Andy Clark, *The Experience Machine: How Our Minds Predict and Shape Reality*. Penguin Press, 2023.

From Chapter 3
ACTION AS SELF-FULFILLING PREDICTION

WE HAVE seen that expectations and predictions deeply influence what we see, hear, and feel. But we have so far said little about how they influence what we do. Yet the fundamental task of the brain is to help us to stay alive, and that means acting in a complex and uncertain world. Action is where the rubber really hits the road—where the high metabolic cost of having a brain must really earn its evolutionary keep.

Perhaps surprisingly, prediction is also the engine of action. This is because ordinary daily actions (according to predictive processing) are caused by predictions of bodily sensation. They are caused, more precisely, by predictions of the flow of bodily sensations that would occur if that very action were to be performed. The predictive control of action thus has a kind of subjunctive quality. The brain predicts how things would look and feel if the action were being successfully performed, and by reducing errors relative to that prediction, the action or movement is brought about. Predicting just how it would look and feel to hit that perfect drive, or make a killer serve, brings that longed-for result about. But this is not a facile nod toward "positive thinking." Rather, it is a detailed proposal about how our brains control our bodies. The upshot is that successful action involves a kind of self-fulfilling prophecy. Predicting the detailed sensory effects of a movement is what causes that very movement to unfold.

By making prediction the common root of both perception and action, predictive processing (active inference) reveals a hidden unity in the workings of the mind. Action and perception form a single whole, jointly orchestrated by the drive to eliminate errors in prediction.

<u>Ideomotor Theory</u>

There is a mode of controlling action that is remarkably well suited to delivering fluid, flexible control. It is also a mode of control that comes very naturally to a predictive brain. Its roots go back to the mid-nineteenth century and the work of the German philosopher Hermann Lotze—work that was then taken up by the American philosopher and psychologist William James. The core idea was that actions come about because we mentally represent the completed effects of the action. In other words, the idea of the completed action is what brings the actual action about. This is sometimes said to reverse a commonsense notion of causality, since instead of the action causing the effect, it is the representation of the effect

(the completed action) that causes the action itself to unfold. It's not really that the effect precedes the cause, but rather that the cause turns out to be a kind of mental image of the effect. This became known as the "ideomotor theory of action," since the idea (or mental image) of the completed motor action is what brings the actual movements about.

Let's begin to consider how this might work in practice. Imagine you have a wooden marionette, with multiple articulated joints, that can be animated by a network of strings. You want to make it raise its hand. By pulling the string attached to the hand, you move the hand to where you need it to be. But in so doing, you automatically move all the interconnected arm, elbow, and shoulder joints in exactly the ways required (see Fig. 3.1). This means that the movement planner (in this case you, the puppet master) need not worry about exactly how to move (say) the shoulder joint or the elbow joint. They take care of themselves, falling into the correct configuration as the hand is drawn toward the desired endpoint.

In slightly more technical language, you don't have to worry about all the many degrees of freedom in the arm, elbow, and shoulder. By solving the problem for the endpoint of the hand, you automatically ensure that everything necessary falls into place. From the point of view of the marionette (assuming it had one) it would feel like its hand was pulled by some external force directly toward some desired location and that the rest of its body simply fell into the shape and form required. This is also known as the passive motion paradigm. This states that the task of the brain, when controlling action, is to determine how each bodily joint would have to move if some external force somehow pulled the body toward the goal. It is then the brain's careful simulation of all the bodily effects expected under that scenario that causes the bodily parts to move in exactly the ways required.

This method of controlling movement involves a profound inversion that will appear again and again as we look at how predictive brains control action. One approach has it that our brains must find the right motor commands by working forward from the actual state of the body toward the target state—computing the complex sequence of commands to take us from "hand at rest" to, say, "hand gripping coffee cup." This is a very complex problem with many possible solutions. Predictive processing suggests something like the reverse. Representing some desired end result, such as grasping the cup, automatically recruits (in the skilled agent) the set of motor commands needed to make that very thing happen.

