"Look, with all your eyes, look!"
(Jules Verne)

Seeing; Not Seeing

"A breeze lured me from down the street and I reflexively pursued it."

Begin taking a series of walks around the block and, if ironic twists tend to befall you, soon enough you may find yourself unable to walk. This was what happened to this walker. A few weeks after herniating the disk in my back, I found that I could not push myself forward with my left leg. That is how it felt: I could use my leg *at all,* but I was not using it *at all well.*

My sciatic nerve was not on speaking terms with my left foot. I was frustrated that I could not run (a minor obsession) or pick up my son (a necessity), but I was alarmed to have a temporary disability: I could not walk normally. I was lucky: I could still walk, in an "ish" sort of way. Walking was an awkward, slow affair. Even after I had back surgery, I was still not walking well: my foot was paralyzed and I was forced to swing my leg around to the side instead of propelling it forward.

The street changed for me during those months, as it certainly

changes for anyone who is temporarily or permanently injured, or suffers the ultimate injury of simply aging. I had no balance on my left side, so to maneuver I had to plant my right foot. This meant that small adjustments—stepping back to make room for someone on an elevator; moving slightly to the side to let someone pass on a narrowed sidewalk—were impossible for me to do quickly, and even with time were laborious and graceless.

I became aware of the little movements that we do naturally when we see people approaching us on a path. I had learned from Fred Kent (and Whyte by implication) about the pedestrian sidewalk dance. Though interaction with your fellow pedestrians feels as though it begins when they come within handshake distance, you are each adjusting your path and stride to the other well before that. In *theory*. Now I saw it in practice. Without the nerves relaying messages to the muscles to make that adjustment, a walker becomes a blundering target. I made more personal, tactile contact with people in those months than I had over the decade of my urban residency.

I was very much in the throes of this handicap when I met Arlene Gordon. The day was still with heat. Along the sidewalks, air conditioners gurgled and thrummed with an unseen number of chilled apartment dwellers sealed away behind their windows. Park benches sat lonely. I could almost hear the "grass grow and the squirrel's heart beat."

I turned a corner onto a broad street unshaded from the sun. A generator was sputtering nearby; a siren dopplered across the horizon, the toenails of a small dog being dragged out for his constitutional scraped the concrete, other sounds melted into the air. Hoses snaked the sidewalk and emptied themselves into tree pits smelling of moist dirt. At the third building on the left side of

the street, inset more deeply than its neighbors, I approached the doors. They sighed open for me. I passed through the marble-floored lobby, pulled myself up a few stairs, weaved over to the elevators, fingered their engraved buttons, entered, and emerged after six beeps. On that, the seventh floor, I turned left and heard someone call my name: "Alexandra?"

Gordon stood in the doorway across the hall. Tall, smiling, with perfectly white well-coiffed hair, she held the door open with one hand and held out the other. Her fingers were directed slightly to my left, but as I greeted her, she looked me straight in the eyes. Highlighted by her shocking blue shirt, Gordon's eyes shone an iridescent blue-green. She led me into a compact, tidy apartment. The blinds were drawn and there was a low light on. A bookcase held a television, neat lines of hardbacks, and shelves and shelves of treasured objects: delicate porcelain boxes; figurative objects; tiny stone sculptures of seals, elephants, birds.

As I moved to examine these tchotchkes, Gordon spoke up: "Pick up anything; I'll tell you about the trip."

I placed one of the objects in her palms. She grasped it gently, gazing down at her hands. Her fingers quickly worked over its surface. As she dislodged a lid she said, "Oh, this is one of my little boxes. Let's see what this is . . . this has a picture on the cover . . . flowers . . . I'm sure I got this in China. I've been to China twice—actually three times if you count Hong Kong."

Over the last forty or so years Gordon has traveled the world, often with friends. She once took a three-week cruise up the North Atlantic, around Iceland and Greenland. On each trip, she gathered mementos, these souvenirs, which she calls her "pictures." On this summer's day, she had just returned from a visit to Storm King, an open-air art museum north of the city whose large-scale sculptures and site-specific pieces are scattered across a few hundred acres of manicured landscape.

"Storm King!" she smiled to tell the story. "I was absolutely flabbergasted when I got there because I was there many years ago. And nothing fit my memory of it."

This flabbergastery, her many trips, and the souvenirs therefrom might seem unremarkable were it not for the fact that for the last forty-two years Gordon has been blind.

Her memory of Storm King was a creative one—not concocted, but also not experienced entirely through her own senses. It was formed partially from the descriptions provided by her companions. Gordon experiences most trips through those she travels with. She prompts them to describe what they see, and not just the spectacles but also the ordinary details of every eyeful come alive for them both.

