Chapter Two

what *is* play, and why do we do it?

what is play? i hate to say

What are we talking about when we talk about play? Though I have studied play for decades, I have long resisted giving an absolute definition of play because it is so varied. For one person, dangling hundreds of feet above the ground, held there by only a few callused fingers on a granite cliff face, is ecstasy. For someone else, it is stark terror. Gardening might be wonderful fun for some but a sweaty bore for others.

Another reason I resist defining play is that at its most basic level, play is a very primal activity. It is preconscious and preverbal—it arises out of ancient biological structures that existed before our consciousness or our ability to speak. For example, the natural tussling of sibling kittens just happens. In us, play can also happen without a conscious decision that, okay, I'm going to play now. Like digestion and sleep, play in its most basic form proceeds without a complex intellectual framework.

Finally, I hate to define play because it is a thing of beauty best

appreciated by experiencing it. Defining play has always seemed to me like explaining a joke—analyzing it takes the joy out of it.

I was forced out of this stance by Lanny Vincent, a colleague and friend who is an accomplished business consultant. Lanny and I were making a presentation to a group of Hewlett-Packard engineers, and shortly before I spoke, Lanny asked me what definition of play I planned to present.

I adopted my usual academic stance. "I don't really use an absolute definition," I said. "Play is so varied, it's preverbal, preconscious . . ."

Lanny was having none of it. "You can't go out there without a definition. These are engineers. They design machines. They munch on mountains of specs and wash them down with streams of data. If you don't have a definition they will eat you alive."

Lanny's portrayal of engineers as threatening technological Paul Bunyans was an exaggeration, of course, but he was basically right. Engineers are professional skeptics. To them, good things and useful ideas last, like laws of nature. Engineers build on the bedrock of established fact. They usually regard emotional components of a system as too vague to be useful. But play inevitably has an emotion-laden context that is essential for understanding. I could see that without some foundational definition, they were going to see the field of play as very squishy, marshy ground on which to build.

Luckily, from my own scientific training I knew that what I needed was a good chart. Nothing soothes the restive natives of Techland like charts, graphs, and data. With that in mind, I quickly put together a couple slides laying out the properties of play. Here is what I showed them:

PROPERTIES OF PLAY

Apparently purposeless (done for its own sake)
Voluntary
Inherent attraction
Freedom from time
Diminished consciousness of self
Improvisational potential
Continuation desire

What do these mean? As I explained to the engineers, the first quality of play that sets it off from other activities is its **apparent purposelessness**. Play activities don't seem to have any survival value. They don't help in getting money or food. They are not done for their practical value. Play is done for its own sake. That's why some people think of it as a waste of time. It is also **voluntary**—it is not obligatory or required by duty.

Play also has **inherent attraction**. It's fun. It makes you feel good. It provides psychological arousal (that's how behavioral scientists say that something is exciting). It is a cure for boredom.

Play provides **freedom from time**. When we are fully engaged in play, we lose a sense of the passage of time. We also experience **diminished consciousness of self**. We stop worrying about whether we look good or awkward, smart or stupid. We stop thinking about the fact that we are thinking. In imaginative play, we can even be a different *self*. We are fully in the moment, in the zone. We are experiencing what the psychologist Mihaly Csikszentmihalyi calls "flow."

Another hallmark of play is that it has **improvisational potential**. We aren't locked into a rigid way of doing things. We are open to serendipity, to chance. We are willing to include seemingly irrelevant elements into our play. The act of play itself may be outside of "normal" activities. The result is that we stumble upon new behaviors, thoughts, strategies, movements, or ways of being. We see things in a different way and have fresh insights. For example, an artist or engineer at the beach might have new ideas about their work while building a sand castle. A kid playing tea party might come to understand that good manners and social conventions can provide safety and power rather than being something imposed merely to make her feel uncomfortable. Those insights weren't the reason they played, but they arrived as the result of it. You never really know what's going to happen when you play.

Last, play provides a **continuation desire**. We desire to keep doing it, and the pleasure of the experience drives that desire. We find ways to keep it going. If something threatens to stop the fun, we improvise new rules or conditions so that the play doesn't have to end. And when it is over, we want to do it again.

These properties are what make play, for me, the essence of freedom. The things that most tie you down or constrain you—the need to be practical, to follow established rules, to please others, to make good use of time, all wrapped up in a self-conscious guilt—are eliminated. Play is its own reward, its own reason for being.

I also showed the engineers a framework for play devised by Scott Eberle, an intellectual historian of play and vice president for interpretation at the Strong National Museum of Play in Rochester, New York. Eberle feels that most people go through a six-step process as they play. While neither he nor I believe that every player goes through exactly these steps in this order, I think it's useful to think of play in this way. Eberle says that play involves:

Anticipation, waiting with expectation, wondering what will happen, curiosity, a little anxiety, perhaps because there is a slight uncertainty or risk involved (can we hit the baseball and get safely on base?), although the risk cannot be so great that it overwhelms the fun. This leads to . . .

