were they cooked for the right amount of time? We engage in this mental simulation effortlessly and spontaneously, but it requires some sophisticated accounting. We have to create several distinct models of reality—a model of what happened, a model of what we wanted to happen, a model of what we could have done differently, and a model of
what might have happened instead—and then coordinate those models to isolate the events we want to change in the future, the causal events.

There are other ways to identify causal events, such as cooking the same meal over and over again, with slight permutations, or consulting others who have cooked the same meal and then comparing their process to ours. These methods might prove useful, but they might also waste our time. Without speculating on the events that caused our cooking disaster, we could spend months comparing one meal preparation to another before hitting upon the critical difference between a successful preparation and an unsuccessful one. Counterfactuals let us tinker with reality without the hassle of producing or investigating real outcomes. Our counterfactual simulations may not always be accurate, but they help us narrow a vast space of possibilities within minutes rather than months.

Using counterfactuals to improve causal reasoning does not have to be instructed. This skill emerges on its own, early in development. Children as young as three recognize that a person with muddy shoes would not have muddied the floor if they had left their shoes outside. Slightly older children can discriminate between counterfactuals that would change the course of events from those that would not, acknowledging, for instance, that a person would not be cold if they had worn a jacket but would still be cold if they had worn a shirt of a different color.

A child’s ability to discriminate between effective and ineffective counterfactuals develops alongside their ability to explain why events happen. The better they can imagine how things might have been different, the better they can identify the causes of things that actually happened. Children who generate appropriate counterfactuals are also better at generating future hypotheticals, recognizing not just how past events could be altered but also how future events could be brought about, given the right circumstances.
Space, time, and causation are all manipulable within the workspace of imagination. But the utility of such manipulations has its limits. Counterfactuals that alter too many facts will no longer be informative. Goals that depart too far from current circumstances will no longer be achievable. And predictions that stray too far from prior outcomes will no longer be correct. Imagination may have evolved for contemplating alternatives to reality, but we use it most naturally to contemplate close alternatives, like preparing a different meal, rather than far alternatives, like riding on clouds. In fact, the alternatives we most commonly consider hew so close to reality that we do not think of them as products of imagination. When we use imagination to contemplate far alternatives—to innovate or fabricate—we’re not tapping into an innate appreciation of the extraordinary; we’re coopting a tool designed to explore the ordinary.

Imagination’s Structure

Imagination is limited in scope because it is limited in structure. When contemplating alternatives to reality, we manipulate some dimensions but fail to consider many others. We fixate on possibilities that are physically plausible, statistically probable, socially conventional, and morally permissible. When told about possibilities that violate such regularities, we usually balk at their suggestion, denying they could happen. Our ideas about what could happen are firmly rooted in what we expect to happen.37

Imagine, for instance, you’re at a restaurant and the diner next to you discovers a fly in his soup. What might he do next? You would expect him to ask the waiter for a new bowl of soup or possibly leave the restaurant. You wouldn’t expect him to eat the soup with the fly in it or pull a new, uncontaminated bowl from under the table. You also wouldn’t expect him to swap his bowl for his date’s when she is in the bathroom or recite an incantation over the bowl.
to remove the fly by magic. What’s more, the events you expect to happen are the only events you entertain. You don’t imagine the diner pulling a fresh bowl of soup from under the table and then dismiss the possibility as unlikely—you don’t entertain that possibility at all.

Of course, you shouldn’t entertain such possibilities, at least not when navigating real-world situations. They would only interfere with proper decision making. The eighteenth-century philosopher Count Buffon called highly improbable outcomes “morally impossible” in the sense that we are obliged not to consider them. But this mindset, when applied broadly, conflates possibility with probability. We only consider what’s probable as possible, either when generating ideas or when considering the ideas of others.

This mindset is most apparent in young children, who are quick to dismiss the unexpected as impossible. For example, in one study four-year-olds were told about commonplace problems and asked to contemplate various solutions to those problems, some more unusual than others. One of the problems was about a girl named Melissa who didn’t like to go to school because she missed her mother too much. What could Melissa do to solve her problem? Could she and her mother agree to do something special after school to take her mind off her worries? Could she wear her pajamas to school for comfort? Could she bring her mother to school to attend classes with her? Could she lie to her mother and tell her that school is closed today so she doesn’t have to go? Could she snap her fingers and make it Saturday so school is actually closed?

Four-year-olds thought only the first solution (the afterschool treat) could happen in real life; the rest were judged impossible. Children claimed not only that these events could not occur in real life but also that it would take magic to make them happen.

Changing the day of the week is of course impossible, but the other solutions are not. There are reasons why a student might not want to wear pajamas to school or bring her mother to school or
lie to her mother about school being closed, but these reasons do
not preclude the events from occurring. Children’s earliest intuitions
about possibility conflate what could happen with what should
happen. Children are not confused about possibility itself; they rec-
ognize that multiple outcomes are possible in most situations and
that low-probability outcomes are different than zero-probability
outcomes. Still, they tend to mistake reasons why events do not
occur for reasons why they could not occur.