How could this possibly work? In the case of the marionette, the puppet master is quite literally pulling the strings. But for this to be a way of understanding how brains control movements, we need to understand how we can be both marionette and puppet master at the same time. Fortunately, predictive brains are ideally suited to enable just this kind of "magic" to occur. In the broadest possible terms, the solution is that the brain learns, through training and experience, to predict what we would see and feel if—but only if—our bodies were

moving in just the right ways so as to achieve our goals. Those predictions (of what we would see and feel as the right movements unfold) then act—in a way we are about to explore—as motor commands bringing those very movements about. In this way predictive processing provides a way of carrying out the procedure envisioned, in very general terms, by the older ideomotor story. It shows how the "idea" of a successful action can be the very thing that brings that action about.

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Muscular Bonding

In September 1941 I was drafted into the army of the United States and underwent basic training in Texas along with thousands of other young men. Supplies were short. We boasted a single (inoperative) anti-aircraft gun for the entire battalion, so that practical training on the weapon we were supposed to master was impossible. Consequently, whenever our officers ran out of training films and other ways of using up time, we were set to marching about on a dusty, gravelled patch of the Texas plain under the command of an illiterate noncom. A more useless exercise would be hard to imagine. Given the facts of twentieth-century warfare, troop movement in the rear was a matter of trucks and railroads. Close-order marching within range of machine guns and rifles was a form of suicide. All concerned realized these simple facts, yet still we drilled, hour after hour, moving in unison and by the numbers in response to shouted commands, sweating in the hot sun, and, every so often, counting out the cadence as we marched: Hut! Hup! Hip! Four!

Treasured army tradition held that this sort of thing made raw recruits into soldiers. That was enough for our officers and the cadre of enlisted men who were in charge of our training. But why did young Americans not object to senseless sweating in the sun? At the time I was too busy getting used to totally unfamiliar routines and social relations to ask the question,

much less reflect upon it. What I remember now, years afterwards, is that I rather liked strutting around, and so, I feel sure, did most of my fellows.[1] Marching aimlessly about on the drill field, swaggering in conformity with prescribed military postures, conscious only of keeping in step so as to make the next move correctly and in time somehow felt good. Words are inadequate to describe the emotion aroused by the prolonged movement in unison that drilling involved. A sense of pervasive well-being is what I recall; more specifically, a strange sense of personal enlargement; a sort of swelling out, becoming bigger than life, thanks to participation in collective ritual.

But such phrases are far too analytical to do justice to the experience. It was something felt, not talked about. Words, in a sense, destroy what they purport to describe because they limit and define: in this case, a state of generalized emotional exaltation whose warmth was indubitable, without, however, having any definite external meaning or attachment. The strongest human emotions—love, hate, and fear—are ordinarily triggered by encounters with other persons or particular external circumstances, and the emotion in question helps us to react successfully. But the diffused exaltation induced by drill has no apparent external stimulus. Instead, marching became an end in itself. Moving briskly and keeping in time was enough to make us feel good about ourselves, satisfied to be moving together, and vaguely pleased with the world at large.

Obviously, something visceral was at work; something, I later concluded, far older than language and critically important in human history, because the emotion it arouses constitutes an indefinitely expansible basis for social cohesion among any and every group that keeps together in time, moving big muscles together and chanting, singing, or shouting rhythmically. "Muscular bonding" is the most economical label I could find for this phenomenon, and I hope the phrase will be understood to mean the euphoric fellow feeling that prolonged and

rhythmic muscular movement arouses among nearly all participants in such exercises.[2]

