CHAPTER FIVE

The Body Speaks a Different Language

In which we consider how actions of the body, especially the hands, turn into gestures that act on thought, our own and others, and provide the social glue underlying cooperation.

> The Winter's Tale *act 5, scene 2, First gentleman: "There was speech in their dumbness, language in their very gesture."*

WATCHING PEOPLE, EVEN FROM AFAR, YOU KNOW WHAT IS HAPPENing. You know what they are doing and you know what they are feeling, happy, angry, energetic, anxious—no need to hear. You know their intentions. You know their relations. One couple huddled arm-in-arm, another erect and apart. You see people in conversation. One head tilts, quizzically. Someone leans forward, in confidence. Another leans back, yielding the floor. One shakes a fist at another, the other steps back. One minute the exchanges are slow and relaxed; another they are rapid and intense. What others are doing tells you what to do. You go to the back of the line at the theater, skirt around teams fixing potholes, and cross the street to avoid a fight. These coordinated actions of bodies are often as subtle, as highly articulated, as exquisitely timed as a virtuoso string quartet. They are actions, but not actions on things, like making dinner or getting dressed. They are unlike the other myriad actions that we perform throughout the day that change things in the world.

Our bodies perform an astonishing assortment of actions. We prepare food and consume it; we dress and undress; we arrange books, clothing, food in cabinets and closets; we assemble furniture and sew clothing; play pianos, flutes, and drums; operate vacuum cleaners, cars, and bicycles; we walk, run, dance, climb trees, chase dogs, shoot hoops and rapids, do yoga, and ski. Some are actions by hands that can even change the world, like assassinations; others are actions by feet that simply change where we are in the world. But there's another set of actions that neither change the world nor our locations in it. These actions change thoughts, our own or those of others. These are gestures. Intriguingly, many gestures are abbreviations of the very actions that change the world or our locations in it: putting, taking, raising, pushing, turning, splitting, mixing, and countless more. As gestures, they express actions on ideas rather than on objects. We talk that way, too, as if ideas were objects and thinking were action on objects. We pull ideas together, put them aside, tear them apart, turn them over or inside out.

Despite the extraordinary expressiveness of the body, the face, and the hands, when we think about thinking, we typically think of words. We teach them to our children, we write them to our friends, we post them on refrigerators, we speak them with strangers. We learn the rules of grammar and composition for organizing words into sentences and sentences into discourse of all kinds. We consult dictionaries for meanings of words and style manuals for techniques of composition. Not so for gesture. There isn't an authoritative dictionary for the meanings of gestures as there is for the meanings of words. There aren't rules of grammar for organizing gestures into sentences; there aren't sentences.

Gestures come first, before words, both in evolution and in development. An insightful, if speculative, theory of the evolution of language from monkeys to people begins with actions that are significant in the lives of monkeys, such as throwing and tearing. A remarkable experimental program has found single neurons in monkey motor cortex that fire when the monkey performs one of those actions and when the monkey sees someone, even a human,

perform the same action. Mirror neurons they are called. They unite the doing of action and the seeing of action in single neurons, different neurons for different actions. The brain basis for understanding action. Some speculate that actions are also the foundation for language, for expressing action. A truncated version of an action like throwing or tearing could signal an intention to perform that action. The truncated action becomes a gesture. The area in monkey cortex representing the hand overlaps an area in humans that represents spoken language. The theory then speculates that the voice came to take over for the hand, both because it has greater articulatory power and because it can project across distance.

If gesture precedes language in evolution, then perhaps it can be seen in primates. The trick is to find it in the wild, not the laboratory where "natural" behavior has been contaminated by interactions with humans. In fact, painstaking observation has shown many cases of communicative gestures by chimpanzees and bonobos in the wild. The intentions of ape gestures seem to be requests for attention, sex, grooming, or companionship. Requests to stop some behavior have also been observed. So far, no one has found apes counting or giving directions. Given that there is cultural transmission of tool use and food foraging in apes, it would be exciting if continued observation found cases of using gesture to teach or explain.

Communicating with the body is ubiquitous but usually implicit. You don't have to think about it; it happens by itself. Somebody asks you a question you can't answer. You shrug your shoulders. "How's school?" I ask D., a five-year-old granddaughter. Her answer: one thumb up, the other down. Body-to-body communication is more direct than word-to-word, performed by one body and understood viscerally by another, often without awareness. I glance at the door, your head and eyes follow my glance. I cross my legs; soon you do the same. As we converse, we increasingly use each other's words and gestures, a phenomenon called *entrainment*. Entrainment undoubtedly serves to make sure we understand each other, to create mutual understanding or common ground. It is also a form of social mimicry.

When we imitate each other, we like each other more. It goes both ways: we're more likely to imitate someone we like. Mutual imitation encourages cooperation. Social mimicry is social glue.

But there's even more to imitation, explicit or implicit. You smile or wince and I feel your pleasure or your pain. I might even smile or wince, automatically, mirroring your emotion. Even babies do this. Emotional mirroring is fundamental to empathy.

Body-to-body communication goes far beyond mirroring. It is often complementary. At a cocktail party, you spot a group of friends chatting. You approach. The circle widens to include you and you enter. During a seated discussion, one person stands, ending the meeting. At a disturbing presidential debate in 2016, the larger of the candidates added drama to a wordy event by circling in place like a lion about to pounce on a prey, a show of power to the audience and a threat to the smaller candidate. What's gesture, what's body language—there's no way to separate the hands from the head from the body, they're all connected. Bodies can be seen from afar; whether the person approaching is young or old, drunk or sober, friendly or aggressive is evident from a distance. Faces and hands require closer viewing. We talked about faces in Chapter Two, when we considered the world the body enters. Hands are especially agile, their many joints and muscles performing remarkable feats on pianos and surgery tables and cutting boards and weaving looms. Those supremely articulated movements of hands and fingers also participate in subtle gestures that express subtle meanings. We turn to those now.

THE HANDS SPEAK

No less impressive than the large performances of the body, small gestures of the hands turn out to be chockfull of meaning. Even in babies, or maybe especially in babies. Babies gesture to communicate before they speak. Many parents complain of becoming slaves to their babies' points, requests to take me there or bring me that. Some gestures by babies are less demanding. C., at eighteen months, is exploring her grandmother's (that's me) overnight kit. She pulls out

a toothbrush and then a small tube she thinks is toothpaste. She tries to open the tube but fails. She hands it to me, that action a request to open it. I say, "C., that's not toothpaste, it's lotion." C. looks at me and rubs her arm up and down as if putting on lotion to show she understands. Another example. A., at the same age, spots a small decal of an airplane on a motorcycle. She makes sure I am watching, points to the picture of the airplane, and then points emphatically to the sky as if to say, airplanes go in the sky. Two-"word" sentences, where one is uttered and the other gestured or where both are gestured, are common in babies just learning to talk. They are also an invitation to an adult to provide the words: "Right, A., airplanes go in the sky." In fact, such multimedia productions are a harbinger of spoken language. Babies who gesture to communicate early usually speak early.