Adults recognize that improbable, unconventional, and immoral
events are possible, but we too conflate these distinctions when
making snap judgments. If given only a couple of seconds to decide
whether an action is possible, adults judge immoral actions and
unconventional actions as impossible, just like children. Our judg-
ments of possibility converge with our judgments of probability
and permissibility the less time we have to reflect. We claim not just
that lying to your mother is wrong but that a person couldn’t lie
to their mother, despite many observations (and personal experi-
ences) to the contrary.

 Wouldn’t, shouldn’t, and couldn’t are distinctions that require
learning and reflection; they are not inherent features of imagi-
nation. As further illustration, consider the following riddle: “A
young woman attends her mother’s funeral. At the funeral, she
meets a man she doesn’t know. She discovers that he is amazing
and falls in love with him immediately. But she forgot to ask for his
name or number and afterward could not find anyone who knew
who he was. A few days later, the woman kills her own sister. Why
did she do it?”

This riddle has been circulated on the internet as a test for psy-
chopathy, as only psychopaths would infer that the woman killed
her sister in the hope of meeting with her love interest at another
family funeral. The reasoning is that if he appeared at her mother’s
funeral then he might appear at her sister’s funeral as well. This test
is apocryphal—it doesn’t actually diagnose psychopathy—but its
perceived credibility highlights how notions of possibility are constrained by notions of permissibility. The average person does not entertain the possibility of murdering a sibling for instrumental reasons and then reject it on moral grounds; we never entertain such a possibility at all.

It may be good that imagination steers clear of immorality, but it’s not so good that it steers clear of unconventionality and improbability as well. The improbable event of traveling faster than a horse was once considered impossible, as was traveling by air or traveling into space.\(^4^2\) Before the advent of trains, planes, and rocket ships, there were good reasons to think that people could travel only so far and only so fast. But these reasons were empirical, not logical. They could be altered, and they were. Imagination, on its own, lumps the improbable with the impossible, but we can coordinate imagination with other faculties—namely, knowledge and reflection—to disentangle the two. Unstructured imagination succumbs to expectation, but imagination structured by knowledge and reflection allows for innovation.

**Expanding Imagination**

The focus of this book is on how we discover new possibilities, be it new technologies, new scientific principles, or new ethical commitments. Imagination is necessary for these discoveries but not sufficient; knowledge is required as well. Einstein famously quipped that “imagination is more important than knowledge,” but the two are not distinct. Quite the opposite, they are intrinsically linked.\(^4^3\) Knowledge supports imagination by providing the raw materials for generating alternative possibilities. You have to represent reality before you can tinker with it, to know the facts before you can entertain counterfactuals. But knowledge also impedes imagination by limiting the scope of our investigation, leading us to false starts or down blind alleys.
As an illustration, try your hand at the Remote Associates Test, which is commonly used to measure creativity. In this test, you’re given three words and must find a fourth word that can be combined with each to form a compound word or phrase. What word, for instance, can be combined with “house,” “guard,” and “hot”? “Safe” can be combined with “house” to make “safe house” and with “guard” to make “safeguard,” but it can’t be combined with “hot;” “safe hot” and “hot safe” are not valid compounds. What word can be combined with all three?

This task, which is hard, is made even harder by considering a nonstarter solution like “safe.” We fixate on “safe” and are unable to consider alternatives. To solve this task, we need to clear our mind of “safe” but not clear our mind completely. The solution won’t surface on its own. Rather, we have to identify options that work for one word and then apply that option to the others. Focusing on “house,” we can come up with several candidates: “tree” as in tree-house, “boat” as in boathouse, or “white” as in White House. But these candidates don’t work when tested against the other words: “tree” doesn’t pair with hot or guard; “boat” pairs with guard but not hot; and “white” pairs with hot but not guard.

The solution—“dog,” as in “doghouse,” “guard dog,” and “hotdog”—is discovered by actively consulting our knowledge of compound words. We cannot solve this problem if we do not know enough compound words or if we do not access them in a useful manner. The same is true for any other task that requires coordinating multiple possibilities. We must consult some knowledge base—animal facts, historical events, product designs, cooking procedures, painting styles, mathematical operations—and we must consult it purposefully and productively. What we know and how we know it provide the foundation for what we can imagine.

In this way, knowledge acts a double-edged sword. It hampers imagination when it leads us to search for solutions where none can be found, but it facilitates imagination by allowing us to change
course and search somewhere else. The psychologists Douglas Hofstadter and Emmanuel Sander have likened the relation between imagination and knowledge to that of a train and a track. The track constrains where the train might go but is necessary for the train to move at all. If we wish to move the train in a new direction, then we should lay down new tracks, not destroy the tracks that already exist. Trains can switch tracks, after all.

