THE GARDENER AND THE CARPENTER

What the New Science of Child Development Tells Us about the Relationship Between Parents and Children

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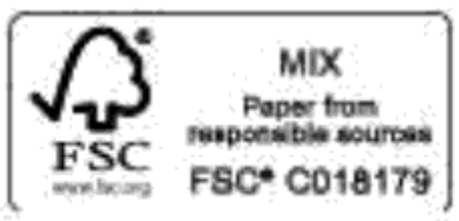

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Introduction: The Parent Paradoxes

Why be a parent? Taking care of children is demanding and exhausting, and yet for most of us it is also profoundly satisfying. Why? What makes it all worthwhile?

A common answer, especially for middle-class fathers and mothers today, is that you are a parent so that you can do something called "parenting." "To parent" is a goal-directed verb; it describes a job, a kind of work. The goal is to somehow turn your child into a better or happier or more successful adult—better than they would be otherwise, or (though we whisper this) better than the children next door. The right kind of parenting will produce the right kind of child, who in turn will become the right kind of adult.

Of course, people sometimes use the word "parenting" just to describe what parents actually do. But more often, especially now, "parenting" means something that parents *should* do. In this book, I'll argue that this prescriptive parenting picture is fundamentally

misguided, from a scientific, philosophical, and political point of view, as well as a personal one. It's the wrong way to understand how parents and children actually think and act, and it's equally wrong as a vision of how they should think and act. It's actually made life worse for children and parents, not better.

The parenting idea is so pervasive and seductive that it might seem self-evident, incontrovertible, and obvious. But at the same time that parents, most definitely including the parent writing this book, feel the pull of the parenting model, they also feel, often in an inchoate way, that there is something wrong about it. We simultaneously worry that our children are not doing well enough in school, and that they are suffering from the pressure to make them do well in school. We compare our children with the children of our friends and then feel despicable for doing it. We click on the latest headline praising or attacking some new parenting prescription and then say, perhaps a little too loudly, that we are actually just going to act on instinct after all.

Working to achieve a particular outcome *is* a good model for many crucial human enterprises. It's the right model for carpenters or writers or businessmen. You can judge whether you are a good carpenter or writer or CEO by the quality of your chairs, your books, or your bottom line. In the parenting picture, parenting follows the same model. A parent is a kind of carpenter; however, the goal is not to produce a particular kind of product, like a chair, but a particular kind of person.

In work, expertise leads to success. The promise of parenting is that there is some set of techniques, some particular expertise, that parents could acquire that would help them accomplish the goal of shaping their children's lives. And a sizable industry has emerged that promises to provide exactly that expertise. Some sixty thousand books are in the parenting section on Amazon, and most of them have "How to" somewhere in the title.

Many of the parenting how-to books, of course, simply give practical advice about being a parent. But many more promise that if parents just practice the right techniques, they can make a substantial difference in the way their child turns out.

The parenting model isn't just something you find in how-to books, though. It shapes how people think about children's development in general. I'm a developmental psychologist—I try to figure out what children's minds are like and why they are like that. Even so, practically everyone who has ever interviewed me about the science of childhood has some question about what parents should do, and what the long-term effect of what they do will be.

The parenting idea is also a major source of grief for parents—especially mothers. It helps fuel the never-ending "mommy wars." If you accept the idea that parenting is a kind of work, then you must choose between that kind of work and other kinds of work (such as, for example, work). Mothers in particular become endlessly defensive and conflicted about whether it is possible to both successfully parent and successfully work at other jobs, and they feel forced to choose between de-emphasizing the importance of motherhood and forgoing their careers. But the same dilemmas affect fathers, all the more intensely because they are less acknowledged.

Partly as a result there is a countervailing impulse to devalue the importance of being a parent—hence all the wry memoirs in which women self-consciously confess to their ambivalence about motherhood. After all, if being a parent is a kind of work aimed at creating a successful adult, it's a pretty lousy job—long hours, nonexistent pay and benefits, and lots of heavy lifting. And for twenty years you have no idea if you've done it well, a fact that in and of itself would make the job nerve-racking and guilt-inducing. But if it isn't a kind of work, why do we do it? If the point is not to create a particular kind of adult, what is the point?