In later years I had occcasion to recall and reflect upon my response to close-order drill anew. In particular, when writing *The Pursuit of Power,* I concluded that the modern superiority of European armies over others was largely due to the psychological effect of the sort of close-order drill I had experienced. Maurice of Orange had introduced incessant drill to the Dutch army in the 1590s, and it spread across Europe like wildfire in the ensuing half century.[3] One obvious reason was that well-drilled troops were more efficient in battle; but an additional advantage was that it became safe to arm even the poorest classes, pay them a pittance, and still expect and secure obedience. The emotional resonance of daily and prolonged close-order drill created such a lively *esprit de corps* among the poverty-stricken peasant recruits and urban outcasts who came to constitute the rank and file of European armies, that other social ties faded to insignificance among them. Such troops soon came to constitute a cheap, reliable instrument in the hands of European statesmen and generals. Within two centuries, they carried European power around the globe; and in time of domestic disturbances, European soldiers were even willing to fire upon their own kind—at least most of the time.

Reflecting on my odd, surprising, and apparently visceral response to close-order drill, and recalling what little I knew about war dances and other rhythmic exercises among hunters and gatherers, I surmised that the emotional response to drill was an inheritance from prehistoric times, when our ancestors had danced around their camp fires before and after faring forth to hunt wild and dangerous animals. It was easy to suppose that by rehearsing what had been done before and would be done again in pursuing and killing their prey, ancient hunters' actual performance in the field gained precision. If so, better success was assured; survival became easier. I concluded that rigorous selection in favor of groups that kept together in

time had led to genetic transmission of this capability, which then was inadvertently tapped by Maurice of Orange and innumerable drill sergeants ever since.

Such a hypothesis means that emotional response to rhythmic movement in unison ought to be universal; its manifestations pervasive; and its importance in history enormous. But in fact close-order drill is conspicuous by its absence in most armies and military traditions. From a world perspective, indeed, the way Greeks and Romans and then modern Europeans exploited the psychological affect of keeping together in time was an oddity, not the norm of military history. Why should Europeans have specialized in exploiting the extraordinary possibilities of close-order drill? More important, how has the phenomenon of muscular bonding manifested itself across the centuries and among innumerable different societies?

The specifically military manifestations of this human capability are of less importance than the general enhancement of social cohesion that village dancing imparted to the majority of human beings from the time that agriculture began. Two corollaries demand attention. First, throughout recorded history, moving and singing together made collective tasks far more efficient. Without rhythmical coordination of the muscular effort required to haul and pry heavy stones into place, the pyramids of Egypt and many other famous monuments could not have been built. Second, I am convinced that long before written records allowed us to know anything precise about human behavior, keeping together in time became important for human evolution, allowing early human groups to increase their size, enhance their cohesion, and assure survival by improving their success in guarding territory, securing food, and nurturing the young.

That may perhaps count as a political expression of the emotional force of muscular bonding; and festive village dancing was political too, smoothing out frictions and consolidat-

ing fellow-feeling among the participants. But such descriptions are unduly analytical, since in the depths of evolutionary time as well as in agricultural villages of historic ages, social, religious, political, and economic aspects of community life presumably constituted an undifferentiated whole.

In ancient civilized societies, where different groups went their separate ways, older forms of muscular bonding continued to exercise their influence in everyday rural settings; but, in addition, specifically religious manifestations of such bonding became an important way of creating emotionally vibrant primary groups within which human lives found meaning and direction. Then, in modern times, political and military expressions of this human capability separated out from more generalized social and religious contexts. Their importance was enormous, as the historic role of close-order drill for modern armies and of calisthenics and parades for nationalist movements of the nineteenth and twentieth centuries amply attest in every part of the earth.

Our television screens show continuing, pervasive manifestations of the human penchant for moving together in time. American football crowds, South African demonstrators, patriotic parades, and religious rituals of every description all draw on the emotional affect of rhythmic movements and gestures. So of course do dancing, military drill, and the muscular exercises with which, it is said, workers in Japanese factories begin each day. Yet, so far as I can discover, scientific investigation of what happens to those who engage in such behavior remains scant and unsystematic. Psychologists and physiologists have not been much interested. Extreme states, especially the onset of trance after appropriate warm-up by song and dance, have excited considerable discussion. But precise measurement of neural, hormonal, and other physiological changes incident to trance is conspicuous for its absence; only a few, crude experiments have sought to measure what happens within the brain when eyes and ears are sub-

jected to rhythmic external stimuli. Despite two bouts of library research, I found no physiological studies of human emotional responses to rhythmic muscular movement in groups, nor even to choral singing.