Surprise, the unexpected, a discovery, a new sensation or idea, or shifting perspective. This produces . . .

Pleasure, a good feeling, like the pleasure we feel at the unexpected twist in the punch line of a good joke. Next we have . . .

Understanding, the acquisition of new knowledge, a synthesizing of distinct and separate concepts, an incorporation of ideas that were previously foreign, leading to . . .

Strength, the mastery that comes from constructive experience and understanding, the empowerment of coming through a scary experience unscathed, of knowing more about how the world works. Ultimately, this results in . . .

Poise, grace, contentment, composure, and a sense of balance in life.

Eberle diagrams this as a wheel. Once we reach poise, we are ready to go to a new source of anticipation, starting the ride all over again.

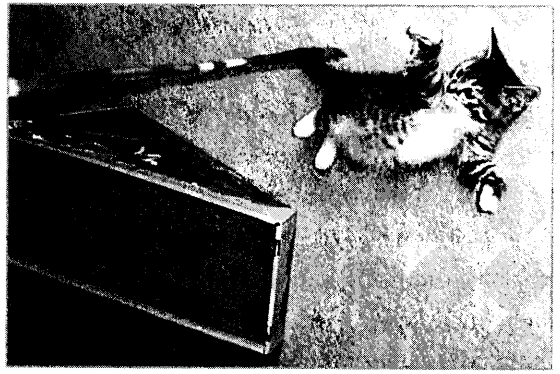
When I flashed these slides on the screen, I could see the engineers relax, as if they had been lost but now caught sight of a familiar landmark. The rest of the talk went very smoothly, and afterward many of them told me that they saw play in a new light.

The Dutch historian Johan Huizinga offers another good defini-

tion of play. He describes it as "a free activity standing quite consciously outside 'ordinary' life as being 'not serious' but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained from it. It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner. It promotes the formation of social groupings which tend to surround themselves with secrecy."

This parallels the definition I use in many ways, although I don't think the "rules" have to be fixed, or that there even have to be rules at all. I do agree that play often promotes social interaction and that it fosters new terminologies and customs that set a group apart, but it doesn't have to promote secrecy. Indeed, one of the hallmarks of play is that *anyone* can do it.

In the end, for me, all of these definitions fall short. I can create a thousand PowerPoint slides chock-full of diagrams, charts, and definitions, but there is no way to really understand play without also remembering the feeling of play. If we leave the emotion of play



out of the science, it's like throwing a dinner party and serving pictures of food. The guests can understand all they care to about how the food looks and hear descriptions of how the food tastes, but until they put actual food in their mouths they won't really appreciate what the meal is all about.

I've sometimes found that just a few slides of kids playing hopscotch, or a cat playing with string, or dogs playing fetch, creates more recognition and understanding than all the statistical analysis in the world.

why do we play?

Hudson seemed to be a very dead dog. That's what musher Brian La Doone thought as he watched a twelve-hundred-pound polar bear quickstep across the snowfield, straight toward the sled dogs that were staked away from his camp. That November, the polar bears in the Canadian far north were hungry. The sea had not yet frozen, denying the bears access to the seals that they hunted from the ice. La Doone spent much of his life in the polar bear's territory, and judging from the appearance of this particular bear he knew it had not eaten in months. With a skull-crushing bite or a swipe of its massive claws, the bear could easily rip open one of his dogs within seconds.

But Hudson had other things on his mind. Hudson was a six-year-old Canadian Eskimo sled dog; one of La Doone's more rambunctious pack members. As the polar bear closed in, Hudson didn't bark or flee. Instead, he wagged his tail and bowed, a classic play signal.

To La Doone's astonishment, the bear responded to the dog's invitation. Bear and sled dog began a playful romp in the snow, both opening their mouths without baring their teeth, with "soft" eye contact and flattened hair instead of raised hackles—all signaling that each was not a threat.

In retrospect, the play signals began, even before the two came together. The bear approached Hudson in a loping way. His movements were curvilinear instead of aggressively straightforward.

When predators stalk, they stare hard at their prey and sprint directly at it. The bear and the dog were exchanging play signals with these sorts of curving movements as the bear approached.

The two wrestled and rolled around so energetically that at one point the bear had to lie down, belly up: a universal sign in the animal kingdom for a time-out. At another point during their romp, the bear paused to envelope Hudson in an affectionate embrace.