I'm one of those anxious, middle-class working parents myself, and all my life I've felt both the pull of the parenting model and the reaction against it. My three sons are all grown up, reasonably happy and successful, and starting to have children of their own. But I have also found myself perpetually assessing my responsibility—or should that be credit?—for the ups and downs of their lives. Was I overprotective when I walked my youngest son to school every day when he was eight years old? Or was I neglectful when I didn't do the same when he turned nine? I wanted my children to follow their own paths and discover their own gifts. But should I have insisted that my oldest child finish college instead of trying to become a musician? I believed—and still do—that good public schools are best for all children. But when my older kids were suffering at the local public high school, should I have sent them to a fancy private school in the suburbs, as I did with my youngest son? Should I have forced my youngest to turn off the computer and read, or should I have let him master coding? How could I have made sure that my "gifted" middle child had lots of free time to play, and did his homework, and at the same time went to an advanced math tutor and ballet classes? Hardest of all, I got divorced when my youngest child finished high school. Should I have done it sooner or later or not at all?

My professional expertise and knowledge about development has brought me no closer to answers than anybody else. Looking back on my nearly forty years as a parent, I suspect the best answer is that these are just the wrong questions.

Reflecting on your own experience as a parent may make you skeptical about parenting. But reflecting on other parents and children makes the parenting model look unsatisfactory, too. After all, the members of my generation, the happily cocooned and prosperous baby boomers, aren't actually a dramatic improvement on our Greatest Generation parents who grew up in the

miseries of depression and war. And we all know people with terrible childhoods who grow up to become wonderful grown-ups and loving parents themselves, and good parents who end up with tragically unhappy children.

The most telling, heartbreaking counter to the parenting model comes when we think about the parents of children who will never reach adulthood. In 2011, Emily Rapp wrote an immensely moving and much circulated article about her son, Ronan, who she knew would die of Tay-Sachs disease before he turned three. That made no difference to the intensity of the love she felt for him. Her son would never become an adult at all, and yet we feel that Emily Rapp and others like her are the most profound examples of what it means to be a parent.

Is it important to figure out why being a parent is worthwhile? Worrying about parents and children is often relegated to the Lifestyle section and the Mommy blogs. But I'll argue in this book that, in fact, those everyday worries reflect genuine and deep aspects of the human condition itself—tensions that are built into who we are as human beings. From a biological point of view, our exceptionally long and helpless human childhood, and the enormous investment in children that goes with it, is a crucial part of what makes us human. What purpose does that investment serve? Why did it evolve?

Figuring out why being a parent is worthwhile isn't just a personal or biological question, but a social and political one, too. Caring for children has never, in all of human history, just been the role of biological mothers and fathers. From the very beginning it's been a central project for any community of human beings. This is still true. Education, for example, is simply caring for children broadly conceived.

As with other social institutions, the way that we care for children has changed in the past and will continue to change in

the future. If we want to make good decisions about those changes, we need to think deliberately about what caring for children is all about in the first place. What should preschool look like? How can we reform public schools? Who gets to make decisions about a child's welfare? How should we deal with new technologies? Caring for children is a political subject as well as a scientific and personal one, and the tensions and paradoxes emerge at greater as well as smaller scales.

There must be a way of thinking about children that goes beyond "how-to" on the one hand or wry memoir on the other. Taking the long view offered by science and philosophy might help. But I've recently become a grandmother, and maybe that view can give an even better perspective. Grandmothering provides a more empathetic kind of distance, both from the mistakes and triumphs of the young mother you once were (who couldn't tell the two apart at the time) and from the struggles of your own children.

So this book will be the work of a grandmother as well as a scientist and philosopher—a bubbe, as my own Jewish grandmother would have said—but a bubbe at Berkeley, a grandmother who runs a cognitive science laboratory and writes philosophy papers in between telling stories of the olden days and making blueberry pancakes. Grandmother scientists and philosophers have been rather thin on the ground in the past, so perhaps combining both perspectives can help us understand the value of being a parent in a way that takes us beyond parenting.