Yet some things seem reasonably sure. The primary seat of bodily response to rhythmic movement is apparently situated in the sympathetic and para-sympathetic nervous systems.[4] These nerve complexes are involved in all emotions; but exact paths of emotional excitation by the sympathetic nervous system and of compensatory restoration of bodily homeostasis by the para-sympathetic nervous system are not understood. Various hormones excreted by the pituitary gland and by other organs of the body play a role;[5] so do the hypothalamus, the amygdala,[6] and the right side of the cerebral cortex.[7] Only after filtering through these levels of the brain does excitation derived from rhythmic muscular movement and voicing reach the left side of the brain, where our verbal skills are situated.[8]

With such a pathway of response to rhythmic muscular movement, it is no wonder that our words fumble when seeking to describe what happens within us when we dance or march. The initial seat of excitement is far removed from our verbal capabilities. It centers instead in those parts of the nervous system that function subconsciously, maintaining rhythmic heartbeat, digestive peristalsis, and breathing, as well as all the other chemical and physiological balances required for the maintenance of ordinary bodily functions.

The critical fact, however, from my point of view, is that whatever happens at a subconscious level in response to rhythmic stimulation from movements of the big muscles results in a diffused state of excitement that is definitely pleasurable at the conscious level. Why this is so remains obscure.[9] Experiments have shown that rhythmic stimulation of eye and ear enhances brain waves in the cortex, and when the periodicity of the light or sound stimulus is close to natural rhythms, the two tend to match up.[10] But the experiments that produced this

result were conducted in a laboratory, where the subjects sat or lay down in order to allow electrodes, wired to their heads, to transmit brain-wave impulses to a recorder. Obviously, cerebral response to flashing light and rhythmic sounds under such circumstances proves nothing about actual dancers' reaction to rhythmic kinesthetic stimulation. Experimental exploration of exactly what the sympathetic and para-sympathetic nervous systems do when we dance or march together seems never to have been attempted, perhaps because it would be difficult (or impossible?) to carry through without altering the dance or damaging the bodies of those subjected to such experiments.

Reflecting on these matters, it has occurred to me that rhythmic input from muscles and voice, after gradually suffusing through the entire nervous system, may provoke echoes of the fetal condition when a major and perhaps principal external stimulus to the developing brain was the mother's heartbeat. If so, one might suppose that adults when dancing or merely marching together might arouse something like the state of consciousness they left behind in infancy, when psychologists seem to agree that no distinction is made between self and surroundings. It seems plausible to suggest, therefore, that prolonged and insistent rhythmic stimuli may restore a simulacrum of fetal emotions to consciousness. Obviously no one knows, and experimental validation seems intrinsically impossible.

All the same, the idea accords nicely with what anthropologists and dance historians have to say about the state of mind induced by keeping together in time. Thus, for example, when an anthropologist questioned ritual dancers in Greece, they explained that they felt "light, calm and joyful."[11] Another observer reports that hunters and gatherers of the Kalahari desert say: "Being at a dance makes our hearts happy."[12] More commonly, anthropologists rely on their own vocabulary and intutition, as A. R. Radcliffe-Brown obviously did

when he wrote of the Andaman islanders: "As the dancer loses himself in the dance, as he becomes absorbed in the unified community, he reaches a state of elation in which he feels himself filled with energy or force immediately beyond his ordinary state, and so finds himself able to perform prodigies of exertion."[13]

