18 BOB DYLAN'S NOBEL

Language, Literacy, and How the Senses Interact to Produce Literature

"A poem is a naked person. . . . Some people say that I am a poet."
—Bob Dylan, musician and poet

Communicating by symbols (written, sung, spoken, or tactile) is not uniquely human. Chimpanzees and gorillas can use sign language and symbols to communicate with humans. Other animals have unique communication capacities, too. But no other species on this planet has developed communication with pictures, sounds, words, and symbols as intricately as *Homo sapiens*. We also are uniquely capable of developing genealogies of different languages and of creating fictional languages for recreation. Dothraki (from HBO's hit series *Game of Thrones*, fig. 18.1) and Na'vi (from James Cameron's movie *Avatar*) are two recent examples of this well-respected and scholarly endeavor. The Language Creation Society encourages the creation of novel, or constructed, languages (also known as conlang to those in the know). Some online translators even include in their options for translation such languages as Dothraki, Na'vi, Klingon, Elvish (Quenya and Sindarin), Dwarvish (Khuzdul), Entish, and Black Speech. Although such endeavors may seem a bit extreme, by following the genesis of a fictional language, conlangers open up new ways to learn about how our brains work while on language. As

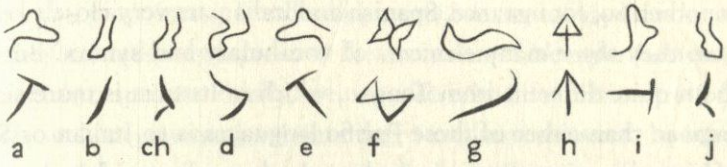

Figure 18.1. Part of the mythical Dothraki alphabet.

the Dothraki might say, "Atthirar nesolat lekh, shafka nesat rhaesheser" (loosely translated as "If you learn language, you know the world").

For more than three centuries humans have also tried to take the elements of different languages and decipher how they are related. Think about this. New languages arise from old ones. They have ancestral characteristics that allow linguists to attempt to reconstruct how certain languages actually evolved. You might be asking how many languages are there, or how many languages have there ever been? The first question is answered from studies accomplished by anthropologists and linguists. Today nearly seven thousand distinct languages are spoken on our planet, but more than half of these will most likely be lost within the next twenty years.

The following is a bald-faced example of a back-of-the-envelope calculation and is a very rough estimation of the answer to the second question, the number of languages that have ever existed. The rate of loss of languages in the next twenty years will be much higher than in the past as a result of globalization, and rates before this century work out on the back of the envelope to about two a year. If we accept that languages go back at least ten thousand years, then probably twenty thousand or so languages have existed on this planet, with 90 percent of them having gone extinct. At this rate, by 2100 probably less than 1 percent of the languages that have ever existed on this planet will be spoken. In other words, 99 percent of all languages that have ever existed on Earth will have gone extinct by the end of this century, and other than a few made-up conlangs, there will be no replenishment with new ones. Not as bad as the extinction rate of species on the planet (99.9 percent of all species that have lived on Earth have gone extinct), but species have been around for billions of years.

The different elements of language such as syntax and vocabulary can be used to figure out which languages are most closely related to

one another. So, for instance, Spanish and Italian are very closely related because they share many elements of vocabulary and syntax. But they are both quite different from Tongan, which in its turn is more similar to Samoan than either of those Pacific languages is to Italian or Spanish. Using this general approach, humans have dissected language to do something incredibly unique with spoken words—to understand the genesis of how the varied ways we communicate with one another arose.

To describe the nuances of linguistics and the particulars of language would be a daunting task far beyond the scope of this book. My goal here is to show that language is connected to the senses (easy) and that linguistic capacity, as well as our capacity for music and art, leads our brains to do something unique in the animal world (a little harder) and how this connects us to the world through our minds (much, much harder). The senses involved in language processing are primarily auditory and visual. But tactile senses are also used in braille and other means of communicating words using touch. For instance, some of the fictional languages created by the conlang community involve holding hands and speaking through grips and grasps. And in the long run it would not be surprising to me if a society for the creation of smell as a language crops up sooner or later. Certainly there are enough unique odorants that we humans have the potential to smell to provide us with a large enough vocabulary.