From Parenting to Being a Parent

If parenting is the wrong model, what's the right one? "Parent" is not actually a verb, not a form of work, and it isn't and shouldn't

be directed toward the goal of sculpting a child into a particular kind of adult. Instead, to be a parent—to care for a child—is to be part of a profound and unique human relationship, to engage in a particular kind of love. Work is central to human life; we couldn't do without it. But as Freud and Elvis both remarked, apocryphally at least, work *and* love are the two things that make life worthwhile.

The particular love that goes with caring for children is not just restricted to biological mothers and fathers, but includes all the people whom academics call caregivers and the British, more elegantly, just refer to as carers. It's a form of love that is not limited to biological parents, but is at least potentially part of the lives of us all.

We recognize the difference between work and other relationships, other kinds of love. To be a wife is not to engage in "wifing," to be a friend is not to "friend," even on Facebook, and we don't "child" our mothers and fathers. Yet these relationships are central to who we are. Any human being living a fully satisfying life is immersed in such social connections. And this is not only a philosophical truth about human beings, but one that is deeply rooted in our very biology.

Talking about love, especially the love of parents for children, may sound sentimental and mushy, and also simple and obvious. But like all human relationships, the love of children is at once a part of the everyday texture of our lives—ubiquitous, inescapable, and in the background of everything we do—and enormously complicated, variable, and even paradoxical.

We can aspire to love better without thinking of love as a kind of work. We might say that we try hard to be a good wife or husband, or that it's important to us to be a good friend or a better child. But I would not evaluate the success of my marriage by measuring whether my husband's character had improved in the

years since we wed. I would not evaluate the quality of an old friendship by whether my friend was happier or more successful than when we first met—indeed, we all know that friendships show their quality most in the darkest days. Nevertheless, this is the implicit picture of parenting—that your qualities as a parent can be, and even should be, judged by the child you create.

If being a parent, especially a parent of young children, is a pretty awful kind of work, it's a pretty great kind of love, at least for most of us. The love we feel for our young children and the love they feel for us is simultaneously unconditional and intimate, morally profound and sensually immediate. The most important rewards of being a parent aren't your children's grades and trophies—or even their graduations and weddings. They come from the moment-by-moment physical and psychological joy of being with this particular child, and in that child's moment-by-moment joy in being with you.

Love doesn't have goals or benchmarks or blueprints, but it does have a purpose. The purpose is not to change the people we love, but to give them what they need to thrive. Love's purpose is not to shape our beloved's destiny, but to help them shape their own. It isn't to show them the way, but to help them find a path for themselves, even if the path they take isn't one we would choose ourselves, or even one we would choose for them.

The purpose of loving children, in particular, is to give those helpless young human beings a rich, stable, safe environment—an environment in which variation, innovation, and novelty can blossom. This is true both from a biological and evolutionary point of view and from a personal and political one. Loving children doesn't give them a destination; it gives them sustenance for the journey.

The Paradoxes

So being a parent is simply about loving children. Except that love is never simple. Volumes have been thought, spoken, written, sung, and sometimes screamed about the paradoxes, complexities, and unique craziness of erotic love. Our love for children is just as intense, just as paradoxical and complex, just as uniquely crazy. But the discussion of relations between parents and children, particularly young children, is almost entirely confined to the how-to books or the memoirs.

In this book I'll focus on two kinds of paradoxes: paradoxes of love and paradoxes of learning. These paradoxes are built into the evolutionary nature of childhood itself. The parenting model just can't deal with them. They emerge when we think about childhood scientifically as well as personally. In fact, the most recent scientific research makes these paradoxes especially vivid.

But they aren't just abstract scientific and philosophical questions. They're instantiated in the real-life tensions and dilemmas that bedevil the lives of parents. And they're at the root of the difficult moral and political decisions that arise when we try to care for children as a society.

The Paradoxes of Love

The first dilemma comes from the tension between dependence and independence. Parents and other caregivers must take complete responsibility for that most utterly dependent of creatures, the human baby. But they must also transform that utterly dependent creature into a completely independent and autonomous adult. We start out feeding and changing diapers and phys-

ically holding our children most of the day, and doing all this with surprising satisfaction and even happiness. We end up, if we're lucky, with the occasional affectionate text message from a distant city. A marriage or friendship that was like either end of our lives as parents would be peculiar, if not down-right pathological. Children move from a dependence that is far greater than that of the neediest lover to an independence that is far greater than the most distant and detached one.