After fifteen minutes, the bear wandered away, still hungry but

seemingly sated by this much-needed dose of fun. La Doone couldn't believe what he'd just witnessed, and yet he was even more astonished when the same bear returned the next day around the same time for another round of frolicking with Hudson. By the third day, La Doone's colleagues had heard about this interspecies wrestling match and his campsite was filled with visitors eager to catch a glimpse of the two new best friends. Every night for a week, the polar bear and Hudson met for a playdate. Eventually, the ice on the bay thickened enough for the famished but entertained polar bear to return to his hunting grounds for seal.

What was it in these animals' nature that was strong enough to overcome hunger and survival instincts? How can two species that don't interact peacefully read each other's intentions well enough to roughhouse and play-fight, when any misunderstanding could become deadly? As I began to look at these sorts of questions, I started to see that play is a tremendously powerful force throughout nature. In the end, it is largely responsible for our existence as sentient, intelligent creatures.

understanding the biology of play

As with the polar bear and the Canadian Eskimo sled dog, you can see an impulse to play in humans. My first scientific clue about the biological importance of play came to me while I was a medical student during my pediatrics rotation at Texas Children's Hospital, part of Baylor College of Medicine in Houston. We would get up early to make rounds. It was an unnerving place at dawn, few adults,

no sounds except from the sick kids or the regular beeping and humming of machines that kept them alive.

The kids who ended up in the hospital were for the most part really sick. They had congenital disorders, metabolic disorders, or serious infectious diseases like meningitis. One particular kid that I remember was about two years old and had lymphocytic choriomeningitis, a potentially fatal viral infection that could not be treated with antibiotics. We had to sustain him on IVs, support his vital functions—and keep monitoring him with a battery of laboratory tests—hoping that he would get better rather than worse.

Like most kids who are recovering from a serious illness, he didn't respond to much outside stimuli. But one morning as I walked into his room for my morning rounds, I greeted him with "Hi, Ivan," and he returned my hello with a big smile. Then he reached out to me. His smile was a sign that joy had returned to his life and was an invitation for me to join him in that feeling. I smiled back and held his hand. Later the same day, I checked his lab tests. They showed no change. But the next day's test showed signs of improvement.

I was intrigued. All standard medical signs had shown no change, and yet something was going on in Ivan's body. In a way not measurable by medical tests, Ivan had turned the corner that day. And the very first thing to come back to normal was not his blood sugar, heart rate, blood pressure, blood electrolytes, cell counts, or any of the other twenty-five "objective" signs. What came back first was his smile. This was not just relief from discomfort, but a play signal. When anyone smiles at another person, they are reaching out, engaging in a play invitation as clear as a dog's play bow. Ivan's first visible sign of returning health was an invitation to play.

I noted this surprising fact, but began to understand it only in retrospect, after I had been studying play for some time.

In the years that followed, I studied a range of people from all walks of life—from murderers to businesspeople, socialites, scientists, artists, and even Nobel Prize winners—and systematically mapped how their unique "play histories," a careful review of the role of play in childhood and adulthood, affected their life course. On one end of the spectrum, I studied murderers in Texas prisons and found that the absence of play in their childhood was as important as any other single factor in predicting their crimes. On the other end, I also documented abused kids at risk for antisocial behavior whose predilection for violence was diminished through play.

play in the animal kingdom

By the 1990s, I had studied play and its lack extensively in humans, but I began to realize that if I really wanted to understand what play does for us, I would have to know about how it operates in other animal species. I would have to place the behavior in a biological and evolutionary context. I sometimes say that I'm like James Michener, who begins his book *Hawaii* with lava rising up out of the seabed millions of years ago and ends with hula at the hotel. I needed to look at the really big picture to bring the details into focus.

Interestingly enough, at that point in time, people who had been studying play in humans didn't generally talk to the people who studied it in nonhuman animals, even though there had to be commonalities. I wanted to pull together the human and nonhuman research that was needed to better ground a science of play in evolutionary biology. I found a remarkable expert in animal play behavior, a maverick scholar named Bob Fagen. Fagen had meticulously compiled the world's knowledge of animal play, from aardvarks to Zonotrichia (sparrows). With his background in ethology, mathematical statistics, and biology, he was the world's foremost expert on the nature of animal play and how it had evolved. In addition, he was conducting the world's longest-running observations of animal play in the wild.

I first contacted Bob and his wife, Johanna, in 1989, looking for some of the answers about what play in animals actually is. Which is why, by the summer of 1992, with the support of the National Geographic Society, I found myself thirty feet up in an old-growth cypress with Fagen at his study site on Alaska's Admiralty Island. For ten years, Bob and Johanna deployed video cameras, a Questar spotting scope, computer programs, and more to conduct an intimate surveillance of the grizzly bears on the island. In doing so, they were compiling the longest and most intricate study of animal play in the wild.