"I've traveled with friends all these years," she offered. "Each one has said how much more *they* see because they're walking with me."

Her memory of Storm King was also the memory formed by experiencing the world with all her nonvisual senses. She might have captured the smell of the air, the way sound bounces off lawn and metal and into open sky, the scale of the space as felt by the amount of time spent traveling from one artwork to another.

I grappled with this while sitting in her cool, dusky apartment, Gordon three feet away, bolt upright and facing me. When speaking, her eyes seemed to find mine, then traveled someplace up and to her left, just as they might in a seeing person. Indeed, she was the model of conversational eye contact.* When listening,

* In normal conversation people gaze at each other only about a third of the time, with the listener looking at the speaker about twice as much as the reverse. When speaking, we mostly look not at the person we are talking to, but anywhere else—up to the sky, at our hands, out toward an indefinite segment of air. Many utterances begin with a brief look, then a turn away. (If you are speaking and you want a moment to hold someone's attention before they blast in with their thoughts, look away. Your eyes are signaling that you have got the floor.) We can pass the conversational baton with gaze, too, by

she stared calmly in my direction, her eyes locked onto mine. We chatted about her family and she pointed to a space over my left shoulder, roughly to the wall behind a wide couch. Following her point, I saw what she cannot herself see: two photographs that she nonetheless described perfectly. Her son, now grown, took them, ten minutes apart. They showed a natural jetty in the north Atlantic covered by waves and then bared as the tide receded. Light played on the water in just the way that Gordon said it did.

I had come to meet and walk with Gordon exactly because she is blind. After a handful of city walks I realized that what many of them were missing was any experience other than a visual experience. This was not terribly surprising. After all, humans are visual creatures. Our eyes have prime positioning on our faces. We have trichromatic vision, which is sufficient to paint a Technicolor, million-colored landscape of the world. Our brains' visual areas, with hundreds of millions of neurons designed to make sense of what we see, takes up a full fifth of each of our cortices. The resplendent scene our eyes carry to us is entrancing. As a result, we humans generally do not bother paying attention to much other than the visual. What we wear, where we live, where we visit, even whom we love is based in large part on appearance—visual appearance.

But the world around us is not entirely or even mostly defined by its light-reflective qualities. What of the odors of the molecules making up every object, and those loosened odors wafting in the space around us? Or the perturbations of air that we can hear as

turning and looking at our partner in conversation when we are finished speaking. Just by using eye contact, it is taught in improvisational theater, you can wordlessly establish a relationship between two actors, marking higher status or dominance, for instance, by holding eye contact while speaking.

sound—and the frequencies higher or lower than we can hear? I imagined that someone who has lost her sense of sight could lead me, however superficially, into the invisible block that I miss with my wide open eyes.

The notion that the blind might use their other senses better than the sighted is not fanciful conjecture. Born of necessity, and supported by a nervous system that is much more adaptable than scientists thought even a few decades ago, the blind simply use their other senses to see. Often, people blind from birth get around so smoothly in a seeing world that it is hard to tell from their movement that they cannot see where they are going.

Gordon went blind half a lifetime ago, when she was in her forties, after years of deteriorating vision and unsuccessful surgical interventions. At the time, coincidentally, she was working in the city at a facility that helps the visually impaired manage and negotiate the world. As a social worker and advocate for her blind clients, she knew about and had access to the best technologies for aiding herself. But going blind in adulthood is a slightly different prospect than hereditary or early-childhood blindness. In all groups whose blindness is due to problems in the eyes, the visual cortex remains intact: ready to interpret what we see, but suddenly getting no visitors, no information from the optic nerve. Waiting for the flood through a door that never opens, it eventually starts to get some noise from the side doors: the other sensory organs, or even other cortical areas. Rather than turn off, the area becomes busier than ever.

The result is striking. Though blindness is hardly trivial, the brain of a baby born without the ability to see can undergo significant reorganization, enabling the developing child to depend on other cues to entirely replace vision. Scientists first learned this, as well as most of our knowledge about our brains, not from examining our own brains, but from peering at monkey brains. The

monkeys did not submit to this voluntarily, of course: the content of the words you are about to read come from the poignant sacrifice of enough monkeys to type that Shakespearean play after all. A monkey's brain is similar enough to ours that scientists find it informative about human brains, but different enough that the same scientists are willing to sacrifice a monkey life for that bit of information.