In the early part of a child's life we have more control over the details of their lives than they do themselves. Most of what happens to a baby happens through a parent or caregiver. But if I've been a good parent, I'll have no control at all over my child's adult life.

This tension becomes particularly striking during adolescence. Not only are our children independent and autonomous from us, they are also part of a new generation that is independent and autonomous from the previous one. Infancy and intimacy go together—we hold our babies close, literally and metaphorically. Our adult children are and should be foreigners—inhabitants of the future.

A second tension comes from the specificity of our love for children. I care about *my* children in a special way. We feel that the welfare of our own children is more important than just about anything else, even the welfare of other children or our own happiness. We can be—we even should be—ruthless about advancing it. Think about a poor mom in a terrible neighborhood who scrimps and saves to send her child to a good private school, a school out of reach for most of the other kids around. She's heroic, not selfish or foolish.

But it's a unique kind of heroism. The classical ways of thinking about politics and morality turn on the idea that moral and political principles should be universal. Fairness, equality,

justice—these ideas are supposed to apply to everybody. The very idea of a law, for example, is that some principle applies equally to all. But I care about and am responsible for my own specific children, far more than children in general. And so I should be.

Where does this specific commitment come from? It isn't just a matter of genetic affinity. Almost anyone who cares for a child will come to love just that specific, special miracle. How can we accommodate the dramatic specificity of our love for children within a broader politics of child-rearing? And what would this mean for public policy?

The Paradoxes of Learning

A second set of paradoxes concerns the ways that children learn from adults. In a world where schooling determines success, a lot of parenting focuses on getting children to learn more, learn better, and learn faster. The parenting model is also the default model for much of education. The idea is that adults teach children what they should know and so determine how they think and act. Again, the idea may seem obvious, but both science and history suggest otherwise.

A first paradox concerns play and work. It's a truism that children learn through play. But how do they do it, and why? By definition, play is an act of spontaneous exuberance that isn't designed to accomplish much of anything in particular. And yet the ubiquity of play in childhood suggests that it must be serving some special function.

In fact, just about everybody thinks that children should have time to play. But playtime is one of the first things to go when we start legislating children's lives. Recess is replaced by reading drills, and wall ball and hopscotch give way to soccer practice.

The parenting model gives us a long list of activities that children should do. From Mandarin classes to Kumon math practice to SAT prep, there simply isn't much time left over for kids to just play. We feel bad about it, but we don't quite know what to do.

Conventional moral and political systems are all about the stern and earnest business of human work. They are about how individuals and societies should think, plan, and act in order to accomplish particular goals. But children and childhood are all about play. Why do children play? And how should we value play, not only personally, but morally and politically, too?

Just as children must move from being the most dependent of creatures to the most autonomous ones, they must also move from being people who (mostly) play to people who (mostly) work. This transformation requires profound changes in children's minds and brains. Parents, caregivers, and teachers must somehow manage this transition in a way that both preserves the benefits of play and enables the benefits of work. Schools, the main institutions we use to manage this transition, arguably do a pretty terrible job on both fronts. Is it possible to do it better?

A second tension concerns tradition and innovation. The great twenty-first-century battle of the screens and the books is just the latest skirmish in a long war. We humans have always been caught between preserving the old and ringing in the new. This tension has gone on for a very long time—it isn't just a feature of our technological culture, but a part of our evolutionary program. Children have always, by their very nature, been on the front lines of that war.

Many moral and political views, particularly classical, conservative ones, emphasize the importance of preserving traditions and histories. Continuing a past cultural identity, placing yourself in a tradition, is a deep and satisfying part of human life. Caregivers pass on traditions just in the course of nurturing babies.