I felt fortunate to be learning about animal play from the Fagens, and they had acquainted me with about twenty-eight of the individual bears that frequent Pack Creek. Bob's meticulous observations have granted him worldwide stature in scientific circles.

Bob nudged me and pointed across the tidal flats toward the outlet of the creek, where it flowed into the inside passage of Seymour Canal. We were about an hour's light-plane flight southwest

of Juneau, in a pristine wilderness. The feeding bears we had been watching over those two weeks were round-bellied and high-spirited. The salmon were at the peak of their run, and the creek outlet was gold- and silver-tinged with the pulsating bodies of chum and pinks thrashing upstream.

Two juvenile brown (grizzly) bears in the distance were approaching each other across the meadow that abuts the tidal flats. Ears slightly back, eyes widened, mouths open, they began a playful wrestling match that proceeded over several minutes and across the whole field. The two bears went in and out of the rapids, splashed through clear sparkling pools, circled, pirouetted, then stood and leaned against each other, embracing in an upright dance. Periodically they paused, looked at the water, and then, as if under the influence of a master conductor, set at each other mouth-to-mouth, head-to-head, body-to-body, paw-to-paw, in an agile display of bear play. It is as if they had inhaled some cosmic mist filled with joy and were intoxicated by it.

Fully aware of his encyclopedic knowledge of animal play, but filled with the spirit of the unfettered joyful moment we had just observed, I asked, "Bob, why do these bears play?"

After some hesitation, without looking up, he said, "Because it's *fun*."

"No, Bob, I mean from a scientific point of view, why do they play?"

"Why do they play? Why do birds sing, people dance—for the . . . *pleasure* of it."

"Bob, you have degrees from Harvard and MIT, and an in-depth

knowledge of bears. You're a student of evolution, you've written *the* definitive work on all mammals at play—I know you have more opinions about this. Tell me, why do animals play?"

After a long, tolerant silence, during which I felt as if he were a sensitive artist having to explain a sublime painting to a tasteless dolt, Bob relented. He answered reluctantly: "*In a world continuously presenting unique challenges and ambiguity, play prepares these bears for an evolving planet.*"

Like Bob and many other play researchers, I would prefer to look at the ways in which play makes life beautiful, joyful, and fun, rather than look at the nuts and bolts of play's utility. We would rather study the bird of paradise in flight, in the wild, rather than shooting it down to dissect it. One of the wonderful things about play, one of the elements that *makes* it play, is its apparent purposelessness. But does play really have no purpose? The reason I was in Alaska with Bob is that I was surveying what naturalists and animal behaviorists know about the role of play in the animal kingdom. What Bob was saying was that he, too, hated to saddle play with purpose, but after long study and reflection, there did seem to be purpose after all.

Play is incredibly pervasive in the animal kingdom. Examples of the kind of play-fighting that Fagan and I observed in the bears are common, especially in social mammals and smart birds. Among leopards, wolves, hyenas, rats, cats, and dogs, tussling is simply part of growing up. But there are also a number of animals that seem to play well into adulthood. Adult ravens have been observed sliding down a snowy slope on their backs, flying back to the top and sliding

down again. Bison will repeatedly run onto a frozen lake and slide on all fours while trumpeting exultantly. Hippos in the water will do backflips over and over again.

Other researchers and I used to think that play was found only in mammals, birds, and some reptiles, not lower orders. But animal-play researchers have established specific criteria that define play behavior, and it seems that the farther down the evolutionary ladder they look, they still find it. Octopuses, which have developed along an ancient evolutionary line far removed from us, are one of the most studied creatures in the neurosciences. When animal behaviorists observe octopi engaged in "relaxed, idiosyncratic manipulation of objects," especially when it seems to be a kind of stimulus-seeking behavior, they have little choice but to say this satisfies the definition of play. Certain territorial fishes engage in bubble blowing that appears to be play. The esteemed ant expert E. O. Wilson feels that ants engage in play-fighting. Now I see play where I never imagined it would be.

play with a purpose

Again, one of the hallmarks of play is that it appears purposeless. But the pervasiveness of play throughout nature argues that the activity must have some purpose after all. Animals don't have much leeway for wasteful behaviors. Most live in demanding environments in which they have to compete to find food, compete with other species, and compete to mate successfully. Why would they waste time and energy in nonproductive activity like play? Sometimes play

activity is even dangerous. Mountain goats bound playfully along rock faces thousands of feet high, and sometimes they fall. As a mountain goat mother might say, "It's all fun and games until someone gets hurt."