Building on that metaphor, we can think of knowledge as a familiar path through a landscape of ideas. This path guides imagination from one idea to the next but does not wholly constrain it; imagination can be used to extend the path itself, breaking new ground by contemplating new possibilities. This book is organized in terms of how we break that ground—how we expand the scope of imagination by contemplating three types of possibilities: examples, principles, and models.

Expanding imagination by example is learning about a possibility precluded by our own imagination but realized by the imaginations of others, including new possibilities conveyed through testimony (chapter 2), technology (chapter 3), and empirical discovery (chapter 4). Expanding imagination by principle is generating a new collection of possibilities from an abstract schema, including such schemas as scientific principles (chapter 5), mathematical principles (chapter 6), and ethical principles (chapter 7). Expanding imagination by model is learning about familiar possibilities by immersing ourselves in a world of alternative possibilities, including pretense (chapter 8), fiction (chapter 9), and religion (chapter 10).

Examples are the simplest way to expand imagination. Rather than toil to discover new ideas, we take advantage of ideas already discovered by someone else. When we hear of an event that others have witnessed, interact with a technology that others have invented, or learn of a discovery that others have made, we are immediately transported to a new location in the landscape of ideas, often far from the path we’ve been traveling. The challenge for imagination
is returning to that familiar path—foraging a connection between what we have learned and what we already know.

Some people are more successful at this task than others. The more we’ve explored a landscape, the easier it is to add a new possibility to it. Conversely, the less we’ve explored a landscape, the easier it is to give up and reject the new possibility outright. The chapters in the first section of this book will outline strategies people use to connect new possibilities to prior knowledge, beginning with children’s strategy of simply denying the possibility of anything unexpected.

Learning new principles is a more powerful way of expanding imagination, as principles are more abstract and more generative than solitary examples. Learning that dolphins are mammals may challenge our understanding of marine life, but learning the principle of common descent challenges our understanding of all living things, dolphins included. Learning that snow boots are more expensive in winter may shed light on the pricing of seasonal apparel, but learning the principle of supply and demand sheds light on the pricing of all products, from snow boots to snow cones.

Examples pluck us from a familiar path within the landscape of ideas and transport us to a new location, but principles provide us with the tools for extending the path ourselves. It’s the difference between being air-dropped into a jungle and being given a machete to hack our way through. Principles yield many cognitive benefits, but they also impose costs. Principles can take months to learn and years to apply, and their application can block the application of other, more appropriate principles. Everything looks like a nail to those with a hammer. On balance, though, principled knowledge is far superior to unprincipled knowledge in generating new ideas.

Models, like principles, are another means of expanding imagination more powerful than examples. A model is a simplified version of reality that can be manipulated in ways that reality cannot. We learn from models by intervening on them—tweaking a condition,
adding a parameter, or suspending an assumption—and then watching how their operations unfold. Models are substantively different from examples and principles because they allow us to simulate reality, not just represent it. Simulations reveal the unknown consequences of our beliefs and suggest new means for achieving our goals.

Models abound in all areas of thought, including those covered in the chapters on math, science, and technology, but the chapters in the final section of this book will focus on models of an experiential nature: pretend play, fictional narratives, and religious cosmologies. Sometimes we create our own models, and sometimes we inherit models from others. Either way, learning from a model is not child’s play. It takes skill and effort to learn more from a model than what we already know.

In covering different mechanisms for expanding imagination, this book will also cover different forms of imagination, including historical imagination, technological imagination, mathematical imagination, and moral imagination. Each form has its own conceptual foundations and its own developmental trajectory. Mathematical imagination is grounded in the logic of space and quantity and develops through the discovery of new numbers and operations. Moral imagination, on the other hand, is grounded in interpersonal relations and develops through the discovery of new obligations and permissions. Differences in content from one domain to another lead to differences in how we contemplate new possibilities, from the information we recruit, to the obstacles we face, to the support we require.

Our focus, throughout the book, will be on ideas rather than events. Contemplating how life might be different if we had pursued more education is an act of imagination, but it is personal and subjective, grounded in the details of one’s own experience. This book will focus on possibilities of a more objective nature, grounded in collective knowledge and relevant to anyone.
Index