The similarities are many. First, our brains are shaped much the same: each resembles an overstuffed dumpling, a generous half-sphere with an extra dollop (the cerebellum, which controls movement, and thus is a crucially important dollop) on the back. In the early twentieth century a German neurologist named Brodmann made a map of the primate cortex, the outer layer of the brain, identifying dozens of distinctive areas whose cells essentially do different things. There are visual areas; smelling areas; hearing areas; areas that register when you are being tickled in your belly; areas that coordinate your reaching for a cup. What Brodmann effectively demonstrated with this mapping was that the brain does not serve as a general-purpose depository for sensation: when our eyes spy the horizontal line of a knife blade held over our thumb, that event registers in one specific area of the brain; the pain we feel when the blade slices into our thumb involves another area. What was stunning about Brodmann's work, and the reason that the areas of the brain he identified still carry his name, is that he was able to create a map showing the shape and approximate location of each area in *every* brain. The "visual area" of your brain is going to match up, more or less, to mine (the "more or less" is important, too, of course, in making you *you* and me *me*). Were we skilled at such things, and if neurons regenerated like succulent roots (which they do not), we could each lop off this portion of our brains and we could swap. It appears that the role of the cells of the brain are designated in the genome. All

else being equal, twins are born with the same brain.* Later, as their lives unfold and their experiences diverge somewhat, their brains develop differently—as, indeed, does every brain. But no one's brain reorganizes itself so much that it is not recognizable with Brodmann's map.

Except. The brains of those who have prolonged sensory deprivation are different. What research on these people or other animals reveals is the *plasticity* of the brain: its ability to fundamentally reorganize itself, most especially (and in some ways exclusively) early in life.

This plasticity is rooted in the way the brain represents information about the world. Per Brodmann, something seen with the eyes gets sent to a very particular part of the brain: the occipital cortex, also called the visual area. When we perceive an object, and when we later remember perceiving that object, there are cells in that visual area that fire, generating electrical connections with other cells that light up fMRI machines and our imaginations. This is how the brain represents our experience, present and past.

Now, say you have been looking at many examples of a certain kind of object—to make it simple, let's imagine you are employed to look for errant blue marbles at a green-marble production facility. Your occipital cortex will reflect this experience: it will change its very structure in a way that reflects that you have seen many green marbles, and it will react with a heightened interest and attention to the blues. This is a simplification of what happens in natural, real-world settings all the time. Our brains are changed by experience—in a way directly related to the details of that experience. If we have enough experience doing an action,

* All else is never *exactly* equal: even the same genome will be expressed differently given the slightest difference in environmental exposure, which every twin has from the time he is in the womb.

viewing a scene, or smelling an odor to become an "expert" in a field, then our brains are functionally—and visibly—different from nonexperts. So Charley Eiseman's brain is insect changed; Paul Shaw's is full of lettering; Sidney Horenstein sees rocks as we see faces. Examine the brain of a professional cellist (should such a brain make itself available to you), and you will find traces of her expertise in the gross anatomy of the organ. Not only will her auditory cortex be more developed—and larger—than that of someone who had not spent her life pursuing music, the traces are even more specific. In the somatosensory cortex, the part of the brain that receives tactile input from our bodies, there are individual, identifiable groups of neurons that receive input from each finger. In other words, there are "first finger" cells, cells committed to the "second finger," and so on. The somatosensory representation of the cellist has many more cells in the areas that map to the fingers of the left hand. Why? The expert cellist is a prodigious user of her left fingers to not only create, automatically and without reflection, the correct note on demand, but to do so with just the right pressure and vibrato to make it musical.

The brain is especially plastic early in life. Ordinarily, each baby's occipital cortex represents largely visual information but also receives some input from the other senses. What if that baby cannot see? There is not yet a change in the brain that can make him see if his eyes do not function. But many studies have confirmed that if there is no input from the eyes, the neurons of the visual area begin to reorganize themselves. Rather than dying off, more and more neurons start to fire upon receiving sensory information from the ears, from the nose, from the mouth or the skin. This neural plasticity can involve changes in the structures of neurons, the neurons' firing rates, or the connections between them. The result is that the blind baby grows up to be extra-attuned to his other senses.

This is the principle of plasticity of the brain: especially when we are young, our brains change depending upon what we are exposed to. Even in adults, the brain is always changing: the simple fact of learning something means that neural changes have occurred—if not as radically as in youth. A child who, in his first years of life, is unfortunate enough to lose an entire cerebral hemisphere, a half of a brain, due to tumor or other problem, will develop relatively *normally*. The other hemisphere simply takes over all the responsibilities of the lost one. By adulthood, though, a sudden loss of half a brain would mean the loss of impossibly many critical abilities, knowledge, and experience—and would be devastating. If it were the left hemisphere, for instance, the ability to understand language, use words, or write would likely be entirely wiped out, and the other hemisphere could not muster the forces to re-create them.