There is a lot of controversy over how and when language arose in our lineage as well as controversy about language in our closest relative, *Homo neanderthalensis*. The problem is that language is not observed directly in the fossil record. Instead, we are left with four indirect approaches to understanding the origin of language. First, we can look at the fossil record with respect to the anatomical structures that produce speech such as the voice box or, more technically, the hyoid bone and its location in skeletons of extant species and reconstructed extinct species. Second, we can examine artifacts such as stone tools and other easily preserved items that might be relevant to language. The idea here is that if an archaeological artifact implies symbolic reasoning and communication through such reasoning, then language more than likely existed for the maker of the artifact. Third, we can make some inferences about the origin of language by looking at linguistic patterns in *H. sapiens* and seeing how these compare to communication in chimpanzees. This ap-

proach can pinpoint *sapiens* developments but cannot say with impunity that they are uniquely *sapiens* to the exclusion of Neanderthals or other genus *Homo* species. Finally, we can also take information from living species such as genome-level data that have been shown to be involved in speech or language comprehension and use those data for interpretation of past events in the evolution of language.

Let's look at archaeological evidence first. The most compelling archaeological evidence would be some form of preserved writing such as the hieroglyphics of ancient Egypt. This kind of evidence does not exist for either archaic *sapiens* or Neanderthals. Another way to infer the existence of language from archaeological evidence might be to find evidence of the kinds of thought processes used in constructing language. Because symbolic thought is a major component of language, archaeologists have looked for evidence of this aspect of the human mind. Although the use of symbolic thought is not so hard to detect in our modern objects such as art and music, how an archaic human or a Neanderthal might have expressed it is difficult to ascertain. Ritualistic objects like colored shells in necklaces and formalized burials have been observed in both the Neanderthals and *sapiens* archaeological record. These items suggest some sort of symbolic thought. Perhaps the most interesting and, more important, oldest archaeological item to which symbolic thought can be inferred is a small stone with strong and intentional etchings found in an archaic *sapiens* site in the Blombos Cave in South Africa (fig. 18.2). The artifact is one hundred thousand or so years old and is thought to be the first strong evidence of the use of symbolic thought in human communication. On the other hand, there is scant evidence in the archaeological record that suggests Neanderthals could speak or that they had developed language. This doesn't mean that Neanderthals didn't have sign

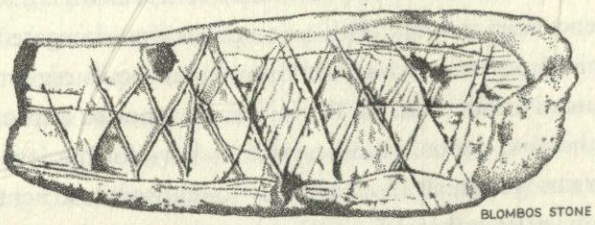

Figure 18.2. The Blombos Stone.

language or some other form of very basic language, though, nor that they didn't use symbolic thought. And it is arguable that the archaeological evidence for language in *sapiens* is scant and not much better.

The anatomical arguments about language origins concern the apparatus that *sapiens* uses to make the sounds that result in speech and implement language. The toolbox concerns the placement of the larynx in the throat region of the skeletal system. Specifically, the larynx has dropped to a lowered position in our lineage as opposed to the higher ancestral position seen in chimpanzees and Neanderthals. There is recent evidence that at least one Neanderthal skeleton from the Middle East may have had the larynx lowered, and this suggests that this specimen may have made speechlike sounds similar to ours. Anatomically modern *H. sapiens* appears to have evolved the morphological structures for a working voice box after our species diverged from the common ancestor of *neanderthalensis* and our species about two hundred thousand years ago.