A contemporary dance historian offers a more economical description, referring to "boundary loss, the submergence of self in the flow,"[14] though what the flow may be she does not say. Subhuza II, a Swazi king who had studied anthropology in England before assuming his royal duties, was a bit more down to earth when, in 1940, he explained what happened among his subjects: "The warriors dance and sing at the Incwala [an annual festival] so that they do not fight, although they are many and from all parts of the country and proud. When they dance they feel they are one and they can praise each other."[15]

"Boundary loss" is the individual and "feeling they are one" is the collective way of looking at the same thing: a blurring of self-awareness and the heightening of fellow-feeling with all who share in the dance. It matches my own recollection of what close-order drill felt like, so I take this to be the characteristic alteration of consciousness that sets in as the rhythm of muscular movement takes hold, and before prolonged or heightened exertion brings on ecstatic states when awareness of others fades away and excitement concentrates within the self. Very likely trance is provoked when restorative responses, triggered by the para-sympathetic nervous system, take over dominance from the excitatory reponses of the sympathetic nervous system.[16] Ecstasy induced among adepts by physical exercises, and the encounter with spirits or God that ecstasy was commonly believed to bring in its train, add a complex, extra dimension to what I hold to be the more generally significant social bonding that rhythmic moving together arouses among ordinary people. Seeming contraries, they are

indissolubly connected and both have had great importance throughout human history.

Obviously, the impact of marching in unison is much more subdued than the emotions aroused among dancers. Perhaps for that reason, military writers have been remarkably inarticulate about the emotional effect of drill. To be sure, Maurice de Saxe, Marshal of France (d. 1750), explained how fatigue should be countered:

> Have them march in cadence. There is the whole secret, and it is the military step of the Romans. . . . Everyone has seen people dancing all night. But take a man and make him dance for a quarter of an hour without music and see if he can bear it. . . . Movement to music is natural and automatic. I have often noticed while the drums were beating for the colors, that all the soldiers marched in cadence without intention and without realizing it. Nature and instinct did it for them.[17]

Nature and instinct still operate in the twentieth century and affect thoroughly urbanized, highly educated persons, as my own response to close-order drill in 1941 illustrates, and as testimony from the distinguished military historian, Sir Michael Howard, confirms. Having spent many youthful hours on the drill field, he recalled that "Drill developed group cohesion to a very high degree."[18] But military writers have preferred to justify continued resort to close-order drill, after it lost its practical meaning on the battlefield in the 1840s, by making unconfirmed assertions about how drill inculcates automatic, unthinking obedience. Before then, the obvious, intended effect of improving the effectiveness of volleyed fire was all the justification that drill, and still more drill, needed; and only Maurice de Saxe seems to have taken note of one aspect of its emotional side effects.

A few observers of modern warfare have emphasized the strong attachment to "buddies" that allows armies to function as they do. Sociologists studying World War II experience

discovered that what kept men fighting was not propaganda nor words of any kind, but an intense fellow-feeling for those close at hand and sharing imminent, obvious danger.[19] A reflective soldier's ruminations expressed the phenomenon more vividly:

> Many veterans who are honest with themselves will admit, I believe, that the experience of communal effort in battle, even under the altered conditions of modern war, has been the high point of their lives. . . . Their "I" passes insensibly into a "we," "my" becomes "our," and individual fate loses its central importance. . . . I believe that it is nothing less than the assurance of immortality that makes self sacrifice at these moments so relatively easy. . . . I may fall, but I do not die, for that which is real in me goes forward and lives on in the comrades for whom I gave up my life.[20]

Obviously, this sort of merger between self and the surrounding group, attained in the heat of battle, is analogous to the "boundary loss" attributed to dancers. It is also induced by close-order drill, though only in attenuated measure. If so, drill, dance, and battle belong together. All three create and sustain group cohesion;[21] and the creation and maintenance of social groups—together with resulting rivalries among groups—constitute the warp and weft of human history.