The baby born blind is (relatively) lucky: her brain will reorganize. With adults, the process is less dramatic. But even those who lose their vision as adults often pick up a heightened sensory ability or two. After he became blind as an adult, James Thurber continued to draw his famous long-faced hound dog, moving the pencil in a characteristic way between his fingers that let him trace its head without seeing what he was producing. He also had visual hallucinations: his visual system continued to think it was seeing something (including a blue Hoover vacuum, dancing brown spots and melting purple spots, and a couple of eight balls). All these images could well have informed his own whimsical writing and drawing.

Some blind people notice smells more vividly. Sacks writes of a doctor who became hyper-sensitive to the odors that we carry around with us. That would include body odor, certainly, but also the fragrances of the lotions or soaps or detergents that cling to us; and, for this doctor, even the odor we emit when anxious or

unhappy. The doctor felt that through smell he perceived others' emotions more clearly than he had as a seeing person. This perceptual acuity is not just the realm of olfactory prodigies: with training, or simply attention, even the sighted can detect these smells. Might Gordon smell the lotion I spread on my face or the shampoo I lathered into my hair? Would people be olfactory curiosities or olfactorily offensive?

If she was vexed by the varieties of cosmetic scents we encountered in the elevator, Gordon did not let on. In fact, she told me she was sure she had *not* developed superhuman sensory powers with her blindness. Instead, she said, she simply used her senses better than she had before. But she belied this in the next breath. ". . . And a number of years later I also realized how much kinesthetic memory meant."

We were heading outside. I hesitated on the stairs, trying to step out of the way of other residents in the entryway while staying close to Gordon, but she moved with confidence, freed of this visual clutter. Gordon was using a cane, and it promotes and expands a kinesthetic image of the world. Kinesthesia is one of our senses—one that works within our bodies, mapping where our limbs are in space. Sensory receptors on muscles and joints give feedback to the brain, mostly without our thinking about it. Kinesthetic memory is, thus, muscle memory. It is what was at work for me when I got on a bike after a dozen years of not being on bikes, or when my fingers roughly knew their way around that Chopin waltz I long ago could play on the piano. Though you often are not consciously aware of your kinesthetic ability, it is always with you. Should you find it easier to show someone where an object is, or demonstrate how to do something, rather than tell him, your kinesthetic ability is trumping even your linguistic ability.

At Gordon's previous home, she explained, she navigated

the kitchen while cooking—or found a coordinated outfit in her well-organized closet—using this sense, her body's sense of how it should move within the space of the kitchen or closet. Thus the reliability of everything being in the same place was crucial to her. After her kitchen was remodeled, shifting the placement of appliances and commonly used items, Gordon spent years reaching for the dish towel in the place where it used to hang. Her magnificent new top-of-the-line oven was functionally useless to Gordon: its interior was so cavernous that she would lose track of where the casserole was inside. In the old oven, it fit perfectly, and she knew the width and depth of that warm dark space.

When a compressed nerve led to some loss of feeling in her left hand, she became more aware, too, of how she used touch in her closet, "to feel the fabric, to know whether I was hitting a knit, or a silk, or a cotton." Nonetheless, despite a reduced sense of touch, on the day we met, her clothes were impeccably coordinated. Even the color of her cane matched her outfit.

The cane was a long fiberglass number with a single colored stripe and a round ball at its tip. Gordon tentatively tapped the ground about two steps in front of her. She held my arm lightly and lingered a half step behind me. That way, "if we get to the edge of a cliff," she suggested, "you'll fall—but I won't." I accepted this deal.

As we progressed, I noticed that Gordon angled her head ever-so-slightly to the side, her ear leading her as much as her eyes. She was listening—for the cane, where it touched the world a step ahead of her. Cane work, as using a cane for navigation is called, is still a common skill taught to the visually impaired or blind. Though seeing-eye dogs get all the press, the "long cane" remains the most popular companion of the blind. Typically, users move the cane so that it traces a low arc in front of the body, touching down before the foot that is next to step forward. Approaching more troublesome spots—doorways, curbs—the cane might be swept lightly across the ground. Variant techniques, learned through much practice, are employed for ascending stairs, descending stairs, and walking along a continuous wall.

As we slowly made our way down the street together, I saw how much holding a cane serves as a signal for others: it fairly shouts out that this person is to be navigated around. With my relatively inconspicuous injury temporarily hobbling me, I appreciated the usefulness of the neon sign signaling that this person must be treated differently. (I can imagine not wanting different treatment, too, but on a city sidewalk it seems salutary.) For the most part, pedestrians walking toward us abandoned the sidewalk jockeying game wherein two approaching people try to yield as little as possible to each other.