As a scientist, I know that a behavior this pervasive throughout human culture and across the evolutionary spectrum most likely has a survival value. Otherwise, it would have been eliminated through natural selection. All else being equal, the mountain goats that are not inclined to play would survive better (they wouldn't fall off the cliff doing some unnecessary stunt) and would pass on their genes more successfully. Over time, if play had no benefit, the playful goats would be pushed out of the gene pool by the offspring of the non-players. But that is not what happens, so there must be some advantage to play that offsets the greater risk of death in playful goats.

In fact, play can be scientifically proven to be useful. After carefully documenting the play behavior of the Alaskan grizzlies over more than fifteen years, the Fagens analyzed the results and were able to differentiate play from all other behaviors (the observational criteria and statistical analysis are not easy to summarize, but they are quite specific and constitute statistically significant data). They found that the bears that played the most were the ones who survived best. This is true despite the fact that playing takes away time, attention, and energy from activities like eating, which seem at first glance to contribute more to the bears' survival.

The real question, then, is why and how play is useful. One major theory is that play is simply practice for skills needed in the future. The idea is that when animals play-fight, they are practicing to fight or hunt for real later on. But it turns out that cats that are

deprived of play-fighting can hunt just fine. What they can't do—what they never learn to do—is to socialize successfully. Cats and other social mammals such as rats will, if seriously missing out on play, have an inability to clearly delineate friend from foe, miscue on social signaling, and either act excessively aggressive or retreat and not engage in more normal social patterns. In the give-and-take of mock combat, the cats are learning what Daniel Goleman calls emotional intelligence—the ability to perceive others' emotional state, and to adopt an appropriate response.

"I believe that play teaches young animals to make sound judgments," Bob Fagen told me that day in Alaska. "For instance, play-fighting may let a bear learn when it can trust another bear and, if things get too violent, when it needs to defend itself or flee. Play allows 'pretend' rehearsal for the challenges and ambiguities of life, a rehearsal in which life and death are not at stake."

Play lets animals learn about their environment and the rules of engagement with friend and foe. Playful interaction allows a penalty-free rehearsal of the normal give-and-take necessary in social groups. In the animal world, it is common to see a kitten, puppy, or cub playfully lunge and bite at its mother. This pouncing practice may serve them well later in a fight or hunt, but the more important lesson may be how to show off for siblings or learn just how much abuse Mom can take before she freaks out.

In humans, verbal jousting may take the place of physical rough-and-tumble play. Kids at play can learn the difference between friendly teasing and mean-spirited taunting as they explore the boundaries between those two, and learn how to make up when

the boundary is crossed. Adults at cocktail parties learn similar social guidelines about how to get along with others, or how to seem to.

the brain on play

Animals that play a lot quickly learn how to navigate their world and adapt to it. In short, they are smarter. Neuroscientist Sergio Pellis of the University of Lethbridge in Canada, and neuroscientist Andrew Iwaniuk and biologist John Nelson of Monash University in Melbourne, Australia, reported that there is a strong positive link between brain size and playfulness for mammals in general. For their study, which was the most extensive quantitative comparative study of juvenile play ever published, they measured brain size and tabulated play behavior in fifteen species of mammals that ranged from dogs to dolphins. They found that when they made allowances for differing body size, the species with larger brains (compared with body size) played a lot and the species with smaller brains played less.

Another renowned senior play researcher, Jaak Panksepp, has shown that active play selectively stimulates brain-derived neurotrophic factor (which stimulates nerve growth) in the amygdala (where emotions get processed) and the dorsolateral prefrontal cortex (where executive decisions are processed).

John Byers, an animal play scholar interested in the evolution of play behavior, has undertaken a detailed analysis of brain size correlated with the degree of playfulness and the relative rung of the

evolutionary ladder to which the player belongs. He discovered something: the amount of play is correlated to the development of the brain's frontal cortex, which is the important brain region responsible for much of what we call cognition: discriminating relevant from irrelevant information, monitoring and organizing our own thoughts and feelings, and planning for the future. In addition, the period of maximum play in each species is tied to the rate and size of growth of the cerebellum. This part of the brain lies in back of and below the main hemispheres, and contains more neurons than the whole rest of the brain. Its functions and connections were once thought to be primarily for coordination and motor control, but through new brain-imaging techniques researchers are finding that the cerebellum is responsible for key cognitive functions such as attention, language processing, sensing musical rhythm, and more.

Byers speculates that during play, the brain is making sense of itself through simulation and testing. Play activity is actually helping sculpt the brain. In play, most of the time we are able to try out things without threatening our physical or emotional well-being. We are safe precisely because we are just playing.

For humans, creating such simulations of life may be play's most valuable benefit. In play we can imagine and experience situations we have never encountered before and learn from them. We can create possibilities that have never existed but may in the future. We make new cognitive connections that find their way into our everyday lives. We can learn lessons and skills without being directly at risk.