Now consider B., an adult who has been blind since birth. She's been asked for directions, how to get from one place to another. As she speaks, her hands show each part of the route in sequence. She can't see her gestures and can't know if you are looking, or know if they help you understand.

Another example—you see this every day: people walking down the street jabbering, one hand holding a small, flat rectangle, the other one gesturing emphatically in the air. Although we are not party to the conversation, we can see the gestures, but the conversation partner cannot. And we no longer regard such behavior as loony.

Why do people gesture? The answer is simple. Gestures express so many meanings directly; words take time to find and to assemble. Words are arbitrary. Except for a few onomatopoeic words, words like *buzz, hiccup,* and *gurgle,* words bear no relationship to their meanings. It's all the more remarkable that we learn so many of them so early and so quickly when they are only arbitrarily connected to the meanings they express. Gestures, by contrast, more often than not bear immediate relations to their meanings. C. expressed lotion by pretending to put lotion on her arm. A. expressed "airplane" by pointing to a picture of an airplane. She then expressed "in the sky" by pointing to the sky. What could be more direct than conveying an object by pointing to it or showing how it's used? These gestures

seem to do what words or short phrases do in spoken language. The gestures essentially substitute for words; they're easier to produce than words certainly at that age, before the fluency that allows words to pop out before the thought has finished—often with regret. In fact, for babies, many gestures of this kind will eventually drop out and be replaced by words.

The gestures made by B., the blind adult, are different. They accompanied her speech; they expanded her speech, presenting more or less the same information but in a more natural format. Her gestures worked with her speech or more likely her thinking. Her gestures didn't substitute for words. As she spoke, her gestures sketched the route segment by segment, drawing straight lines for the streets and bending her hand for turns. Strung together, her gestures formed a map of the route. Did her gestures serve her own thinking, or were they meant for her unseen and unseeable listener?

On the one hand, gestures can represent thoughts that can be conveyed by single words, as when C. rubbed her arm to represent *lotion*. On the other hand, gestures can serve to create an overall structure in space, as in B.'s gestural sketch of a route. That spatial structure, unlike *airplane,* can't be expressed in a single word; unlike *in the sky,* it is even difficult to express in several words. Her gestures followed a logic quite different from the logic of language. They created a continuous diagram that organized and expressed an integrated set of thoughts. Their structure was not the structure of language. Gestures don't follow the rules of grammar. It probably hasn't escaped you that the expression I used to create a dimension of the breadth of meanings for gestures was a set of words describing a pair of gestures: on the one hand, on the other. That pair of gestures creates a virtual diagram in space, a horizontal line representing a continuum of expansiveness of meaning.

THE HANDS DRAW

Gestures do so many things. One of them is to draw in the air, and there are fundamental similarities between gestures and graphics

such as sketches, drawings, diagrams, charts, paintings, and models. Both gestures and graphics are created by actions in space. Both are used to represent something other than themselves, though on occasion—think painting and dance—they have dual roles: they both represent and are objects of contemplation in and of themselves. Both follow a different representational logic, a more direct one, from that of language. Crucially, both resemble what they represent. Of course, there are differences between gestures and graphics as well. Gestures draw, but in broad strokes, strokes of the fingers or the hands or the body, not of a pencil or fine brush. They necessarily lack the refinement of paintings or sketches. And they quickly disappear. Graphics stay there but stay still—except for animated graphics, and those have problems of their own. Yet another significant difference: gestures are performed in the here and now. Depictions and graphics of all sorts are free of the momentary context of here and now; crucially, they can represent things and events not in the present, things and events that are in the past or future, an advantage they share with language.

That gestures can show so little and show it so imprecisely forces abstraction. At a minimum, abstraction entails slimming the information, not uniformly but by selecting the essential features of the ideas and eliminating the irrelevant (I hear you saying, *But so do words*). For gesture, that also means selecting features that can be enacted or spatialized. Graphics, too, force selecting what to show and what to ignore, but they can show far more, sometimes too much, overwhelming viewers and forcing them to search and further select. In contrast to graphics, gestures are fleeting, they don't hang around to be explored. But graphics require implements, pencil and paper; gestures require no more in the way of implements than the body we carry with us. And quite frequently, the surrounding world. Finally, gestures are actions, often abbreviated actions in the world, and as such better suited to show action than static graphics. These features of gestures—that they use actions in space to create meaning, that they represent something other than themselves, that they can resemble what they represent, that they are abstract and schematic, that

they are fleeting, and that they are in and of themselves actions—all these features help us to understand what they communicate and how. And how they affect thought both in those who create them and in those who see them.

KINDS OF GESTURES

Everyone likes to put things into bins, to make piles of like things and separate them from unlike things. That is, taxonomies, dictionaries, catalogs, categories. They're so useful. Putting information into bins and the bins into bigger bins makes everything simpler. But there's no way to produce a neat catalog of gestures much less of all the ways that our actions in space create meanings. Except for a small set of frozen gestures like "okay," "thumbs up," and "high five," gestures are constantly—indeed, typically—invented on the fly and adapted to the situation. Of course, words, too, can be invented on the fly—when did *email* and *spam* become nouns and then verbs? But words tend to be invented from other words, and invented words conform to parts of speech; they're nouns or verbs or adjectives. There is no syntax for gestures, no grammar, nothing that corresponds to parts of speech. Sentences are almost always invented on the fly in conversation or carefully crafted in poetry, and there is no comprehensive catalog of sentences. There are, however, typologies of utterances and of discourse, and even of gestures. These typologies aren't rigidly defined; many gestures fall into more than one category. Nevertheless, they are useful. For gestures, the commonly accepted types are emblem, beat, deictic, iconic, and metaphoric. The features that distinguish the types are partly form, partly function, partly semantic, partly a combination.

Emblems are frozen gestures that are word-like: the signs for "okay" or "thumbs up" or "peace." Nodding the head sideways back and forth for "no" and up and down for "yes." Waving to say hello or goodbye. Emblems typically serve as crisp replies or greetings. As such, they usually stand alone; they rarely combine with other gestures or words to form longer utterances.