But the real utility of the cane is in what it conveys to its holder about the space she is approaching. It carries tactile information about the surface underfoot, whether grass or concrete, smooth or rocky. It locates holes, gradients, obstructions, even errant distracted texters (although rarely fast enough to avoid collision). But more than that, it conveys information via sound. The cane is the fiberglass version of an echolocating little brown bat: it sends out a sound—a tap—which then bounces around the environment. Listening, Gordon, with her ear trained to the bounced sound, could discriminate the sounds of the space not just underfoot, but above her head and to her side.

Dolphins and bats naturally echolocate, sending out high-frequency sounds and listening for the sounds to bounce back at them. The frequency of the reflected sound paints a picture of the objects in their environment. Amazingly, these animals do this in real time, using it to make their way with the speed of, well, dolphins and bats: incredibly fast. Humans, sighted or not, also have some ability to learn to do a kind of rudimentary echolocation,

using mechanical clickers, but we do not spend a lot of time flexing that muscle. Often, blind persons do. In some, this sensitivity is accompanied by an ability to hear the echoes of clicking sounds they produce themselves. With this skill, some can fluidly ride bikes and skateboard.

I became aware of Gordon's auditory acuity as we walked along her street. A classic Upper West Side street in New York City, it houses various towering apartment buildings. One barely notices the difference among them from street level: the bottom floors are often lined with a similar limestone. Any characteristic brickwork, cornice, or grotesques on the building face needed distance to be appreciated. Along this stony monolith to our side, Gordon suddenly spoke up:

"Are we under an awning?"

We were not. Each of the buildings we were passing had an awning projecting over the sidewalk. It is in its shade that the building's residents can wait for a taxi when it rains, or simply relax in the quasi-private transition from the city streets to home. But Gordon and I were not under an awning. We were, however, fast closing in on one.

"We're about two feet from it," I said, a little disappointed that she had gotten it wrong.

A moment later, we moved under it. With the warmth of the sun blocked temporarily from grilling our skin, even I, sighted and unobservant, could notice the change. The shade spoke relief for my arms and head.

"I sensed it," Gordon said with satisfaction. "There was a big difference in the sound."

Oh. *Oh!* The sound. The clap of her tapping cane bounced off and hit the underside of the awning, coming back at us muted, clipped. I could suddenly feel the closeness of the awning overhead, the way it broadened the sounds of our footfalls. A doorman

chatting with a tenant in a low tone was perfectly intelligible. This public space felt private, protected from the sounds of the city.

Three short steps later, we were out from under the awning's shading reach, and noises again flew away into the open air. I asked Gordon if she could tell we had emerged. She took another step.

"*Now* we're out."

The awning Gordon perceived, I realized, was wider on either side than the awning I could see. This "sound" awning projected a good two or three feet more on both left and right: that was where the sound from the cane tap began to change. Gordon could see the awning. Hers was just a broader umbrella.

A professor of religion named John Hull, who lost vision in one of his eyes during his teens and in the other eye in his midlife, describes in his memoir how rain colors the landscape for him. With its "tapping" on everything in sight, it "throws a coloured blanket over previously invisible things," Hull writes. "Instead of an intermittent and thus fragmented world, the steadily falling rain . . . presents the fullness of an entire situation all at once." The lawn, the hill, the fence, the path, the bush are articulated by the pitter-patter of rain. Distances, variation, height, material, and curves all appear in splashes and drips.

This is how the cane does its canely magic. Gordon described

to me what she was hearing of the landscape from its echo off her cane tap. She heard when an alleyway appeared between buildings lining our route. She heard the height of buildings and noticed when we had arrived in front of a school (quieted in summertime) set back more deeply from the street. Inside her building, she told me, she uses the sound of the floors that present themselves when the elevator doors open to identify whether she has arrived at the basement gym or the penthouse. "In a carpeted room," she added, "I'll sometimes get lost. Because I can't hear sounds." A tap on the carpet bounces exactly nowhere.

In Gordon's case, using the cane has changed her brain. Beyond "personal space," the space around us that we discourage most other bodies from entering into, our brains are also alert to "peripersonal space," the bubble of space outlined by and directly surrounding our bodies. The bubble extends to right about where our limbs can extend—so it is larger for people with longer arms, piano-player fingers, or legs up to there. Neuroscientists discovered cells in the brains of monkeys and humans that are specialized to fire to sounds, touch, and sights in this near space. Even with normal fingers and limbs, if you have ever sensed someone sneaking up behind you as you sat engaged in a book or a meal, you were experiencing your own peripersonal space. For even the sneakiest of persons creates small noises of movement and breath, emits ample odor, warms the air, and, with his body, changes the way sounds bounce around your head. We can feel his presence.