So how do we create these "simulations"? Through watching and engaging in sports, physical activities, books, storytelling, art, movies, and much, much more. By living through Rick and Ilsa's doomed romance in *Casablanca*, we learn a little bit about love and how to live our lives with honor and a sense of irony when love is lost. When we really get into following the victories and defeats of a favorite football team, we learn about perseverance and how to argue with our friends (about who is the best quarterback, for instance) in a constructive way. When we experience a new physical challenge like learning to ski, we may find that the things we learn on the slopes—like avoiding falling by keeping our weight forward and committing to the turn—may come to mind during business negotiations as important reminders to press forward and commit to the deal—or fail.

On the basis of highly technical research and his speculations stemming from it, the Nobel laureate and neural scientist Gerald Edelman has created a theory about how new information is functionally integrated into the brain. When I correlate his opinions with my observations on how play may craft the developing brain, what he says makes good sense to me. Edelman describes how our perceptual experiences are coded within the brain in scattered "maps," each of which is a complex network of interconnected neurons. For instance, the many different shapes and sizes of trees that exist in the world are encoded into a common map that encodes what "treeness" is, allowing us to recognize a tree even when we have never seen its particular kind before. In this way the brain achieves a rich and flexible series of maps that permit the recognition of innumerable sorts of objects, sounds, colors, social settings, and so on.

The perceptual generalizations arising from these maps are not static. They flex and change. They also have emotional connotations.

We find our way in the world by navigating this huge and organically growing cartography of life.

The vitality of these maps depends on the active and incessant orchestration of countless details. It seems likely that this orchestration happens most fully through play. The act of pretend playing, for example, is a rich stew of mixed perceptions. Imagine a three-year-old sitting on the floor, playing with a stuffed animal, talking to it in various voices. This child is forming neural connections that make more and more sense as they are added to the growing body of stored, mapped information. The very rich connections among the brain's maps are reciprocal and may involve millions of fibers. My sense of these interconnecting and dynamic maps is that they are most effectively enriched and shaped by the "states" of play.

Play's process of capturing a pretend narrative and combining it with the reality of one's experience in a playful setting is, at least in childhood, how we develop our major personal understanding of how the world works. We do so initially by imagining possibilities—simulating what might be, and then testing this against what actually is.

Though this may seem to be a primarily childish trait, close examination of adult internal narratives (our stream of consciousness) reveals something similar. Our adult imaginations are also continually active, predicting the future and examining the consequences of our behavior before it takes place. Just as in children, adult streams of consciousness are enriched through the simulations of childlike imaginative play. We all daydream about events in our future—even if we are not consciously aware of it. These thoughts leave an imprint on our brains. Someone might not even notice as they fantasize

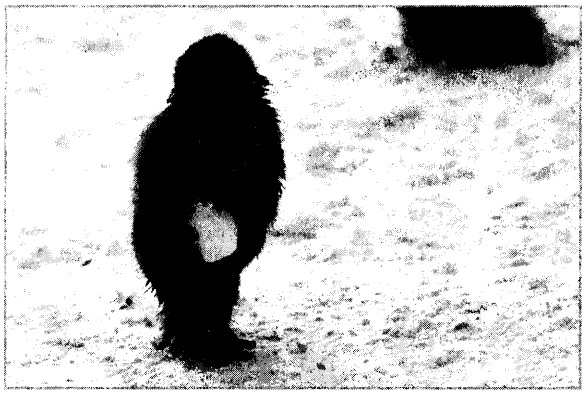
about what kind of house they would like to live in, or whom they would like to marry, but the brain is constructing a working profile of a future house or future spouse. Psychoanalyst Ethel Person writes that, through therapy, one client discovered that much of his effectiveness in business came from his repeated imaginings of possible interactions that he might have on a particular issue. By the time he actually had the conversation, he was usually pretty well prepared for any contingency.

The genius of play is that, in playing, we create imaginative new cognitive combinations. And in creating those novel combinations, we find what works.

One biologist who studied river otters decided to train some of them to swim through a hoop by offering a food reward for completing the task. Shortly after the otters learned to do this, the animals started introducing their own twists to the task. They swam through the hoop backward and waited to see if they got a reward. They swam through and then turned around and swam back through the other way. They swam halfway through and stopped. After each variation, they waited expectantly to see if this version of the task would earn a reward or not.

Through their behavior, the otters were testing the system. They were learning the rules of the game, the rules that govern their world. This was not a thought-out strategy. Otters are naturally extremely playful and are always attracted to new and interesting things. Their natural search for novelty and avoidance of boredom leads them to try the task a number of different ways. By having fun and mixing it up, the otters were learning far more about the way their world works than if they had simply performed the initial task

flawlessly. It's a lesson we all could learn. The biologist ruefully noted that he had been trying for years to get his graduate students to use such playful investigation rather than rote learning and mechanical thinking in their research.