Another example of the approach of focusing on anatomical structures involves reconstructing the brain of extinct specimens. If the parts of the brain involved in speech and language comprehension can be examined and approximate modern human brain wiring for this trait, then we can make some inference about the existence of language in such specimens. So, for example, if we used fully developed and connected Broca's and Wernicke's regions of the brain as benchmarks for speech and language, then a logical approach to determining if Neanderthals spoke (at least in the way we *sapiens* do today) would be to examine Neanderthal brains for such structures. If we could reconstruct Neanderthal brains the same way that Michel Thiebaut de Schotten and his colleagues reconstructed Phineas Gage's brain wiring from images of his skull, discussed in Chapter 6, then we would have an answer. The problem is that the reconstruction of Gage's brain wiring required the researchers to make the assumption that his neural wiring was similar to a reference human brain. This assumption would negate asking the very questions one would want to know about brain regions involved in speech in a Neanderthal. So, the question cannot be approached that way. And because the only tool researchers have for the reconstruction of fossil brains is through endocasts that roughly reconstruct the surface of the brain, paleoanthropologists have yet to precisely reconstruct the brain of a Neanderthal. Hence, there is no way to see what the physical

states of Broca's and Wernicke's regions were in this species or in any fossilized archaic human.

What can be done, on the other hand, is to use the brain size and shape from endocasts to make inferences about brain development or anatomy. There is novel evidence that the development of the brains of Neanderthals and *sapiens* were quite different during early critical phases of cognitive development. Such evidence comes from examining the skulls of infant Neanderthals and comparing them to *sapiens* and chimpanzee infant skulls. The evidence from these reconstructed infant brains, when added to earlier studies showing that chimpanzee and *sapiens* brains develop very similarly after the first year of life but not during the first year, indicates that this first year of development in humans and its globular result on the brain has something to do with cognitive differences of chimpanzees, Neanderthals, and *sapiens*.

Philipp Gunz, Simon Neubauer, and their colleagues were able to reconstruct a newborn Neanderthal skull to examine the dynamics of the structure of the developing brain case to make inferences about the shape of the brain that sat in the tiny skull. Both Neanderthal and *sapiens* babies have elongated brain cases at birth. What happens after birth in both species is significantly different, even though both species attain the largest brain of genus *Homo* members. *Homo sapiens* babies develop a more globular brain shape in the critical first year of life, while Neanderthals retain the elongated brain shape. What this means is that *sapiens* brains develop to become bigger in a very different way than Neanderthal brains, and more important, the growth differences occur in a period of brain development that is critical for increased cognitive capacity.

This first year of life is essential for establishing broad connections in the developing brain that are key for cognition, behavior, and communication. Some of these connections are pruned away later in the developmental process, but the richness of connections made in this first year of life is critical. Because chimp, Neanderthal, and *sapiens* brains all appear to develop similarly after the first year of life, this mode of development after year one most likely existed in the common ancestor of all three species. It also means that something novel or derived occurred in our lineage, and that novelty is the globular brain stage in the first year of brain development. It appears that Neanderthals may not have had the neural wiring that *sapiens* did for the kind of cognition and communi-

cation we evolved, suggesting that Neanderthals were more than likely quite different in how they viewed the world and communicated about it. These studies also suggest that not only does there need to be an anatomical change in the structure of our voice box for language to arise but there also needs to be a correlated change in brain wiring that increases or at the very least changes cognitive capacity in our species. This change in brain wiring includes better integration of our sense of sound and how we process it when we hear language.

Researchers have sequenced the genomes of several extinct Neanderthal individuals and the close relative known as Denisovan, and they have used the genome data to determine if Neanderthals had the genetic components for language, much in the same way color vision has been examined in Neanderthals (see Chapter 9). There are two major problems with this genomic approach, the first being that although there is most likely a genetic basis for language in *sapiens*, it is very likely an incredibly complex genetic phenomenon. The second problem is that at this time we simply do not have a hold on the actual genetic loci that might be involved except in a couple of interesting but all too general genetic phenomena. The phenotypic complexity of a trait like language is a major roadblock to understanding the genetic basis of the trait. We have already seen this problem manifest itself in this book with synesthetic traits and schizophrenia. Traits like these are difficult to define phenotypically, even with clever tests, and so without a well-defined idea of what the trait really is, genetic dissection is very difficult. In addition, even if one could pin down the phenotype, it is still possible that the trait could be caused by hundreds of genes, all with small effects. Researchers then turn to unique cases in the general population where the phenotype occurs and focus on families where strange phenotypes exist. One "language" gene, FoxP2, has been studied in this way, having been found in a family of people lacking language comprehension. The genetic basis of this trait has been studied at length, and the gene is known to be present in Neanderthals from genome scans. Detailed analyses of the FoxP2 gene sequence indicate that the Neanderthal version of the gene and the *sapiens* gene are identical at the DNA sequence level. This evidence, however, is circumstantial at best with respect to determining whether Neanderthals spoke.