Wonderfully, our brain extends that bubble when we extend ourselves. Wear a top hat for a day and you will soon stop knocking it on low doorway lintels; after using chopsticks regularly, the brain begins to consider them extensions of your fingers. The brain of a baseball player experiences his bat as a continuation of his hands; the trumpeter's trumpet is an adjunct of herself. And a

blind person experienced with using a cane has the athletes' and musicians' skill with it.

Your top-hat or chopstick bubble, though, lasts only as long as you wear the hat or eat your meal. The brain is plastic, and can creatively adapt to a new situation, but it changes right back when it no longer needs to be creative. In one study, researchers who blindfolded willing subjects for five days used fMRIs to show that the subjects' visual centers (their occipital cortices) had begun to fire at non-visual stimulation, such as when feeling the bumps of Braille. A day after removing the blindfolds, their brains morphed back into their ordinary, non-Braille-reading shapes. The authors speculate that connections in the brain that already exist but lie dormant are simply unmasked with visual deprivation. In blind people, they suggest, these connections are what are exploited, temporarily and then indefinitely, to help them take advantage of that visual real estate.

For an expert cane user, the broader sense of peripersonal space is permanent, too. The space around the cane tip is as thoroughly experienced by her brain as the space around a sighted person's hand is to him. She will be able to react as quickly to a sound from or touch to the cane tip as sighted people do to something near their heads or hands.

After a short way, Gordon let go of my arm, mindful of my promise that I would not let her wander off a cliff or into traffic. Immediately, her cane found a bulky concrete planter, which she probed, identified, and negotiated around. Clear of any obvious obstacles, Gordon nonetheless began veering very definitely to her left. And to her left was a fourteen-story prewar building made, I could see at a glance, of the kind of stone that is extremely unlikely to give if you walk into it.

So here I committed a cardinal walking-with-the-blind sin: I tried to guide her. I reached out, about to grab Gordon's arm to prevent this inevitable progress into the wall. Barely restraining myself, I managed to plainly offer, "Um, you're swerving to your left quite a bit. You've about a quarter of the sidewalk left before . . ."

Gordon was unfazed. "If I go too far, I'll hit the building. But I know where I am."

I couldn't be convinced. ". . . And now you're pretty close to hitting the side of the building . . ."

She stopped and seemed to look at me steadily, then resumed walking. True to her word, she went ahead and banged right into the building with her cane. Gordon's cane tapped a quick pattern on the wall and sidewalk, a perfunctory petting of an unbeloved animal. Then she smoothly righted herself, turning just enough to take a path parallel to the building's line.

Gordon had deliberately veered, I realized, in order to get a reference point. Out of the sea of the middle of the sidewalk, she headed for something tangible that could give her her bearings.

I was at least in good company in my overweening desire to help her avoid bodily injury. People grab her all the time as she approaches buildings, Gordon said. But they, and I, were simply not seeing how *she* was seeing the space. She was aiming to run into the building, not trying to avoid it.

"It's not an obstacle at all, is it?" I asked. "It's something you're using to navigate the space."

"Exactly." Gordon smiled, continuing on a perfectly parallel course.

I had watched her do something similar earlier as we left her apartment building together. Rather than merge into the flow of pedestrians walking to and fro along the sidewalk, Gordon cut straight across them until she hit something tangible—a lamppost—at the far side of the sidewalk. Heading into an undefined

space, she had begun to define it by locating its breadth and its edge.

Even without a visual sense of it, she was essentially drawing a map of the space. Sighted people, blindfolded, do something similar. Left alone in a room, people tend to explore first by making loops out and back—and then they try to find a wall. Having found one, the blindfolded will follow it, then tentatively cut across to the opposite wall. After only ten minutes of this wall-bouncing, they are quite good at describing the shape and size of the room.

Essentially, Gordon and the blindfolded are developing what psychologists call cognitive maps: representations in their head of the space of their environment. This is something we all do, even under ordinary, non-blindfolded circumstances. Arriving at a new scene, we first compare what we see (or hear or feel) to the various stored representations of previously constructed maps of environments we have been in. If there is a match, we can proceed to ignore what we see—save anything novel or unusual that pops up—and wander into it with confidence. Thus we do not find ourselves truly examining a familiar environment every time we step into it. Stumble out your front door in the morning, and you can count on that stored map to guide you, blearily and barely awake, through the streets to your car or subway station. You already know which block has the fewest missing sidewalk stones, where the potholes are, on which side the sun is low and direct. Blindness does not stop this process of developing a cognitive map; it simply obliges map-making through non-visual means. For Gordon, that meant wayfinding by locating the edges of her path first. Once a location was familiar, she could use her stored map of the environment to walk through it without "looking" in her path-veering way.