Beats are rhythmic gestures that accompany speech, typically at phrase or clause breaks. They can serve to structure the discourse and advance it; they can serve to emphasize. Although they are regarded as not having semantic content, they often do. The repeated pounding on a lectern timed with each of the faults of the opponent in a political debate are beats. The emphatic hand slices that accompany a list, first, second, third . . . are also beats, but because those beats usually proceed along a horizontal line in space, they carry semantic meaning by establishing a dimension along which a set of things is ordered, events in time, teams by order in a league, movies by ticket sales. The human mind does like to order and to rank.

Deictic gestures point. The word *deictic* and the noun form *deixis* derive from a Greek word that means to show or demonstrate or prove or point to. Oddly, despite its origin, *deixis* was first used with respect to words, not gestures. *Deixis* refers to words like *here, there, me, this, that, next,* and *now,* words that rely on the current context, the here and the now, to be understood. The *now* in the previous sentence is no longer now.

One fundamental role for points is to bring the world, the here and the now, into the conversation. Points simultaneously direct attention to something in the world and refer to that something in the world. Airplane <point sky>. Eat <point cookie>. Go <point outside>. Daddy <point shoe>. So much conversation, especially with children, is about the here and now. But pointing to bring something in the world into the conversation isn't just for children. Adults point: to show someone which way to go, to indicate which dessert they want, to designate whose turn is next.

Points are often regarded as the simplest gestures. What could be simpler than extending a finger in the direction of the focus of one's thought? That's their meaning, right there in front of our eyes. Babies point early and proficiently. But simple points are not. Suppose while talking I point to a book. I could be referring to any old book, to an object that could be used as a door stop, to a recent purchase, to something a friend forgot, or to that specific book. If to that book, I could be referring to its title, to its contents, to its author,

to the pleasure it brought me, to its influence, to its size or its cover or to countless other features associated with the book. Context can clarify.

To complicate things further, pointing is not a single gesture. It needn't even use the pointer finger. We can point with a finger or a hand or our heads or our shoulders or even with our eyes. How we point varies. Perhaps we've been told that pointing isn't polite or perhaps pointing with the head or the eyes is more private and can't easily be seen by others. A sweep of the eyes toward the door can signal a companion to see what's going on there or that it's time to leave. How we point depends on so much, on who the point is for, on what is pointed to, on the surrounding context, physical, social, and conversational.

Even odder, points can be directed at something that isn't there at all. A nod in the direction of the place of someone who has left the room or a dish that has been removed from the table can refer to that absent someone or that absent dish. But more than that, I can set up an imaginary world with points, a remembered world or a completely hypothetical world, a concrete world or an abstract one. And I can continue to point to the imaginary things I've arranged in my imaginary world, even rearranging them using moving points. Setting up an imaginary world and animating it is in fact a feature of American Sign Language.

Iconic gestures depict. They show properties of objects, spaces, or actions. The prototypic iconic gesture is the "big fish" gesture, the drawing out of the hands to indicate the impressive length of the fish that was caught or that got away. Iconic gestures do not and cannot exhibit all the features of an object or action. The big fish gesture shows the length and horizontality of the fish, but it doesn't show the shape of the fish or its swimming motion. Iconic gestures can also represent actions as in "he walked into the room looking as if he owned the place" while swaggering and strutting.

Metaphoric gestures express depictable but nonliteral properties or abstract concepts. There are *big* fish and there are *big* ideas. Of course, ideas can't literally be big. Ideas might be big because they are

inflated or because they encompass many other ideas or because they have many implications. A gesture accompanying *big idea* would be different from one accompanying *big fish*. Fish have shapes and orientations; ideas don't. How do you indicate that something, an idea, can be regarded as an entity but that it has no particular shape or orientation? A sphere. So, a *big idea* is more likely to be conceived of as something rounded rather than something elongated like a fish. For *big idea,* the fingers might be curved as if holding a ball. Actions can also serve as metaphoric gestures. A head bobbing this way and that can depict a person who bounces from idea to idea. A flattened hand wobbling up and down signals uncertainty, like a teeter-totter.

Metaphors of all kinds permeate our thought and our talk, and our gestures as well. One reason metaphors work is that they use something that is familiar to represent something that is unfamiliar, something that is concrete to represent something that is abstract, something understood to represent something that is not. Many metaphors are so common—often called, metaphorically of course, "dead"—that we don't notice them as such: the heart pumps, the brain computes, life is a journey, political candidates are at war. During a recent presidential campaign, a political commentator remarked that one of the major candidates had a driver's license, the other not even a learner's permit, and a third-party candidate was without a car. Shakespeare was the master metaphor maker: life's a stage, Juliet's the sun, life's a web. Of course, metaphors do not transfer all senses to their targets. What transfers from *web* to *life* is a complex network, a network of events and relationships, not of strands of filament extruded from the nether parts of a spider. Similarly, Juliet lights up Romeo, but she isn't a glowing ball in the heavens. So, too, for metaphoric gestures: only some features transfer. Gesture can make explicit which ones.

GESTURES REVEAL THOUGHT

My husband was a paratrooper in the Israeli army. One of the training exercises was to be dropped alone in the desert in darkness

without a map. You found your way back or . . . He had an uncanny sense of direction. Many years later in more benign environments that were paved and well lit on the rare occasions when I was the driver and he was the navigator, he would tell me to "turn right" and point left. Or vice versa. It didn't matter what language he was speaking. Since the body is faster than the mind, I knew to go with his hand, not the words. The relationship between words and action is arbitrary, but the relationship of pointing to action is direct, it's in the body and the world. You point the way you want to go. Sometimes people's gestures contradict their speech. In those cases, pay close attention to their gestures.

This is true in spades for children because they are often less adept at explaining in words. Here's an example from young children in a standard Piagetian conservation task. Two equal rows of checkers are lined up in front of the child. The experimenter spreads out one row and asks, "Are there more checkers now [pointing to the widened row] or are they just the same?" The experimenter also asks why. Very young children say more; older ones correctly say same. But some children say one thing and gesture another; the researchers called these discordances *mismatches*. For example, a kid might say *more* but make a gesture pointing to corresponding pairs of checkers in the two rows. That one-to-one gesture suggests the kid is on the cusp of grasping conservation. In this case, the mismatched gestures don't contradict the words, as in the case of my husband and *left* and *right*. In many mismatches, the gestures and the words simply carry different information.