abacus, 142–143
accidental harm, 148–152, 256
affirming the consequent, 189–190
afterlife, 224–225, 233–238, 252
air travel, 50–51, 112
alternative explanations, 88
amnesia, 6
analogical learning, 112–113
analogy, 111–116
anomalies: discounting of, 79–81; in history of science, 75–77; neglect of, 81–82; relation to awe, 91–95; relation to explanation, 86–88; social, 45–48
anthropomorphism, 223–230, 252
arithmetic, 124, 137, 142
artificial intelligence, 259–261
atomic structure, 111
attempted harm, 148–152, 256
autism, 64, 151
awe, 91–95
baptism, 231
Beatles, The, 263
Bible, The, 236, 244
Blade Runner, 258
Boy Scout pledge, 146
brain imaging, 42, 84, 93, 151, 232
brainstorming, 190, 243, 262–263
Brooklyn, 99, 191
Candide, 154
candle problem, 68
cardinality, 127–130
causality: appeals to, 242–243; expectations about, 199–202; focus on, 102, 110; forms of, 104–106, 116; in science learning, 102–104. See also counterfactuals
children’s fiction, imagination in, 1–2, 5
chimpanzees, 58, 63, 72, 90
chirality, 140–142
Christianity, 220–221, 224–229, 231–234, 242
claims, evaluation of, 26–28, 36–38
Clifford the Big Red Dog, 197, 215
climate change, 109–110
coexisting concepts, 229–230
continental drift, 75–76

counterfactuals, 3, 12, 18, 190, 194, 248, 267; causal inference from, 7–9; as premises, 189–190
counting, 127–130, 136
count list, 129–131
covariation analysis, 82–84, 107–108
creative generation tasks, 66–67, 176–179
creativity, 13, 17, 20, 59, 119, 261–262, 265–266
cultural evolution, 70–71
cultural ratcheting, 71–73
curiosity, 38, 56, 91–95

Darwin, Charles, 100
Dawkins, Richard, 29
daxing, 184–186
death, understanding of, 233–235
decimals, 132–136
decoupling, 191, 194, 218
design fixation, 67
diffusion chain, 72–73
dinosaurs, 79–80, 255, 258
direct instruction, 85, 183
discovery learning, 20; failures of, 84–85, 182; successes of, 85, 183

Disney, Walt, 202
divine beings: Allah, 226, 228; ancestors, 225; angels, 220–223; Ganesha, 226, 228; Krishna, 226, 228; Muhammad, 226, 228; nature spirits, 225; Satan, 223. See also God
divinity, 224–225, 229, 252
division, 123, 126, 133–137

Dune, 208, 219

East-West comparisons, 154, 173, 202, 234, 237
Einstellung, 65–66, 73
Electric Field Hockey, 182–183
emergence, principle of, 104–105
emotion-based decisions, 146, 164
emotions, identifying, 210–211
episodic knowledge, 6–8, 25–26
epistemic vigilance, 27–28
equality, 158–162
equity, 158–162
estimation, 128
events: impossible, 30–31, 34–38, 244; improbable, 34–40, 43–44, 261; magical, 31–32, 199, 204, 251; unconventional, 44–47; unexpected, 31, 36–37, 46, 88, 264

Darwin, Charles, 100
Dawkins, Richard, 29
daxing, 184–186
death, understanding of, 233–235
decimals, 132–136
decoupling, 191, 194, 218
design fixation, 67
diffusion chain, 72–73
dinosaurs, 79–80, 255, 258
direct instruction, 85, 183
discovery learning, 20; failures of, 84–85, 182; successes of, 85, 183

Disney, Walt, 202
divine beings: Allah, 226, 228; ancestors, 225; angels, 220–223; Ganesha, 226, 228; Krishna, 226, 228; Muhammad, 226, 228; nature spirits, 225; Satan, 223. See also God
divinity, 224–225, 229, 252
division, 123, 126, 133–137

Dune, 208, 219

East-West comparisons, 154, 173, 202, 234, 237
Einstellung, 65–66, 73
Electric Field Hockey, 182–183
emergence, principle of, 104–105
emotion-based decisions, 146, 164
emotions, identifying, 210–211
episodic knowledge, 6–8, 25–26
epistemic vigilance, 27–28
equality, 158–162
equity, 158–162
estimation, 128
events: impossible, 30–31, 34–38, 244; improbable, 34–40, 43–44, 261; magical, 31–32, 199, 204, 251; unconventional, 44–47; unexpected, 31, 36–37, 46, 88, 264

Evolution, 99–101, 109–110, 249
event examples, 14–15, 18, 66–67, 115–116, 177, 254–255
expectations, 3, 21, 32, 43–44, 82–85, 198–202, 248–251
expertise, 106, 117–119, 263–264
exploration: of conceptual possibilities, 19–20; in contrast to exploitation, 57, 252–253; in play, 180–183; self-directed, 84–85; triggered by curiosity, 92–93

failures of imagination, 2–4, 39, 245–247, 262
fairness. See equity
faith frame, 238–241
false belief task, 150–151
fandom, 197–198
fantasy characters: Cinderella, 42, 203; Easter Bunny, 29; Santa Claus, 2–3, 29–30, 37–38, 248; SpongeBob