At the same time one of the basic functions of childhood is allowing for innovation and change. Indeed, paradoxically there would be no specific cultures and traditions to pass on if past human beings hadn't done something new. Without unprecedented new events there would be no history. By adolescence, children characteristically invent new ways of dressing, dancing, talking, and even thinking. How can we value and pass on our own culture and traditions, yet also allow and encourage our children to invent entirely new ones?

Science speaks to these paradoxes of love and learning, and I'll outline new scientific research that helps us understand just how love and learning work. Research in evolutionary biology is elucidating the origins of our love for children, and the ways that dependence and independence, the specific and the universal, play out in that love.

In cognitive science, there are new approaches to learning, and a new line of research about how children learn from the people who care for them. Even babies and very young children are sensitive to social norms and traditions and quickly adopt them from their caregivers.

But equally, one of the great discoveries of the past few years has been that even very young children can imagine new possibilities and consider new ways they themselves, or the world around them, could be. And new studies actually demonstrate and explain the ways that play contributes to learning.

In developmental neuroscience, we are starting to understand how young brains are different from old brains. And we are starting to understand how the transformation from early play-based learning to later, more focused goal-directed planning takes place neurologically.

All this scientific research points in the same direction: Childhood is designed to be a period of variability and possi-

bility, exploration and innovation, learning and imagination. This is especially true of our exceptionally long human childhood. But our remarkable human capacities for learning and imagination come at a cost. There is a trade-off between exploration and exploitation, learning and planning, imagining and acting.

The evolutionary solution to that trade-off is to give each new human being protectors—people who make sure that the child can thrive, learn, and imagine, in spite of being so vulnerable. Those protectors also pass on the knowledge that previous generations have accumulated. And they can provide each child with the opportunity to create new kinds of knowledge. Those protectors are parents, of course, but they are also grandparents and uncles and friends and caregivers. Human caregivers must both fiercely protect each individual child and give that child up when they become an adult; they must allow play and enable work; they must pass on traditions and encourage innovations. The parent paradoxes are the consequence of fundamental biological facts.

The Uniqueness of Childhood

I won't suggest a simple resolution to these paradoxes or a simple solution to the personal and political dilemmas that stem from them. There just isn't a simple way to deal with the transformation from profound dependence to equally profound independence. There is no formula to resolve the tension between the fact that we love just this one child but still have to make policy decisions about children in general. There is no simple algorithm to weigh the values of work and play, or of tradition and innovation.

But at least we can try to recognize these paradoxes and acknowledge that they go far beyond the scope of the usual parenting discussion. We need to go beyond thinking about whether

hallmark of good gardening. There are admittedly some kinds of gardening where the aim is a particular outcome, such as growing hothouse orchids or training bonsai trees. Those kinds of gardening demand the same sort of admirable expertise and skill as fine carpentry. In England, that land of gardeners, they use the term "hothousing" to refer to the kind of anxious middle-class parenting that Americans call helicoptering.

But consider creating a meadow or a hedgerow or a cottage garden. The glory of a meadow is its messiness—the different grasses and flowers may flourish or perish as circumstances alter, and there is no guarantee that any individual plant will become the tallest, or fairest, or most long-blooming. The good gardener works to create fertile soil that can sustain a whole ecosystem of different plants with different strengths and beauties—and with different weaknesses and difficulties, too. Unlike a good chair, a good garden is constantly changing, as it adapts to the changing circumstances of the weather and the seasons. And in the long run, that kind of varied, flexible, complex, dynamic system will be more robust and adaptable than the most carefully tended hothouse bloom.

Being a good parent won't transform children into smart or happy or successful adults. But it can help create a new generation that is robust and adaptable and resilient, better able to deal with the inevitable, unpredictable changes that face them in the future.

Gardening is risky and often heartbreaking. Every gardener knows the pain of watching that most promising of sprouts wither unexpectedly. But the only garden that didn't have those risks, that wasn't attended with that pain, would be one made of Astroturf studded with plastic daisies.

The story of Eden is a good allegory for childhood. We grow as children in a garden of love and care, a garden at its best so

rich and stable that, as children, we don't even recognize the work and thought that lie behind it. As adolescents we enter both the world of knowledge and responsibility and the world of labor and pain, including the literal and metaphorical labor pains of bringing another generation of children into the world. Our lives wouldn't be fully human without both phases—Eden and the Fall, innocence and experience.