The same happens in school-aged children learning to solve arithmetic equations. Some kids calculate incorrectly but point to both sides of the equation with a V gesture, suggesting nascent understanding that the two sides of an equation must be equal. Significantly, children's mismatches predicted leaps in understanding in both cases. That is, a child pointing to two sides of an equation will soon understand that the two sides of an equation must be equal or that stretching the row of checkers doesn't change the quantity

of checkers. What's more, teachers seem to pick up the discrepancies between words and gestures and use them in teaching, by helping the child articulate their understanding. Teachers sense that these are teachable moments and give more instruction to children who produce mismatches.

Students' gestures provide other information that is helpful to teachers, notably their problem-solving strategies. When children are asked to gesture as they explain how they solve equations, their gestures reveal strategies not explained in speech, for example, which numbers in the equations they are summing. It's a bit like asking students to show their work. They are then more likely to benefit from instruction.

Conversely, children learn better when their teachers provide two different problem-solving strategies, one in their words and another in their gestures, than when their gestures and speech match or when both strategies are conveyed by speech.

GESTURES PUT THOUGHT ON A STAGE

Gestures reveal thought, often far better than words do. This turns out to be especially important for really big thoughts, like the (Kantian) Big Three: space, time, and causality. Each of these is a multifaceted concept that can be spatialized, and spatialized in different ways. Setting up a schematic space of ideas is one of the great powers of gesture. Much research on gesture has analyzed single gestures focusing on hand form or simply counted gestures. Insightful as that work has been, that narrow focus overlooks the force of an integrated sequence of meaningful gestures that put ideas on a stage, poised to interact.

What's missing from the Kantian Big Three is emotion. Emotion was not one of Kant's fundamental *a prioris,* space, time, and causality. If space, time, and causality are successively more abstract, then emotion is even more so, though not on the same conceptual continuum. Emotion is on its own conceptual continuum. Or continua. If

expressing space, time, and causality uses sequences of integrated gestures, usually of the hands, emotion often takes only a single gesture, typically of the face. Still, emotion is part of every perception and every thought, and this cannot be forgotten.

Countless nuanced and nameless emotions can be expressed by the body and the face, even just the eyes and eyebrows. *Raised eyebrow,* either as action or an expression, has become a synonym for skepticism. We discussed emotion in Chapter Two, when we populated the world around the body. Here, we only give lip service to emotion. And the lips play roles, they smile and frown and yawn and pucker. Words emit from them. Suffice it to say that we often experience the emotions of others the way we experience actions of others directly, through mirroring by the body and the brain.

Space. Using space to represent space is a no-brainer. Nevertheless, if you're in psychology nobody trusts you unless you do an experiment. So, we did. We brought people into the lab, gave them schematic maps to study, and asked them to describe the environments represented in the maps to a video camera so that someone watching the video would know where everything was. As expected, most (but not all) gestured. Many produced a long string of integrated gestures that laid out the places and paths in the environment in a spatial array, some on a virtual vertical blackboard, some on a virtual horizontal table. Predominating the gestures were lines for paths and points for places.

Now *time.* Time is usually abstracted to a single dimension, a line. But which one? Depending on the language and the situation, the line might be gestured from left to right or right to left, it might go sagittally from the front of the body to behind the body or vice versa. The direction depends on how time is conceived. In some languages, the future is in front because conceptually we are moving toward it or it is coming at us. In other languages, the past is in front because it is known and the future is behind because it cannot yet be seen. In Mandarin, time might be gestured vertically, earlier up and later down, like a calendar. Arraying time from left to right or right to left

is convenient on a page or in some social situations where the sagittal front/back is complicated to represent. Whether time goes from left to right or vice versa appears to depend largely on reading/writing order.

Causality. Causality is much, much harder; there are so many different kinds of causes and so many of them are invisible. But many causes and consequences of causes are actions, inviting iconic gestures. Back to the lab to see how people gesture when they explain causal systems. In one experiment, students studied the rock cycle or the workings of the heart and then made a video explaining the system. Typically, they first used gestures to create a large virtual diagram that located the parts of the systems, much like the way people create a map of locations in space or a timeline of events using gestures. For causality, gestures can do more than map in space or time. Gestures were used to show the actions of the parts of the system and the causal chain of actions in the system. Thus, gestures do double duty in representing causality, making them all the more important in explanations of causality.

We'll stop here, with examples from the Big Three, but it should be clear that this is only the beginning of ways that gestures can put thought onto a stage. But gestures representing space, time, and causality do far more than put thought on a stage—they have the power to change thought in those who make them as well as those who see them.

Second General Fact Worth Remembering: Representations created by hands and by words are wildly different.

Presumably by now I have convinced you that people spontaneously gesture and that gestures can express a multitude of different kinds of ideas more directly than words can. Yes, all over the world. And, yes, there are also cultural differences. As for just about everything. Now I need to convince you that gestures make a difference, that they are effective and effective beyond words in communicating both to others and to one's self. Fortunately, there's plenty of evidence for both. And that research gives more insight into how gestures work.

GESTURES HELP US TALK

Try this. Sit on your hands. Then explain out loud how to get from your house to the supermarket, train station, your office or school. This isn't just a thought experiment; it works in highly controlled laboratory experiments. When people are asked to explain or describe spatial relations while sitting on their hands, they have trouble speaking. They can't find words.

People blind from birth, both children and adults, gesture, even when speaking to each other. They have never seen gestures nor have their conversation partners. They seem to gesture for themselves. Gesturing by people who are blind, as for the people with sight in the previous experiments, seems to help them speak. But it turns out it isn't just word finding people have trouble with when they can't use their hands. Preventing gesturing doesn't just disrupt speaking, it disrupts thinking.

GESTURES HELP US THINK

There is a perhaps apocryphal story about the venerable poet Wallace Stevens, who walked to his work in an insurance company. As he walked, he wrote poetry, in rhythm with his thoughts. The story is that when he revised a line, he walked backward to where that line had begun in his mind, and then forward again as he rewrote.

Now from poetry to a far more mundane activity of the mind, counting. Try counting a bunch of pennies sprawled on a table without pointing to or moving each one as it is counted. Children are taught to point to each object in turn as they count, and doing so makes counting more accurate and faster. When adults' hands are tied as they count, they count with their heads. And, undoubtedly, if the head were immobilized, people would count with their eyes. Pointing while counting allows keeping track of the count. Is pointing to count an action or a gesture? It seems to be both.