Landmark research done in the 1960s at UC-Berkeley by Marian Diamond also points to the essential role of play in brain development. One warm winter day I went to visit Diamond, a charming and gracious woman who has also been a groundbreaking neuroscientist for nearly a half century. She was uncovering the secrets of neurological development when few other women were top scientists, much less neuroscientists.

Diamond's name isn't known widely outside scientific circles, but her work is familiar to every parent. In the early 1960s, Diamond and her colleagues conducted the landmark experiments showing not only that rats raised in an "enriched" environment became smarter, but their brains were larger and more complex, with a thicker and

more developed cortex—the "gray matter" where the brain's real data processing takes place.

The idea quickly took hold in the popular imagination: If babies were raised in an enriched nursery, with lots of colorful murals and mobiles, they would also experience supercharged brain development.

What Diamond told me about her experiments, though, brought to light an important distinction between her work and its interpretation in popular culture. The rats that grew bigger, more complex brains and became smarter weren't just exposed to a greater variety of stimuli. They weren't merely given more colorful surroundings and more interesting sounds. The secret to brain growth for the rats in the original experiments was that they played with an ever-changing variety of rat "toys" and socialized with other rats.

"The combination of toys and friends was established early on as vital to qualifying the environment as 'enriched,' " Diamond said.

Play was the true key for the rats' brain development. They tussled and chewed, wrestled with each other, explored and interacted with the toys; they investigated and invited other rats to play. Those were *active* things they did. The rats were not passively soaking up their interesting surroundings.

For human babies, the lesson should be not so much that babies should be provided with bright, colorful, interesting nurseries (although this can't hurt). The lesson should be that it is crucial to provide babies and young children with the chance to play and socialize—toys and tots, play and parental interaction—to help them reach their full potential.

Merely changing the surroundings or offering varied challenges

was not enough to get dramatic brain development, Diamond found. In one series of experiments, rats were tasked with finding their way through various mazes to find a reward. This solitary, nonplay activity resulted in neural growth in only one area of the brain, as opposed to the whole-brain growth that play provided.

I think that part of the confusion on the part of parents and pundits may have arisen from the term "enrichment," which sounds less like a play activity than an ingredient you can add to the child-raising stew, and by the lack of discussion of the play aspects of the experiments. Diamond says she still finds the term "enrichment" fitting for what they were doing, but she acknowledges that she avoided discussing "play" or "toys" when describing the experiments.

"Back in the early 1960s, women had to struggle to be taken seriously as scientists," Diamond said. "I was already seen as this silly woman who watched rats play, so I did avoid the words 'toys' and 'play.'"

Diamond's experiments are merely among the most well-established research findings showing that play is crucial to healthy brain development. What is the link between neural growth and play? Why do play activities seem to go hand in hand with brain development? What difference does play make? The truth is that play seems to be one of the most advanced methods nature has invented to allow a complex brain to create itself.

Why do I say this? Consider the fact that there is no exact blueprint for creating the brain. The information encoded in our DNA is far too sparse to define exactly how all the neurons should connect up with each other. Instead, the brain wires itself up. It does this by creating far too many neurons, which in turn make far too many

connections with other neurons throughout the brain. Following rules of interaction laid down in the DNA, the neurons send signals through the circuits, strengthening those that work and weakening or eliminating those that don't.

This process continues throughout life, and is a kind of neural evolution. After birth, most neurons are already in place, but they continue to make new connections. The fittest connections, the ones that work best, are the ones that survive. It's survival of the fittest.

REM sleep, or dreaming sleep, seems to be a critical part of this testing. Sleep and dreams appear to be organizers of higher brain function. While no one is certain yet about all the functions of sleep and dreams, researchers find that these activities seem to create a dynamic stabilization of the brain and improve memory throughout life. Studies have shown that people remember things better if they have a good night of sleep after learning something. We know that REM sleep is most frequent during the periods of most rapid brain development, and the theory is that, during development, sleep and dreams probably contribute to this testing and strengthening of brain circuits.

Play, which is more prevalent during the periods of most rapid brain development after birth (childhood), seems to continue the process of neural evolution, taking it even one step farther. Play also promotes the creation of new connections that didn't exist before, new connections between neurons and between disparate brain centers. It is activated from and organizes what I call "divinely superfluous neurons." These are neural connections that don't seem to have an immediate function but when fired up by play are, in fact, essential to continued brain organization.

In playing we foster the creation of those new circuits and test

them by running signals through them. Because play is a nonessential activity, this testing is done safely, when survival is not at stake. Play seems to be a driving force helping to sculpt how the brain continues to grow and develop.