The dissection of language as a phenomenon and its subsequent

evolutionary analysis have been the focus of work by Johan Bolhuis and his colleagues. They argue that language itself is not all there is to communication. By pointing out that language, although a form of communication, cannot be equated to it, they come to a more precise definition of what language is and hence can look at the phenomenology of it in a more exact and productive way. Language to them is the capacity to merge ideas and words.

Merging, in its simplest form, is the capacity to recognize objects and actions as coming from self or from others and to be able to sort that out and, more important, to express it in symbols. The argument is that, without merging, language cannot exist. You can still communicate, but you will not have language. It is clear that among living species, merging is a uniquely *sapiens* characteristic, because chimpanzees do not do it. Bolhuis and colleagues also argue that the capacity to merge arose in *Homo sapiens* between seventy thousand and one hundred thousand years ago. Although some have challenged their argument for this timing as being too short and illogically deduced, the timing actually makes sense because it coincides with the movement of our species across the globe and our emergence as the dominant force on this planet.

Two aspects of language to make the discussion relatively complete are reading and writing. Literacy is a very modern development in our species. More than likely writing and reading arose in the last ten thousand years. This short period of time for literacy in our species has had a huge impact on the neurobiology of our senses. The portal for the neural information that is needed for literacy is usually through the retina and hence the eyes. Of course, reading can also be accomplished by the blind using braille, but the tactile neural pathways this information takes in braille is quite different from the pathway for visual reading. Studying the emergence of reading takes a comparative approach. It is not hard to follow the acquisition of literacy in humans by following how children acquire it. The assay of choice is usually fMRI, and longitudinal assays of the brain in children acquiring literacy can be compared across different ages.

As with any comparative approach, the research must be done carefully because some of the inferences can be confounded if age and degree of schooling are not considered. Children of specific ages can't be compared directly because of potential differences in their schooling, so age is not a good starting point for setting up the comparisons. The dif-

ferences in schooling create a subtle apples and oranges problem for following the acquisition of literacy. Comparing adults who have acquired literacy later in life with those who have not seems to be a better way to get at the impact of reading on the brain. With these caveats about confounding results, some very interesting inferences have been made about the acquisition of literacy.

As with all of the senses, when the initial information enters the brain from the sensory collection organ (in the case of literacy, the organ is the retina) there is an initial rapid processing of the information (fig. 18.3). With literacy there are subtle differences between figures in writing and reading, so the brain suppresses the capacity to lump and instead becomes quite discriminatory with apparently repeated images. It is clear from comparing fMRIs of literate adults with those of illiterate adults that this suppression is more prominent in people who have acquired literacy. These comparisons have also provided finer resolution of the visual pathways of our species and differences between culturally distinct writing systems. Remember that the information from the retina in early visual processing goes through several areas of the visual cortex, specifically the pathways known as V1, V2, V3, and V4. Western writing uses the V1 and V2 pathways to sort out and recognize the characters used in literacy. By contrast, recognition of characters in Chinese writing

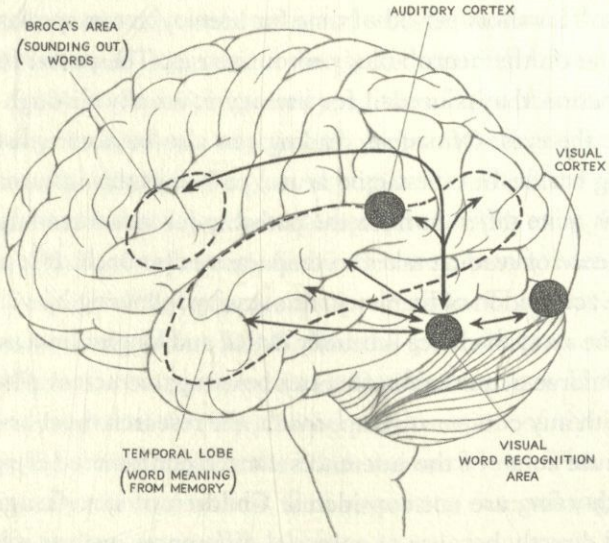

Figure 18.3. The location of specific regions of the brain involved in literacy.