Making the case that gestures help thinking requires gestures that represent thought. And more: that people gesture when they are thinking, but not talking, that when they do so, they think better, and that preventing gesturing disrupts thinking. There's an added bonus. Seeing the kinds of gestures people make when they are thinking also reveals the thinking and does so directly, without the use of machines that peer into the brain.

To do all that means going into the laboratory. We began a research program in which people were alone in a closed room and given problems to solve or complex descriptions to remember. We know that people gesture when they talk about such things, but in our studies, there was no one to talk to.

First, we gave people problems to solve. Here's one of them: *There's a row of six glasses. The three on the left are empty, the three on the right are full. By moving only one glass, change the configuration to empty-full empty-full empty-full.*

Did you figure it out? While thinking about that problem, the majority of students gestured. Their gestures represented the problem, three empty glasses, three full glasses in a row, but in different ways. Some put out three fingers on each hand, side-by-side. Others used an index finger to lay out two separate groups of three along a row on the table. Either way, their gestures represented the problem. These gestures aren't single gestures like deictic or iconic or metaphoric gestures. They are much more; they are a coordinated sequence of gestures that form a spatial representation of the problem, a virtual diagram of the problem. That was an interesting finding in and of itself. But there was another finding, much more surprising. The people who gestured were more likely to solve the six glasses problem than those who didn't gesture. Why should gesturing help problem solving?

Before trying to understand why gesturing helps problem solving, we need to know how general the phenomenon is: Will people gesture to understand and learn other kinds of information? Because it's known that people gesture when they describe environments, we turned to those, roads and landmarks in a small town or the configuration of various exercise rooms in a gym. Environments are inherently spatial, but they are abstracted both in the mind and on

the page—into the paths and places of sketch maps. Dots and lines. Would people, alone in a room, gesture to represent and remember descriptions of environments, and would their gestures form sketch maps? The answer to both questions is yes.

Just as they did while reading problems to solve, most (but not all) people gestured while reading spatial descriptions to remember. Whether or not they gestured didn't depend on whether the environment was indoors or outdoors, large or small. It didn't matter if the description took a perspective from above or from within the environment. Just as for the six glasses problem, people's gestures made virtual sketches of the environments, but their styles of gesturing differed. Some gestured on the table, some in the air, some under the table. Some traced lines or pointed with the index finger, some used an entire hand. But the gestures were similar at a semantic level. Everyone used line-like gestures to represent paths and point-like gestures to represent landmarks. Other features of the environments, like parks or schools or weight rooms or pools, were rarely represented. Only the skeleton, much like sketch maps.

Again, gesturing helped people think. Those who had gestured answered more questions about the environments correctly than those who hadn't. And they answered faster. Those who gestured made more accurate inferences; they were better at answering questions from perspectives they hadn't read. Several people gestured for some but not all descriptions; they performed better on the descriptions they had gestured. To cinch the case for gesture, we asked another group of students to read and remember the descriptions while sitting on their hands. Sure enough, those who sat on their hands performed worse than the group allowed to gesture.

The environments were rich and complex, as were the gestures. Most people produced a long string of gestures, sometimes revising as they worked out their understanding. They rarely looked at their hands, and when they did, it was a brief glance. That means that the gestural representations were spatial-motor, not visual. Given that, it makes much more sense that people blind from birth gesture. What matters are the movements in space, not what they look like.

Surprisingly, gesturing while reading didn't slow reading, even though people were doing two things at the same time. Doing two things simultaneously is supposed to increase cognitive load and lower performance. Not so for gesturing and thinking. Paradoxically, adding to the cognitive load reduced the cognitive load.

Understanding the explanations was hard; it took effort to figure out where everything was. Words march one after another in horizontal rows; they bear only symbolic relationship to the environments. But the gestures resemble the environments, they put the places and paths in a virtual map step-by-step. In essence, the gestures translated the language into thought.

Will gesturing facilitate any kind of thinking? Our guess is that gesturing can help thinking that is complicated and that can be spatialized. Research on understanding elementary actions in physics and mechanics supports those ideas. A string of gears works because adjacent pairs of gears go in opposite directions: a gear that rotates clockwise is surrounded on both sides by gears that rotate counterclockwise. This is called the parity rule. Gesturing helps people grasp the parity rule, that in a chain of gears, each successive gear reverses the direction of rotation.

Gesturing helps people understand the water level problem, that when a glass is tilted, the water level stays parallel to the ground, it doesn't tilt with the glass. Imagining tilting the glass didn't help understanding, but tilting the hand as if grasping a glass did. This is a crucial, if puzzling, distinction. Imagination, that is, visual-spatial reasoning, was not as effective in understanding that the level of water in a glass stays parallel to the ground even when the glass is tilted as was making a tilting action.

Rotating the hand in the right direction also helps some people solve mental rotation problems.

Our own work is venturing farther, beyond the inherently spatial. We have given students descriptions of all sorts of things to remember and reason from: party planners' schedules, people's preferences for film genres, orderings of countries by economic growth, explanations of how a car brake or a bicycle pump work, multiplication

of two 3-digit numbers, and more. In each case, about two-thirds to three-quarters of participants gestured as they read, and their gestures formed virtual diagrams of the problems. The formats of their virtual diagrams varied widely, but the essence of the information represented did not. In all cases, gesturing while studying speeded answering questions at test, indicating that the gesturing consolidated the information. For the mechanical systems, the car brake and bicycle pump, gesturing at study improved performance on the tests as well. We've also found that people gesture when given diagrams rather than descriptions of the mechanical systems and maps of the environments. That is, even when provided with visualizations, many people use gestures to make spatial-motor models of the systems and environments they are trying to learn.

Watching people's hands as they read and understand feels like watching their thinking. Better than peering into the brain, it's all out there before the eyes. Some of our students used the joints of their fingers as the rows and columns of a table for representing preferences or schedules. Others made virtual tables on the table. The gestures that represented the mechanical systems, the car brake and bicycle pump, were remarkably creative and diverse (just as were people's diagrams, as shall be seen). Despite the diversity, the gestures (and the diagrams) abstracted the underlying structure and dynamics of the systems. As before, we required half the participants to sit on their hands. Remarkably, almost a third of those asked to sit on their hands couldn't comply; they could not stop gesturing! It was as if they couldn't think if they couldn't move their hands. Some told us exactly that.