In rats, at least, the same areas of the brain stem that initiate sleep initiate play behavior. Like sleep, play seems to dynamically stabilize body and social development in kids as well as sustain these qualities in adults. I find it exciting to see parallels between these two major behaviors—sleep and play. It's reasonable to see them both as essential long-term organizers of brain development and adaptability.

the drive to play

Play seems to be so important to our development and survival that the impulse to play has become a biological drive. Like our desires for food, sleep, or sex, the impulse to play is internally generated.

All drives are not equal in strength. Our primary need is to survive from one day to the next. The strongest drives are for food and sleep. When we are in peril, play will disappear. But studies show that if they are well fed, safe, and rested, all mammals will play spontaneously.

As the philosopher Jeremy Bentham observed, our behavior is determined largely by pleasure or pain. We are rewarded for behavior that conforms to the dictates of the biological drives and punished for behavior that goes against them. We feel pain when we don't eat, and great pleasure when we are finally able to chow down (as the saying goes, "Hunger is the best sauce"). A great night's

sleep, especially after a string of sleepless nights, is one of the most satisfying, free pleasures available.

As children, our reward for play is strong because we need it to help generate a rapidly developing brain. As adults, the brain is not developing as rapidly and the play drive may not be as strong, so we can do well enough without play in the short term. Our work or other responsibilities often demand we set play aside. But when play is denied over the long term, our mood darkens. We lose our sense of optimism and we become anhedonic, or incapable of feeling sustained pleasure.

There is laboratory evidence that there is a play deficit much like the well-documented sleep deficit. And just as a sleep deficit generates a need for extra "rebound" sleep to catch up, laboratory research shows that animals that are deprived of play will engage in "rebound" play when allowed to do so again. While we don't have statistical evidence that the same happens in humans, anecdotal evidence from parents and teachers, as well as data gathered in many adult play histories I've conducted, indicate that humans also feel a much more intense desire to play when they have gone a long time without it.

The flip side of the play drive is what it does for us when engaged. From the same play histories, I believe that we have anecdotal evidence that with enough play, the brain works better. We feel more optimistic and more creative. We revel in novelties—a new fashion, new car, a new joke. And through our embrace of the new we are attracted to situations that test skills we do not need now, but may need in the future. We find ourselves saying, "I did it just for the heck of it, but it turned out to be good for me."

In an unpredictable, changing world, what we learn from playing

can be transferred into other novel contexts. We seek out a variety of new contingencies through play, allowing us to thrive anywhere in the world. The first steam engine was a toy. So were the first airplanes. Darwin got curious about evolution initially through collecting samples from the seaside and garden where he played as a kid. Throwing stones likely led to the first projectiles, and perhaps the first spear. Fireworks in China preceded the cannon. As I muse on this, I think that math likely came via play with numbers. Wind-up toys led to the development of clocks.

When we are not up against life or death, trial and error brings out new stuff. We want to do this stuff not because we think that paper airplanes will lead to 747s. We do it because it's fun. And many years later, the 747 is born.

is the universe playful?

I like to say that when you open your eyes to it, play is everywhere. And I mean that literally—play may operate at all levels, from the smallest cellular interaction to the far reaches of the universe.

Play can be seen as a key component of evolution itself. The part of evolution that gets the most attention is natural selection, which is often called the "survival of the fittest." But there is another part of the process that is equally important: the generation of diversity. First nature generates many different versions of organisms, mostly through gene

mutation and gene recombination, and then the best are "selected" by nature to reproduce and pass on their genes. The creation of these oddities, which Darwin called "sports," is a kind of play. They are nonessential creations outside of everyday norms. Their creation adds a flexibility to the biological system. Biologists have shown that when this genetic flexibility is large, evolution proceeds more quickly. If this variation is absent, evolution will cease. Nothing changes.

Indeed, this sort of flexibility or play seems to be an essential part of any complex, self-organizing system. Without odd variations thrown in, systems proceed in lockstep fashion. On a cosmic scale, the formation of galaxies, stars, and solar systems was possible because of slight irregularities in the fabric of the universe that came into existence shortly after the Big Bang. Without these irregularities, the universe would be a homogenous soup of energy. Play is the swing off the rhythm in music, the bounce in the ball, the dance that delivers us from the lockstep march of life. It is the "meaningless" moment that makes the day memorable and worthwhile. I believe we live in a playful universe.

Though my sense of this comes from cosmology and biology, the Hindu tradition formalizes play as the ultimate creative source of reality. *Lila* (Sanskrit) is a concept meaning "pastime," "sport," or "play." *Lila* is a way of describing all reality, including the cosmos, as the outcome of creative play by the divine absolute.