Of course, although our young children often think we are omnipotent and omniscient, we parents are all too painfully aware that we utterly lack anything approaching divine power and authority. Still, parents—both literal, biological parents and everybody who cares for children—are both witnesses and protagonists of this most compelling part of the human story. And that makes being a parent worthwhile all by itself.

So our job as parents is not to make a particular kind of child. Instead, our job is to provide a protected space of love, safety, and stability in which children of many unpredictable kinds can flourish. Our job is not to shape our children's minds; it's to let those minds explore all the possibilities that the world allows. Our job is not to tell children how to play; it's to give them the toys and pick the toys up again after the kids are done. We can't make children learn, but we can let them learn.

1. Against Parenting

A curious thing happened to mothers and fathers and children in the late twentieth century. It was called parenting.

As long as there have been animals, there have been mothers and fathers and their young. And as long as they have been *Homo sapiens*, human mothers and human fathers, and others as well, have taken special care of children. "Mother" and "father" are as old as English itself, and "parent" has been around since at least the fourteenth century. But the word "parenting," now so ubiquitous, first emerged in America in 1958, and became common only in the 1970s.

Where did parenting come from? The parenting model has become particularly influential because of a series of distinctive social changes that took place in twentieth-century America, changes that made being—and especially becoming—a parent very different than it had ever been before. Smaller families, greater mobility, and older first-time parents radically altered the learning

curve. For most of human history, people grew up in large extended families with many children. Most parents had extensive experience of taking care of children before they had children themselves. And they had extensive opportunities to watch other people, not just their own parents, but grandmothers and grandfathers, aunts and uncles and older cousins, take care of children. Those traditional sources of wisdom and competence—not quite the same as expertise—have largely disappeared. Parenting how-to books, websites, and speakers are appealing because they seem to fill that gap.

At the same time that families got smaller and more scattered, and people had children later, middle-class parents spent more and more time working and going to school. Most middle-class parents spend years taking classes and pursuing careers before they have children. It's not surprising, then, that going to school and working are today's parents' models for taking care of children—you go to school and work with a goal in mind, and you can be taught to do better at school and work.

So there's a reason the parenting model is popular. But it's a poor fit to the scientific reality. From an evolutionary perspective, the relations between human children and the adults who care for them are crucially and profoundly important; indeed, they are a large part of what defines us as human beings. Our most distinctive and important human abilities—our capacities for learning, invention, and innovation; and for tradition, culture, and morality—are rooted in relations between parents and children.

These relations are profoundly important for human evolution. But they are fundamentally unlike the picture that is invoked by the word "parenting." Parents are not designed to shape their children's lives. Instead, parents and other caregivers are designed to provide the next generation with a protected space in which they can produce new ways of thinking and acting that, for better

or worse, are entirely unlike any that we would have anticipated beforehand. This is the picture that comes from evolutionary biology, and it is also the picture that comes from empirical studies of child development, like the ones we do in my lab.

This doesn't mean that parents and other caring adults have no influence on children. On the contrary, that influence is deep and necessary. Providing a safe, stable context that lets children thrive is important, not to mention hard. After all, being a parent, even a bad one, involves a greater investment of time, energy, and attention than any other human relationship, by a sizable margin. I say hello to my husband in the morning, leave him alone all day, cook him dinner, and spend an hour or two talking to him sympathetically in the evening. He does the same for me (and actually cleans up the kitchen, which is tougher than cooking). That makes me a pretty good wife, but it would be criminal child abuse if he were my literal, rather than metaphorical, baby. Caring adults don't just influence children's lives—without them, children wouldn't have lives at all.

But it is very difficult to find any reliable, empirical relation between the small variations in what parents do—the variations that are the focus of parenting—and the resulting adult traits of their children. There is very little evidence that conscious decisions about co-sleeping or not, letting your children "cry it out" or holding them till they fall asleep, or forcing them to do extra homework or letting them play have reliable and predictable long-term effects on who those children become. From an empirical perspective, parenting is a mug's game.