How curious and surprising that we think with our hands. But gesturing is no panacea. It does not guarantee success. Telling people to gesture doesn't necessarily improve performance. The gesturing has to be part and parcel of the thinking, to represent the thought. And the thought has to be correct. If the thinking goes astray, so do the gestures and so does the correct solution. Another problem we gave students illustrates this nicely. Try it yourself: A ship is moored in a harbor. A rope ladder with 10 rungs hangs over its side. The distance between each rung is 12 inches. The lowest rung touches the water. Because of the incoming tide, the surface of the water rises 4 inches per hour. How soon will the water cover the third rung from the top of the ladder?

This problem *seems* like one of those rate *X* time problems we struggled with in junior high. But it's not. It's a trick, but most of our very bright undergraduates fell for it. A majority of students gestured while trying to solve this problem. Typically, they used one hand to keep track of the rungs of the ladder and the other to calculate. Those who gestured succeeded in computing the wrong answer more accurately, that is, the time at which the water would rise to the third rung from the top—if the boat were attached to the floor of the sea. But the boat floats! So the level of the water relative to the ladder doesn't change as the tide comes in. The answer to *When will the water cover the third rung from the top?* is: Never. Realizing that the boat floats doesn't require gesturing. That's a fact that has to be drawn from memory. So, in this case, those who gestured were more likely to solve the problem incorrectly because their gestures were driven by incorrect thinking.

To be effective, gestures need to represent the thought in the right way. If gestures that are congruent with thought augment thought, then it should be possible to design gestures that can help people comprehend, learn, think, and solve problems. One such gesture is routinely used in teaching physics. Students are taught to form three axes by holding their thumb and two adjacent fingers at right angles and to rotate them to solve vector problems. In school settings, children were taught a gesture designed to help them understand that the two sides of an equation are equal. Children made a V gesture with their index and middle fingers, each pointing to a side of the equation. Children taught that gesture showed greater understanding of the underlying principle of equality.

Touch pads provide an excellent opportunity to induce students to make gestures that are congruent with the desired thinking. For example, addition is a discrete task, each number gets a count. By contrast, number line estimation is a continuous task. In a number

line estimation task, people are presented with a horizontal line representing the numbers from 1 to 100. They are given a number, say 27 or 66, and asked to mark where that number would be on the number line. Children performed better when the addition task was paired with discrete one-to-one gestures and when the number line estimation task was paired with a continuous gesture.

HOW REPRESENTATIONAL GESTURES WORK

We've shown that the gestures people spontaneously make for themselves can help them think. That gestures embody thought. That they map thought directly. They represent thought, not in words or symbols but as actions in space. This is the mysterious part. It's not just motor memory, the kinds of gestures that dancers or pianists or surgeons or tennis players or typists might make to jog their memories. Those gestures are miniatures of the actual actions they would make. Making a map of an environment with hands and fingers isn't at all like walking through an environment. The hands and fingers are used to *represent* the environment. The mappings are abstractions. When we walk through environments, we walk on paths. We can think of the paths as lines and then we can represent lines by moving a finger, moving a hand, or making a discrete chop with a finger or a hand or an arm. We can abstract places to dots and make dots in a variety of ways. Similarly, we can think of each movie genre as a dot, and we can represent our preferences for genres by ordering the dots on a line. We can use that same mapping to represent events in time; each event is a dot ordered on a line. Maps of environments, preferences for movie genres, events ordered in time—and much more—all use the same representational primitives. They use dots to represent places or ideas and use lines to represent relations between them. There's more, circles and boxes, and even more. We'll return to this when we get to graphics in Chapter Eight. The same sorts of mappings are used on the page.

The gestures people make as they think have another boon: they allow seeing thought in action. Others can watch our thinking and

we theirs. In real time, as it happens. Can the kinds of gestures that serve our own thought also serve the thought of others? We turn to that now.

GESTURES CHANGE THE THOUGHTS OF OTHERS

We start with babies again. Babies whose caretakers use gesture and speech simultaneously (rather than unaccompanied speech) acquire vocabulary faster. It could be that gestures like pointing clarify the referents of the speech. It could be that gestures enact or depict the referents of the speech. It is probably both and more. When babies see more gestures, they gesture more themselves, providing, as we saw earlier, yet another route for increasing vocabulary.

Parents are so proud when their toddlers can count. But then they are baffled. Despite getting all the number words in the right order, their young prodigies can't answer: How many? What counting means to the toddlers is matching a sequence of words to a series of points to objects. It's rote learning like the alphabet song, with the addition of a marching pointing finger. It isn't yet about number as we understand number. Don't get me wrong, this is a remarkable achievement. That they can do one-to-one correspondence, one number for each object irrespective of the object and increasing numbers, at that, is impressive. Other primates don't do that. But one-to-one correspondence is only part of the picture. When they can't answer how many, they don't yet understand *cardinality,* that the last number word, the highest number, is the total count for the set. If you show them a picture of two sets, say Jonah's candy and Sarah's candy, and ask them to tell how many pieces of candy each child has, they often count Jonah's and without stopping, continue on to count Sarah's. Gesturing a circle around each set of candy helps them to count each set separately, an important step toward understanding cardinality. The circular gesture creates a boundary around each set, including the candy in Sarah's set and separating hers from Jonah's. Children are more likely to stop counting at the boundary.

Now we jump to bigger people. When we explain something to someone else, we typically gesture. Those gestures are usually larger than the gestures we make for ourselves, there are more of them, and they work together to form a narrative that parallels the spoken narrative. If speakers make larger gestures for others and link them in a narrative, then it's likely they think the gestures help their listeners. We certainly depend on gestures when someone tells us which way to go or how to do something. But that kind of gesture depicts actions we are supposed to take in the world. What about gestures that are meant to change thought, to form representations in the mind?

For this, we turned to concepts that people of all ages and occupations need to learn and that are difficult. Complex systems. The branches of government, what each does, how laws are passed, how they are challenged in courts. How elections proceed, how babies are made, how the heart works. Shakespeare's plays, the main figures, their social and political relations, what each did and how others reacted. Diverse as they are, underneath each is a complex system with a structural layer and a dynamic layer. Structure is an arrangement of parts. Dynamics is a causal sequence of actions. Structure is space; dynamics, time.

Dozens of studies have shown that it's easier to grasp structure than dynamics. Structure is static. Dynamics is change, often causality. Novices and the half of us low in spatial ability understand structure, but it takes expertise or ability or effort to understand dynamics. Structure can readily be put on a page. A map of a city. A diagram of the branches of government, the parts of a flower, a family tree. Networks of all kinds. Action doesn't stay still, it's harder to capture and harder to show. The actions are diverse and the causality is varied and might not be visible, forces and wind.