uses the V3 and V4 pathways. The apparent reason for this difference is that Western writing requires knowledge of a rather small number of components in the alphabet. In English, this number is a mere twenty-six bits of information, and this small number of units is best handled by V1 and V2. There are thousands of Chinese characters, though, and these seem to be best processed by the shape-learning V3 and V4 visual pathways. Beyond the early visual processing, the information passes to other parts of the brain.

For our ancestors this processing was needed to be able to recognize things in the outer world relevant to our survival. Our nonhuman primate ancestors did not have writing, of course, so the visual information from writing has a unique and important impact on our species with respect to the ventral visual (the "what") pathway. There is a clearly defined and repeatable region of the ventral processing pathway that shows activity in fMRIs when a literate individual is presented with writing, whether it is Shakespeare or gibberish, in a writing system with which he or she is familiar. This region is the same regardless of language and characters in the language and is called the visual word form area. (Again, this inference is made by comparing people who have acquired literacy to people who haven't.) It appears that this region of the brain becomes highly active with exposure to writing and even to the rudimentary acquisition of literacy.

One of the more interesting developments with the acquisition of literacy in the visual word form area is that this pathway in the brain learns to suppress the tendency to lump mirror images of objects. This tendency to lump is thought to be adaptive, so suppressing it is difficult. That hyena facing to the left is the same as that other one facing to the right, and so there is no need to discriminate between the two. And it follows more quickly that it is wisest to run away from something regardless of mirror image. With the acquisition of literacy there are subtle differences in the characters used. Examples from the Western alphabet include *b* / *d* and *p* / *q*. And hence the adaptive reason for this so-called mirror invariance of our nonliterate ancestors needs to be overcome to acquire literacy. This repositioning of mirror invariance is only one example of the tendency of our species to rewire or repurpose parts of our visual pathways during literacy acquisition to accommodate the unique capability we have to read and write. As noted previously, our species

acquired writing and reading very recently. As Stanislas Dehaene and colleagues have elegantly stated, "Literacy acquisition therefore provides a remarkable example of how the brain reorganizes to accommodate a novel cultural skill." It would not be surprising if other regions of our brains have already begun to repurpose neural real estate to accommodate other more modern culturally induced phenomena such as interacting with computers and watching movies and television.

Our species has used language in a myriad of ways. Many uses have had direct bearing on the survival of our species. Indeed, some paleoanthropologists look to language as the spark that sets our species so far apart from all other species on the planet. While writing this book I experienced two relatively improbable events: the Chicago Cubs won the World Series, and Bob Dylan was awarded the Nobel Prize for Literature. One of these events brings me great joy, and the other is puzzling but at the same time intriguing. Being the son, grandson, brother, and uncle of Chicago Cubs fans, and one myself, my capacity for rooting for the underdog is well honed. So, when Bob Dylan, certainly an underdog in the literature world for winning a Nobel, was announced as the Laureate in Literature, followed almost a month later by the Cubs' magnificent victory, it was hog heaven for underdogs. But many in the field of literature questioned the awarding of a Nobel Prize to Bob Dylan as a stretch, and as a result some have even started to question what poetry and literature really are. At the very least, some have started to ask questions about whether Dylan's work really is literature.

Why does poetry affect us differently than randomly chosen words or even specifically chosen words not couched as poetry? The answer to these questions resides in understanding the neurobiology of our senses and how language can incite memories and emotions, much in the same way that music and art affect our emotions and memories. Jonah Lehrer, a former journalist, wryly suggests that the great author Marcel Proust was a neuroscientist. His argument stems from the effectiveness of Proust's writing at inciting the emotions and remembrances of the past, most notably with his madeleine, discussed earlier in this book (Chapter 6). In many ways, if we communicate well, using language, art, or music, we are also neuroscientists. We all have our madeleines, and more important, we all can use language to describe the brain when using language or viewing art or listening to music.