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It would be a mistake to think that all that a cane user experiences is the information borne through the cane, though. After a half block of supervising Gordon's left-veering and straightening behavior (never once needing me to help her), I saw an interesting scene ahead. It was the end of the block. Would Gordon see it?

The corner building was another grand old prewar apartment house—tall, well bricked, and shade lending. The moment we stepped past its corner, Gordon stopped.

"Are we at the end of the block?"

I grinned. "Right!" I assumed that she had heard her way to that conclusion. The street intersected with a larger boulevard, full of car and truck activity and its accompanying horns and hubbub. But I was wrong.

"I could feel it."

"Feel it?"

"The breeze."

Indeed, there was a subtle but noticeable current of air traveling along with the traffic, going north to south. City dwellers grow familiar with the superficial appearance of the buildings on their regular walks to and from their home and work, but there is another, unseen architecture that is nearly as consistent: the winds. Though winds change with weather, the shapes of large structures like buildings act on those winds in reliable ways. Urban microclimates are created largely by the changes in airflow induced by the man-made environment. In a city like this one, full of right angles between streets, a turned corner almost always brings with it a change in the flow of air. Though the direction and temperature of the air might vary by hour or day, the contrasting orthogonal airflow is more reliable than the particulars of street or sidewalk activity.

The urban windscape manifests a Who's Who of physics phenomena, involving forces and flows described by the Bernoulli

principle, the Venturi effect, turbulence, and the properties of eddies and vortices. Streets lined by tall buildings become wind tunnels, through which the air being blown around in a large, wide-open area accelerates dramatically as it gets pushed into the small canyon of the street (the Venturi effect). Thus, winds over the rivers flanking Manhattan Island speed down side streets on land. No one who lives along one of these side streets needs to be told that the wind plasters the face and requires a whole-body lean to push through.* This occurs whether the streets are lined with particularly tall buildings or not, but in the former case, the winds blow faster for farther. Tall buildings create other wind effects: winds that hit high on a building rush down its face, sometimes creating enough pressure to make passage in and out of the doorway difficult. Sheer glass towers can pull air not just down, but also up from below (the Bernoulli principle)—as well as lift any skirts being worn in the vicinity. The edges of buildings have their own wind phenomena: circling eddies of air appear as air travels around the building's corner, snatching hats off approaching heads. Combine enough of these forces, and a vortex may appear, an independent whirlwind which lifts fallen leaves, discarded plastic bags, and city debris in its path down the street.

Gordon and I turned left, and I watched as people took a wide berth around us. With her cane and me riding sidecar with a microphone, no one could miss us. I wondered how she fared when there was not someone walking along with her. In particular, thinking back to my walk with Kent, I asked her, what about the cell-phone users?

Walking-while-talking (on phones) or texting is now commonplace, as is decrying the activity (unless you are doing it your-

* This is especially so along Manhattan's westerly edge, as much of the country's weather pattern flows west to east.

self). The decriers can be a sympathetic lot. When Oliver Sacks lost peripheral vision on one side, the West Village outside his home became suddenly unnavigable. In particular, he bemoans the hazards presented by people rushing hither and yon, "so preoccupied with cell phones and text messaging that they themselves are functionally deaf and blind." For people like Sacks, the behavior of people not considerate enough to look out for others makes the sidewalk a perilous, stressful place.

The trouble with cell phones on the street is that, though "talking on the phone" and "walking" do not seem cognitively complex, each requires attention. Even before there were retail mobile phones, there were studies using them to test distraction. A 1969 study asked subjects to listen to sentences on phones while driving to see if this distraction impaired their judgment and increased the mistakes they made (it did, on both counts: including mistakes in judging if that gap up ahead was big enough to fit one's car through). The reams of subsequent research on how cell-phone use impairs driving ability has led to bans in most states on doing these activities simultaneously—and to the subsequent upsurge in hands-free headset use (solving only part of the problem).