Gestures are actions; could gestures that represent actions help people understand dynamics? For a dynamic system, we chose the workings of a car engine. We wrote a script that explained its structure and action, everything that would be needed to answer the questions we asked later. Then we made two videos of the same person using the same script to explain the car engine. One video had eleven

gestures showing structure, such as the shape of the pistons. Another had eleven gestures showing action, say, of the piston. The same rudimentary diagram appeared in both videos. A large group of students watched one or the other of the videos. Because structure is easy, we didn't expect effects of structure gestures, but it was important that both groups of viewers see gestures.

After viewing the explanation of the car engine, participants answered a set of questions, half on structure, half on action. Then they created visual explanations of the car engine. Finally, they explained the workings of the car engine to a video camera so that someone else could understand. Viewing action gestures had far-reaching consequences. People who had viewed action gestures answered more action questions correctly, even though all the information was in the script. The differences in the visual and videoed explanations were more dramatic. Those who had seen action gestures showed far more action in their visualizations: they used more arrows, they depicted actions like explosions, intake, and compression. They separated the steps of the process more cleanly. In their videoed explanations, they used far more action gestures and most of those were inventions, not imitations. They used more action words, even though they hadn't heard more action words. Viewing straightforward and natural gestures conveying action gave students a far deeper understanding of action, an understanding revealed in their knowledge, in their diagrams, in their gestures, and in their words.

Put simply, gestures change thought. Gestures that we make as well as gestures that we see. Next, we turned to concepts of time, using the same technique: identical script, different gestures for different participants. Perhaps because words come one after another, people can have trouble grasping that two steps or events aren't strictly ordered in time. They may be simultaneous in actual time or their order might not matter. When the stages of a procedure are described as, first you do *M*, then you can do *P* or *Q* in either order, and finally you do *W*, people often remember that *P* precedes *Q* (or vice versa). When the description of the steps in time was accompanied by a beat gesture for each step, people made the error

of strictly ordering the steps. However, when the description came with a gesture indicating simultaneity, unordered steps were remembered correctly, as unordered.

Another temporal concept that doesn't come easily for people is cyclicity. Think of cycles like the seasons, washing clothes, the rock cycle, and this one: *the seed germinates, the flower grows, the flower is pollinated, a new seed is formed.* When given the steps of cycles like these and asked to diagram them, people tend to draw linear, but not circular, diagrams. People do understand circular diagrams of cycles perfectly well, but they produce linear ones. Gestures change that. When we presented one of the processes with gestures that proceeded along a line, the linear tendency strengthened. But when we presented one of the processes with gestures that went in a circle, a majority drew circular diagrams. Importantly, they weren't simply copying the gestures. We repeated the experiment with another group and instead of asking them to create a diagram after the last stage, we asked them: *What comes next?* Those who had seen circular diagrams usually went back to the beginning of the cycle and said: the seed germinates. But those who had seen linear gestures tended to continue to a new process, like gathering flowers for a bouquet. So, seeing the circular gestures did change the way people thought.

These studies are only a drop in the bucket of the research showing that the gestures we view change the ways we think. The trick is to create gestures that establish a space of ideas that represents the thought felicitously. That gestures have the power to change thought has powerful implications for communication, in the classroom and outside.

GESTURES DO MATH AND MUSIC

Fingers and toes and other parts of the body have been used for counting all over the world for eons. At first, one finger for one thing, much like a tally. The one-to-one use of fingers and toes is an elegant example of a congruent mapping, one thing to one finger. But the

FIGURE 5.1. Guidonian hand, a device for notating and conducting music, from the eleventh century and often still in use.

number of things can go far beyond the number of fingers and toes, and even shoulders, knees, and every other joint in the body. People eventually came up with the bright idea of using some joints as multiples of others, so some joints became tens, hundreds, thousands, and so on. That transformation left a one-to-one congruent correspondence far behind. Going even further, the hand itself became the first slide rule or calculator. It took practice, just like using a slide rule does, to become adept at bending and straightening fingers in order to add, multiply, subtract, and divide. Like playing the piano. Pianos also have a congruent mapping, the left-to-right order of the keys to the increasing frequencies of the notes the keys play. Using the hand as a calculator began as spatial congruence and evolved into performance congruence, one that mapped hand actions to arithmetic operations.

Continuing with music, not the piano, but singing. Another fascinating use of the hand was to represent musical notes and to lead a chorus, the Guidonian hand, so-called because it has been attributed to an eleventh-century monk, Guido of Arezzo. You can see a version in Figure 5.1.

Guido is also responsible for the way music is annotated to this day: do re mi fa so la ti do. Leading a chorus meant inscribing the notes on the fingers and palm, and pointing to the appropriate notes for the singers. Although the Guidonian hand fell out of use with the availability of printed music, it is making a comeback today.

The gestures used to calculate sums or to lead a chorus are not spontaneous; they are highly codified, even more than language. Nevertheless, like spontaneous gestures, they are intricately involved with thinking.

GESTURES AS SOCIAL GLUE

Conversation

That gestures are social glue is apparent from watching conversation. Gestures of the head, face, hands, and body keep conversation going. You say something and pause, looking at me. I nod my head to indicate I'm with you, or if I'm not, I raise my eyebrows or tilt my head and squint in puzzlement. When I'm ready to give you the floor, I lean back. Instead of answering a question I can't answer, I might shrug my shoulders. If we don't give this silent feedback to each other, conversation is awkward.

Collaboration

Conversation is one form of collaboration, but there are other explicit collaborations where gesture is key, notably where collaboration is facilitated by something in the world that can be pointed to or manipulated. Here's one example: pairs of students were asked to find the best route to rescue wounded people after a hypothetical earthquake. They were given a map of the campus with locations of wounded people and blocked roads. They were asked to sketch a map of the best route. Some pairs worked side-by-side huddled over the same map. Their conversation tools were hands, map, and voice. Although they were deep in conversation, they rarely looked at each other's faces. Instead they looked at their hands. Their hands took

turns suggesting and editing routes on the map, annotated by the voice. The voice said things like: go here, turn there, now this way, not there—expressions that made sense only by looking at what the hands were doing on the map. Their gestures got abbreviated. Initially, participants would trace a whole route; as collaboration proceeded, they just pointed to the successive intersections. They picked up on each other's gestures, a common phenomenon termed *entrainment* that is evident in words as well. Other pairs also worked side-by-side with identical maps but with a thin curtain between them. For those pairs, the only conversational tool was the voice. The first group of pairs, those who could gesture on a shared map, were more interactive, enjoyed the experience more, and produced better maps. The pairs separated by a curtain worked hard to agree on a route—students took this task seriously and enjoyed it. Yet, fully a third of the pairs came up with routes that differed substantially between partners.