Yet historians and social theorists, like psychologists and physiologists, have paid little attention to muscular manifestations of group solidarity. We are captives of language for our explanations, and words do not capture the visceral emotions aroused by keeping together in time. People have always danced but seldom wrote about it, and almost never tried to analyze what they felt while moving rhythmically together. Sources are therefore scant to nonexistent.

This does not mean that the phenomenon of muscular bonding was unimportant. Quite the contrary. This book explores a few of the historically important manifestations of group

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THE RITUAL SPECIES

Every year, an ancient ceremony takes place at the shores of Lake Natron in northern Tanzania. Over a million participants travel from afar, some of them covering thousands of miles to attend the festivities. Upon their arrival, they socialise and feast together in anticipation of the main event. Dressed in flamboyant pink colours, they break off into smaller groups to perform an extraordinary dance. They gracefully move in circles, holding their heads high, bowing them down and turning them from side to side. Every once in a while, they switch partners and repeat the whole sequence. Gradually, excitement builds and the dance becomes more frantic. They start swirling, occasionally letting out excited cries and throwing their feet up in the air. In time, the entire crowd behaves like one pulsating unit. At the culmination of the ceremony, they get in formation and begin to march together in lockstep while chanting in synchrony. This is no frivolous drama – in fact, the stakes could not be higher. At the conclusion of the ceremony, young females pick their favourite male dancers, who will become their sexual partners, often for life. It is a custom that has been handed down through countless generations and remains unchanged to this day.

This mating ritual was recently studied by a group of French ornithologists: the protagonists are flamingos, and the stage for it is known as a 'lek' (a word of Swedish origin that denotes

fun and games). Mating arenas like this one are found around the world, where various species of animals congregate in large numbers to engage in courtship rituals. The researchers took advantage of a pool of 3,000 tagged birds in the Camargue region of the Rhône delta in southern France, an area full of shallow lagoons that make it an ideal habitat for flamingos. The tagging system allowed them to know the sex, age and life history of each individual bird, so that they could study them at a distance without disturbing them. Over a two-year period they used high-definition video cameras to observe and record the behaviour of one hundred of those birds (fifty males and fifty females) during the mating season. They meticulously documented the type, frequency and timing of each bird's dance moves, as well as their success rates in copulating and producing offspring. What they learned is that the most skilled dancers – that is, those who had the largest repertoire and the most varied combinations of moves – had much higher chances of finding a mate.[1] The early bird may get to feed, but the groovy bird gets to breed.

The lekking behaviour of flamingos resembles some more familiar forms of ritualised courtship. If you focused on the movements of a pair of birds dancing in circles, stretching, turning and bowing their heads in synchrony, you might find it strikingly similar to a Viennese waltz. And if you zoomed out to look at the entire entranced flock dancing in unison, you might think of a rave or rock concert. Just like their avian counterparts, those human behaviours involve similar movements performed in synchrony, and they similarly often result in mating. But many social scientists will be quick to offer a word of caution here: they will insist that bird rituals are the product of hard-wired instincts. Flamingos dance because they are programmed to do so. Their brain tells them to do it, and they

obey. Human ritual, in contrast, is complex and full of subtle symbolism, which is the product of our sophisticated culture.

However, as I will show in the pages that follow, rituals are part of human nature just as much as they are part of bird nature – in fact, probably even more so. They are truly universal human behaviours. If you can find a human society without any rituals, I will happily reimburse you the cost of this book. Across all cultures, rituals appear spontaneously in childhood; they are readily learned and transmitted, and are performed by religious and secular individuals alike.