Those scientific facts might not matter, of course. Our human evolutionary inheritance crucially includes the ability to overthrow or revise that very inheritance. Even if parenting is a very recent cultural invention, it might be a good or useful one. Even if it is terribly difficult to do well, and only has marginal effects, we might

want to give up sushi or tortillas or frozen yogurt and return to my grandmother's overcooked brisket and bow ties—or our Pleistocene ancestor's roots and berries, for that matter. Nor would I give up breast pumps or my career as a scientist just because those possibilities didn't exist for previous generations.

In Praise of Mess

But if the details of caregiving don't actually determine how children turn out, why should we invest so much time, energy, and emotion—and just plain money—in raising our children? Why embark on such a demanding, difficult, and uncertain relationship at all?

This is both a personal and political question, and an evolutionary and scientific one. We might just say that evolution makes us care—our genes try to reproduce themselves. But then, why don't we simply become self-sufficient shortly after we are born, as many animals do? Why do children require so much intensive care? And why should adults provide that care if it doesn't make a predictable difference?

The central scientific idea of this book is that the answer lies in disorder. Children are incontrovertibly and undeniably messy. Whatever the rewards of being a parent may be, tidiness is not one of them. In fact, in the perpetual academic search for funding, I've wondered whether I could get the military to consider weaponizing toddler chaos. Unleash it on an opposing army, and they would hardly be able to get out of the house in the morning, let alone coordinate a battle.

Scientists have other words for mess: variability, stochasticity, noise, entropy, randomness. A long tradition, going back to the Greek rationalist philosophers, sees these forces of disorder as

the enemies of knowledge, progress, and civilization. But another tradition, going back to the nineteenth-century Romantics, sees disorder as the wellspring of freedom, innovation, and creativity. The Romantics also celebrated childhood; for them, children were the quintessential example of the virtues of chaos.

New science provides some ammunition for the Romantic view. From brains to babies to robots to scientists, mess has merits. A system that shifts and varies, even randomly, can adapt to a changing world in a more intelligent and flexible way.

Evolution by natural selection is one of the best examples of the merits of mess, of course. Random biological variation leads to adaptation. But biologists are also increasingly interested in the idea of "evolvability," that some organisms may be better than others at generating new alternative forms, forms that can then be preserved or abandoned by natural selection. There is some evidence that evolvability can itself evolve; some species may actually have evolved to produce more varied individuals.

For example, the bacteria that cause Lyme disease are very good at producing new variants that can resist antibodies—that's why Lyme disease is hard to treat. If you expose the bacteria to a lot of new antibodies, they become even more variable. The new potential defenses aren't necessarily effective against the particular antibodies attacking the bacteria now, but they make it more likely that the bacteria will survive another attack from different antibodies in the future.

Human beings produce a particularly wide, variable, and unpredictable mix of children, each with unique temperament and abilities, strengths and weaknesses, types of knowledge and varieties of skill. This provides us with the same kind of advantage as the "evolvable" Lyme bacteria. It lets us adapt to an unpredictable changing culture and environment.

Think about risk-taking. We know that from the time they are

very small, some children are timid while others are adventurous. Alexei, my oldest son, always got to the top of the jungle gym, but never went up a rung without checking that he had a way down again. Nicholas, my middle son, went hell-bent for the top without looking back. As for me, I wouldn't have gotten anywhere near those high rungs, in any circumstances.

The parents of a risk-taking child may live with their hearts in their mouths, with good reason. If risk-taking people really *are* more at risk, why wouldn't natural selection have eliminated those traits long ago? Alternatively, if the rewards outweighed the risks, why didn't the more timid children disappear?

When things are predictable, a more conservative, safety-first strategy will be more successful. When things change, risk-taking becomes important. The same strategies that once served you in the old environment will no longer do. And of course you can't tell in advance whether unpredictable change will happen—that's what makes it unpredictable.

So having a mix of people around, some timid and some adventurous, means that each individual person is more likely to survive. The conservative folk ensure that risk-takers get the advantage of security when things are predictable, and the bold allow the timid to get the advantages of innovation when things change.