Words can be and all too often are ambiguous, even words describing something as basic as space, the surroundings we carry with us at all times. Gestures, by contrast, are explicit. They show the exact places and trace the turns and paths. You already know what gestures predominated: point-like gestures for places, line-like gestures for paths. Zero-dimensional and one-dimensional. A third kind of gesture was also used, a two-dimensional sweep of the hand, to denote an area. The gestures didn't work alone, they worked with an external representation of the task, in this case a map. But remember that we saw earlier that gestures can create a virtual external representation that serves as a platform for gestures. Whether actual or virtual, an external representation creates common ground and serves as a stage for the hands to reason and deliberate.

Design

Here's another case, design. Small, experienced teams of designers were asked to redesign a device that detected properties of materials. Each team was seated around a table and given an engineering

drawing and eventually a tangible model to work with. Needless to say, there was considerable use of gesture, on the drawings and the object. A few of the groups had "radical breaks," sudden changes in design ideas. Insights. Flashbulb moments. These were accompanied by a cascade of new metaphors and new ideas, and notably an explosion of gestures, a switch from small ones on the table to large ones walking around the room enacting interacting with the object. Sometimes the narrated enactments were sketched rather than gestured, again showing the close relations between the two forms of expression, gesture and graphics.

Dance

The entire body participates in dance—dance is inherently and fully embodied. As such, it can readily represent itself. Yet choreographers and dancers have developed other embodied ways to represent dance when they are referring to dancing, techniques they call *marking*. Marking is often done with the fingers of one hand on the palm of another. The fingers dance as the legs would, showing a step to someone else. The whole body can also mark, performing what is essentially an embodied sketch of a dance or a segment of dance, for example, to sketch out position on the stage for lighting or to show in exaggerated fashion a dip of the torso or the stretch of a leg to a dancer. Surprisingly, sketching by marking an entire sequence of dance moves turns out to be a better way to remember the sequence than fully dancing the sequence. Sketching the sequence allows dancers to concentrate on the sequence, per se, rather than on both the sequence and the full expression of the movements.

Conducting

Now consider conducting, a vivid case for which gestures are the social glue. If the job of gestures on maps was straightforward, to express places and paths and areas, the job of gestures in conducting is straightforward but also nuanced and subtle. Among so many other things, conductors synchronize the tempo, oversee the dynamics of the music in space and in time, control the volume and intensity, and cue the entrances and exits of musicians. It is said that the left hand typically sets the tempo, and the right hand does the rest. But actual practice is far more complicated, and in no way systematized. Hand gestures vary wildly across conductors, many use a baton, some don't. Many use their faces, backs, legs, and even their lungs, the rhythm of their breathing. Leonard Bernstein famously conducted Haydn, entirely with his head and plastic face, especially his eyebrows, with hardly a movement of his arms or body. Van Karajan conducted with his eyes closed. Esa-Pekka Salonen dances. The diversity of styles is astounding, all the more so because, according to some research, hundreds of years of social interactions of this sort should have converged on a common language.

Conductors conduct the audience as well as the orchestra. Audience perception of features of music such as expressiveness, articulation, and dynamics are enhanced when emphasized by conductors. Even though the contribution of a conductor is entirely visual, when audio is kept constant and conducting varied, the experience of audiences changes accordingly. For example, conductors could lead listeners to attend to overall melody or to a repeating theme (*ostinato*). When conductors emphasized overall melody, listeners were more likely to describe the piece as connected and regular, but when conductors emphasized repeating themes, listeners were more likely to describe the same piece as disconnected and irregular.

Although conductors only create visual performances, musicians create both sound performances and visual performances. Remarkably, sometimes the visual is more powerful than the sound. Here's a dramatic case: determining the actual rankings of the top three finalists of a piano competition from audio alone, video alone, or both. Make your own prediction about which is best, but be prepared to be surprised. Both experts and novices were most correlated with the actual rankings when they had viewed only the video! This is, of course, despite their beliefs that the sound is more important than the visual.

Moving from music to art. Let me end the discussion of gestures as social glue with da Vinci's iconic *Last Supper*. You can find many copies in Google images. Better yet, go to Milan, to the church of Santa Maria delle Grazie and spend half an hour enjoying the real thing. A double session because the fifteen-minute standard session isn't enough time. Follow the complex interactions of the bodies, the eyes, and the hands. You can see who's talking to whom, how they are related, what they are referring to, how they are reacting. You feel the intensity of the interactions of the groups of guests and the calm detachment of Jesus. This is where we began, observing social interactions from afar, now exquisitely captured by da Vinci.

AFTERTHOUGHT

We can think with our bodies, but can we think great thoughts with our bodies? Yes! There's da Vinci thinking through designs for flying machines and bridges and parachutes. There's Einstein, imagining himself flying on a beam of light, the imagined flight that enabled his insights into spacetime. There are magicians who imagine making knots that undo themselves and surgeons who imagine one-handed knots that don't come undone. Houdinis imagining escapes from locked boxes and thieves imagining cracking safes. Then there are choreographers, football coaches, fashion designers, military strategists, wrestlers, artists, engineers, actors, and mathematicians. All (or most) thinking great thoughts with their bodies.

CHAPTER SIX

Points, Lines, and Perspective: Space in Talk and Thought

In which we consider how linear language describes space, using a perspective, either an inside, body-centered perspective or an outside, world-centered perspective. For insider perspectives, we show that surprisingly taking another's perspective is sometimes easier and more natural than taking your own.

The goal is not only the destination but also the path that takes you to it.

—Paul Andreu, from Lao Tzu

TALK AND THOUGHT

Talking isn't thinking. Talking can reveal thinking and talking can change thinking, but it shouldn't be confused with thinking. Talk is only one way to express thought; there are others. Laughing, gasping, and screaming emerge from the mouth bursting with meaning but are not talk. The face, the hands, the body—all express thought. As do sketches and diagrams and models and arrangements of things in space. Then there are times that our thoughts get stuck in our heads—they can't seem to find their way out. We are speechless, at a loss for words.

But talk can take us far; it's where we'll begin. Talk is words, one after another. Words are symbols, arbitrary and indirect expressions of meaning, expressions of meaning that are highly condensed. There simply aren't enough words. Words do not show their meanings in the ways that facial expressions, gestures, and depictions do.