Besides, not all bird rituals can be brushed away as simple automatic behaviours. Bowerbirds perform their own mating rites in elaborate love nests constructed by the males. All aspects of those ceremonies, including the dance moves, songs and the intricate details of the bower's decorative style, vary between different populations of bowerbirds and are culturally transmitted. When one bird migrates to another area, it will adapt its mating ritual to the customs of the local population.[2] Other birds, such as magpies, ravens and crows, appear to have death rituals. They flock over corpses of deceased members of their group as if standing vigil, and have been observed fetching sticks and other objects and arranging them around the corpse.[3]

Another problem with the comparison between bird and human rituals is that birds are very distant relatives, phylogenetically remote from us. If their rituals and ours are in fact related, we should find analogous behaviours among some of our closest relatives, such as other mammals, and especially other apes.

There are two possibilities here. The first is that bird and human rituals are not directly related but have evolved independently, in a process called *convergent evolution*. This means

that similar traits and behaviours tend to evolve among different species whenever they need to solve comparable problems. For instance, dolphins are genetically no more closely related to sharks than gorillas are to herrings; but because both dolphins and sharks had to face similar adaptive problems associated with moving underwater at high speeds, they evolved very similar streamlined body shapes. In a similar manner, birds and humans have specific similarities that may play a crucial role in their hyper-ritualisation. Specifically, birds use vision and hearing as their primary senses, tend to be social species, engage in pair-bonding, are often monogamous, are excellent imitators and have specific proclivities related to rhythm, synchrony and vocalisation. All of these traits, as we shall see, are crucial to human rituals as well.

Another possibility is that, when it comes to ritual behaviour in animals other than birds, we simply haven't looked hard enough. Indeed, many of the traits previously thought to be uniquely human have now been found in other animals. Until recently, favourite candidates for this human uniqueness included emotions, personality, using and making tools, empathy, morality and warfare, to name a few. But as soon as scientists started studying other animals systematically in their natural environments they realised that, in one form or another, all of these traits can be found in other species. Similarly, until recently there was barely any evidence of ritual behaviour among mammals. Today there is plenty, and mounting. Dolphins engage in a form of group dance, breaching out of the water in synchrony; humpback whales perform collective songs; and various marine mammals seem to have mourning rituals, carrying their dead around for days or swimming around them in unison. Dolphins have even been observed pushing a dead calf towards a boat and waiting for the boat crew to pick up

the corpse, then forming a circle around the vessel before swimming away.[4]

In addition to the air and the sea, rituals abound among land animals too. When courting, giraffes perform a love dance that resembles a tango, with the male and female walking alongside, rubbing, butting and entwining their long necks. Packs of wolves sing together, howling in unison across large distances. And elephants hold rituals to mourn for and pay tribute to their dead.

Elephants are indeed among the few animals who seem to have an understanding of death. They have often been observed trying to bury deceased members of their group by scattering dirt on them or covering them with leaves and flowers. There are even reports of elephants trying to bury other dead animals that they came across, including humans.[5] George Adamson, the wildlife conservationist whose family became the inspiration for the film *Born Free*, told the story of a woman in Kenya who fell asleep as she was resting under a tree. When she woke up, a group of elephants were standing nearby and one of them was gently poking and smelling her. The woman was petrified and decided to stay still and play dead. The pachyderms soon gathered around her and started trumpeting loudly. They collected branches and foliage from the tree and covered her body entirely with them. The next morning, local herdsmen found the woman still under the large pile of branches, too scared to move.[6]

When one of their own perishes, especially when it is an important member of the group such as a matriarch, elephants will remain with the body for days and will return to the

carcass frequently. Even decades later, they travel long distances to visit the bones of their deceased relatives. When they arrive, the entire group stands in silence and they take turns to inspect the remains, gently touching, turning and smelling the bones. Adamson reported that a male elephant in Kenya was shot because he kept trespassing into the government gardens. His body was dragged half a mile away, where it was butchered and the meat distributed to the local tribespeople. That night, other elephants found the carcass, picked up the bones and carried them back to the spot where he had been killed.