Nicholas, the child who went straight for the top rung, ended up being very successful in a career where he has to make risky decisions involving millions of dollars—just thinking about it makes me anxious. My parenting certainly would never have had the goal of creating an adult with a life full of risk and uncertainty. But that turned out to be just the life for Nick.

Here's another example. Hunting was an important part of our evolutionary past. When you hunt, you need to pay attention to everything at once and remain constantly on the alert for even subtle changes in the environment. So you might think that back

when hunting was crucial to our survival, everybody would have developed those traits. People who just paid attention to one thing at a time and screened out everything else might have provided some other benefits, but they would have been less valuable overall.

However, people with this sort of focused attention turned out to be very valuable when circumstances changed. Once schooling, rather than hunting, became the dominant way of life, focused attention became an advantage. Now it's the children with a wide focus who have trouble adapting.

The Ideas That Die in Our Stead

There is still controversy about how evolvability works, and there is still a lot of scientific work to do to discover just how evolution produces variable creatures in response to variable environments. But there is no question that human learning and culture produce a kind of evolvability that works at much faster time scales than biological evolution.

Instead of waiting for natural selection to turn us into more well-adapted creatures, we adapt on our own by trying out many different pictures of the world (different theories), keeping the ones that fit the data and eliminating the ones that don't. The philosopher Karl Popper said that science lets our theories die in our stead.

This also applies to cultural progress. We can try out different pictures of what the world is like, but we can also actually try to make different kinds of worlds. We can do this either through new tools and technology or through new political and social arrangements—new laws, customs, and institutions. Then we can see which technologies and institutions help us thrive.

So the strategy for human success has two parts. We begin by generating many different possibilities, at least partly at random. Then we preserve the ones that work. However, we don't entirely eliminate the alternatives. Instead, we keep generating alternative possibilities to keep in reserve to deal with a new environment or an unexpected set of problems.

Exploring vs. Exploiting

This strategy has a weakness, however. As all parents know, there is an intrinsic tension between messiness and effectiveness; that's why weaponized toddler chaos would be so devastating. There is a trade-off between generating many alternatives that might be useful in the future and having a lean, mean, fast, efficient system right now. Computer scientists and neuroscientists call it the tension between exploration and exploitation.

Exploring possibilities, whether they are possible personalities, theories, technologies, or cultures, allows for innovation. It gives you alternatives in the face of a new environment. But, of course, you also have to act, right now, in this environment. Exploration won't help you then—you don't want to be considering all the options for dealing with a mastodon when one is barreling toward you. Great generals and executives don't think through every possible plan and pick the absolutely best one; they pick one that is good enough and execute it confidently and decisively. Even dithery scientists like me eventually have to choose from among all the possible experiments, and go ahead with just one.

One way to solve this problem is to alternate between periods of exploration and exploitation. A particularly effective strategy is to start out exploring, and then proceed to exploit. You begin

their surroundings; they do especially well in rich circumstances, but do especially badly in impoverished ones. They are more like orchids, flourishing with elaborate care and rich feeding, withering without them. So these children not only are different from one another—they also react differently to their surroundings.

Behavioral genetics researchers try to disentangle how genes and the environment contribute to development. They analyze the similarities and differences between identical and fraternal twins, among siblings, and between birth children and adopted children, and compare them with their parents. Twins, for example, are a kind of natural experiment in nature and nurture. But rather than discovering some simple partition of genes and environment, studies have shown just how complex and unpredictable the interactions between nature and nurture really are.

For one thing, children influence the way their parents behave as much as parents influence children. In fact, much of what looks like the effect of genes may really be the result of the way genes feed back on the environment. If you have a child with a small genetic tendency toward risk-taking, you will probably treat him very differently, even just unconsciously, than you treat his more timid brother, and that difference in nurture will greatly amplify the difference in nature.

One of the most striking findings concerns what is called the nonshared environment. If the parenting view was right, you might expect that siblings, who share most of their genes and also have the same parents, would be very similar to each other. In fact, behavioral geneticists find that siblings are much more different from one another than you would expect. The nonshared environment is simply a way of describing all the factors that influence children other than genes and the shared experiences they have as members of the same family, including parenting. Those factors may range from prenatal influences to epigenetic variation,