It is understandable that cell-phone use is problematic when doing something requiring concentration, such as driving at breakneck speeds down an interstate highway. But even walking down the street requires concentration, albeit of a more unconscious sort. Simply by having open eyes, pedestrians notice changes in the environment: a handcart being pulled across the sidewalk, an approaching carriage, a wayward long-leashed dog. Without consciously intending to, we make small adjustments. My walk on Broadway with Kent had been a testament to the success of this in keeping us, as most people, from colliding.

With Gordon, I became more attentive to the violations of the pedestrian rules. I noticed that people tended to slow down when

using their phones. Rather than a benefit, this could be a menace, as the pace of pedestrian traffic is usually instinctively adjusted by pedestrians considering each other's pace and route. I saw examples of cell-phone walkers weaving, violating the time-honored stay-to-the-right street rules. Most critically, they were not *checking*: they did not look up. Walkers typically acknowledge each other with eye contact, enforcing the social rule of at least attempting to mind other people's paths. Cell-phone talkers are less likely to notice others, let alone acknowledge them. Nor do they notice something unusual at their feet, or even see a unicycling clown with a red nose and purple jumpsuit on their route (as one study tested). The pedestrian dance of Fifth Avenue is replaced by the herky-jerky stop-and-go dance practiced by poor dancers—and by pedestrians who suddenly find someone directly in front of them. With their eyes focused not on the street, but on the conversation in their ears, the skill we have developed in navigating pedestrian traffic is wasted.

So how did Gordon feel about these cell-phone users? They were always a hazard, she agreed, describing a number of full-body collisions because of distracted walkers. As she spoke, a young woman on a cell phone was gaining on us from behind. Her laughter was punctuated by periods of silence presumably filled by the person chatting into her ear. Gordon stopped. She often slowed to a stop herself when she wanted to make a point. The cell-phone laugher passed us.

"But one thing I will tell you. They make it easier to hear people."

For a noisy species, human pedestrians can be awfully silent. Walking with Gordon, I began to notice the numbers of sneakered, light-footed walkers almost stealthy in their passage by us. There are, to be sure, a number of people who give away their presence in their manners or clothing. There are the flip-flopped,

the high-heeled, and those whose boots or hard-heeled shoes gently clip-clopped. There are the key jinglers, the pocket changed; the package burdened, the wheely suitcased; the panters, the grunters, the hummers, whistlers, and singers. You hear the foot scrapers and scuffers coming; and you can smell the perfumed or smoking brushing by. You hear the suspiration of a bag strapped across and banging against the body. The corduroyed.

Apart from these people projecting their path ahead of themselves, most people are remarkably quiet: the electric cars of pedestrian traffic. So people on cell phones may be a nuisance, but to the visually impaired, they are also beacons, sending out information about where they are (and what they are doing). To Gordon, they served to identify at least some of the presence in the otherwise unknown space around her. She appreciated their uncivil loudness.

They also were giving Gordon something I might not have heard (or, at least, attended to): details about themselves, conveyed in their voices. A voice carries a large amount of information about the speaker—from the person's sex to his size, ethnicity to age, even level of fitness (we can all hear the habits of the cigarette smoker or the physique of the obese in their voices). Voices carry emotional information, too, from disgust to sadness to surprise, even when speaking words that have nothing to do with emotional state. Most of us are quite good at naturally distinguishing emotions in vocal sounds. Potentially, the blind could be even better, although they are not always. With this in mind, the Belgian Federal Police force recently hired a few blind officers especially attuned to analyzing voices, especially on wiretap recordings. These officers are masterful at distinguishing accents and identifying what kind of room a speaker is in—things normal listeners can hear but do not attend to.

I cleared my throat, probably in an Alexandra-typical way,

and, telling Gordon something she likely knew, announced that we were at the corner. Gordon was already turning it. She began reminiscing about the building we were passing. As a young girl, she lived in this same neighborhood, less than a block away. "I remember when [the corner building] was being built." Her cane began tapping faster. "It has a gorgeous roof garden, overlooking the river." High above our heads, trees that would have been saplings when Gordon last saw them rustled and murmured.

A huge wind hit us as we turned the final corner back to her home. Gordon stopped in her tracks and stopped reminiscing. "That [wind] would be hard for the blind," she said, clearly thinking about "the blind" as though the category did not include her. The white noise of the breeze drowned out all the little sounds that are such a large part of Gordon's vision of her environment. But as she resumed walking, she continued to talk about her memory of the "new" building that had gone up on the corner. Gordon described the windows and the long, deep garden—and I gazed right at it, into her memory.

In front of her building she turned to shake my hand. "Nice to see you," she said. And then, as if noticing my smile in response, she added: "There's someone in my building who asked me, 'How come you use that word, "see?" How can you say "I see it"?' Well, I do see it. I said, 'see' has many definitions."