Collective rites are also common among members of our own family, the *hominids*, which includes modern and extinct great apes. The primatologist Jane Goodall, who was the first scientist to systematically study non-human primates in their natural environment, described a variety of striking behaviours among apes. She spent several years living with chimpanzees in Gombe National Park in Tanzania. She noted that, when the chimps visited certain places, they engaged in some rather peculiar behaviours. For instance, when they approached a large waterfall, they often performed what Goodall called a 'waterfall dance', a spectacular display that can last for up to fifteen minutes. During this display the chimps stand upright, stamping and swaying rhythmically from foot to foot in a state of hyper-arousal, swinging from tree vines through the spray of the waterfall and hurling large rocks into the water. Once the commotion is over, they sit down and gaze quietly at the waterfall for several minutes. Chimpanzees perform similar dances 'at the onset of a very heavy rain, reaching up to sway saplings or low branches rhythmically back and forth, back and forth, then moving forward in slow motion loudly slapping the ground with their hands, stamping with their feet, and hurling rock after rock. […] Is it not possible that these performances

are stimulated by feelings akin to wonder and awe?' Goodall wondered.[7]

More recently, in a variety of locations in West Africa, chimpanzees were recorded collecting stones and carrying them to specific trees. They placed these rocks inside hollow cavities, used them to drum on the tree trunks or piled them at the base of the trees. Researchers compared these stone piles to the cairns or stone mounds that people in various cultures use to mark sacred locations.[8] Indeed, these trees seem to have some special significance for the chimps, who will often change their course when travelling in the area to visit them before resuming their trip. They then stand upright in front of a tree and start swaying back and forth, panting, hooting and jumping up and down in a state of feverish excitement. At the culmination of this performance they start drumming on the tree trunk with their feet or with rocks.

Most primates are social species, and as such they have social rituals. Some of those species live in what anthropologists call 'fission-fusion' societies, where individuals have a flexible affiliation with their group, breaking into smaller parties to forage and later merging together again. This is similar to what humans do. We divide our free time between our core and extended family, our best friends, our colleagues and various other groups based on our needs, interests and values. In species that form fission-fusion societies, individuals may split off from their group for a long time before meeting again. When they are reunited, they perform greeting rituals that help reaffirm the bonds between them. Humans shake hands, kiss or hug. Chimpanzees, bonobos and spider monkeys also do all of these things.[9] They embrace, they kiss, they groom each other and they pant-hoot (which looks a bit like a group of teenagers screaming 'Oh my God!' in excitement). Chimps perform a

'handclasp', a secret handshake that is unique to each chimpanzee group. And male baboons perform a stereotyped 'scrotum grasp', which is exactly what it sounds like and functions as a trust-building ritual.[10] The anthropologist Mervyn Meggitt observed a similar ritual among the Walbiri, an Australian tribe of aborigines who used a penis-holding ritual to defuse tensions between men. 'If the matter is serious, however, one concerning a previous killing or a death from putative sorcery, the aggrieved person may refuse to hold the visitor's penis.' Such a refusal, Meggitt reported, was a grave insult that could lead to bloodshed.[11]

The primatologist Frans de Waal has even observed chimpanzees engaging in ritualised greetings towards humans. When the chimps at the Yerkes Field Station in Georgia saw their caretakers approaching in the distance, they would burst into loud hooting. 'General pandemonium ensues, including a flurry of embracing and kissing. Friendly body contact increases one-hundred-fold, and status signals seventy-five-fold. Subordinates approach dominants, particularly the alpha male, to greet them with bows and pant-grunts. Paradoxically, the apes are confirming the hierarchy just before cancelling it, to all intents and purposes. I call this response a celebration.'[12]

These observations suggest that ritual is widespread in the animal world. But they also point to another interesting pattern: it seems that some of the most intelligent animals are also the ones that have the richest repertoire of rituals. Needless to say, measuring animal intelligence is a tricky and contentious task. There have been many attempts to come up with some kind of 'IQ of all living things' that would allow us to rank animals in terms of their mental capacity. For instance, the idea that a bigger brain means higher intelligence has intuitive appeal and has therefore been popular for a long time. But the