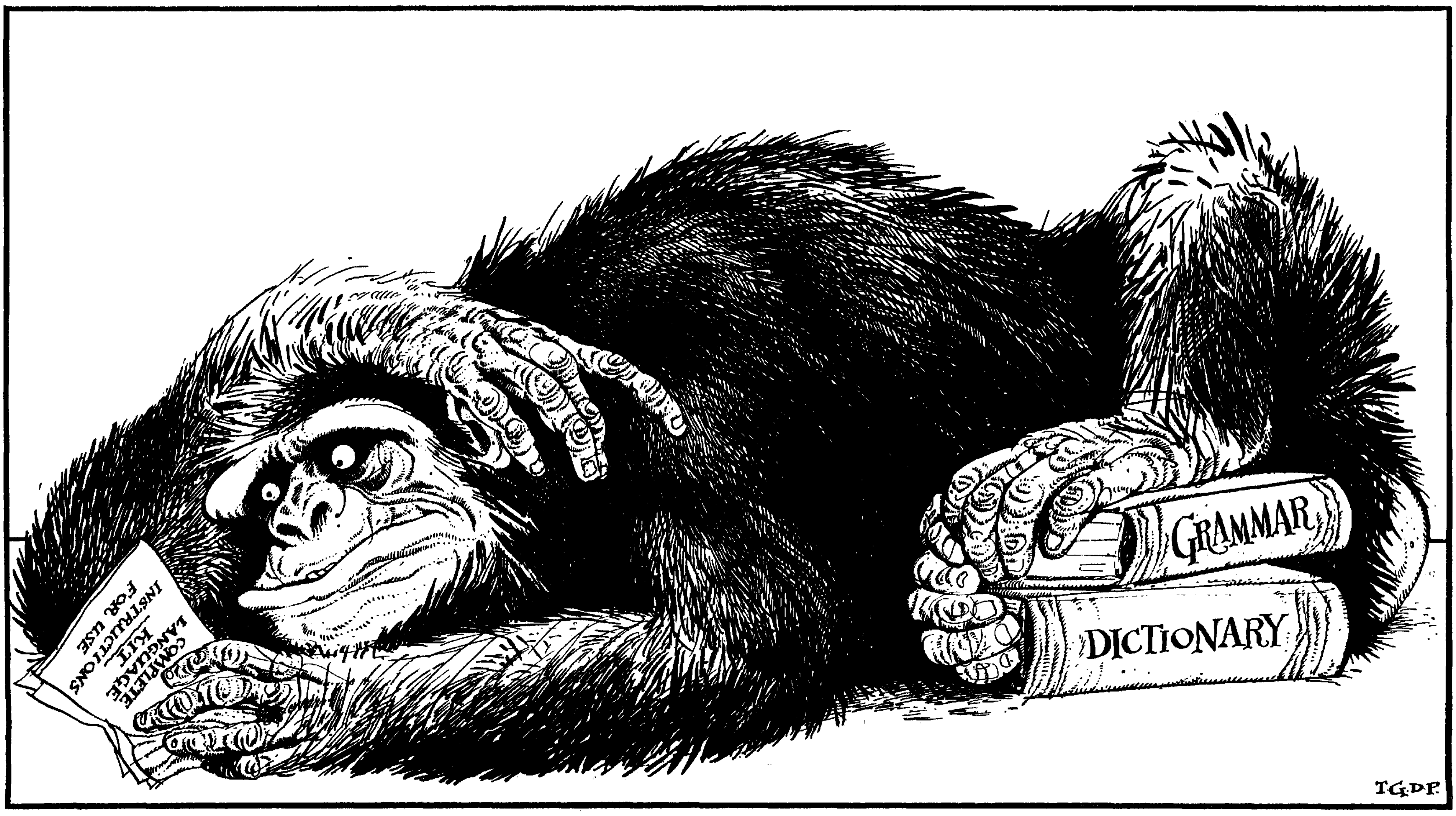
PERSPECTIVE



Daniel Dennett asks whether thought depends on language and proposes a framework for testing brain power

Commandos of the word

WE HUMAN BEINGS may not be the most admirable species on the planet, or the most likely to survive for another millennium, but we are without any doubt at all the most intelligent. We are also the only species with language. What is the relation between these two obvious facts? How does language contribute to intelligence?

I once saw a cartoon showing two hippopotami basking in a swamp, and one was saying to the other: "Funny, I keep thinking it's Tuesday!" Surely no hippopotamus could ever think the thought that it's Tuesday. But on the other hand, if a hippopotamus could say that it was thinking any thought, it could probably think the thought that it was Tuesday.

You can try and refine the question. What varieties of thought require language? What varieties of thought (if any) are possible without language? These might be viewed as purely philosophical questions, to be investigated by a systematic logical analysis of the necessary and sufficient conditions for the occurrence of various thoughts in various minds. And in principle such an investigation might work, but in practice it is hopeless. Any such philosophical analysis must be guided at the outset by reflections about what the "obvious" constraining facts about thought and language are, and these initial intuitions turn out to be treacherous.

We watch a chimpanzee, with her soulful face, her inquisitive eyes and deft fingers, and we very definitely get a sense of the mind within, but the more we watch, the more our picture of her mind swims before our eyes. In some ways she is so human, so insightful, but we soon learn (to our dismay or relief, depending on our hopes) that in other ways, she is so dense, so uncomprehending, so unreachably cut off from our human world. How could a chimp who so obviously understands *A* fail to understand *B*? It seems flat impossible – as impossible a person who can do multiplication and division but can't count to 10. But is that really impossible? What about idiot savants who can play the piano but not read music, or Williams' Syndrome children who can carry on hyperfluent, apparently precocious conversations but are so profoundly retarded they cannot clothe themselves?

Philosophical analysis by itself cannot penetrate this thicket of perplexities. While philosophers who define their terms carefully might succeed in proving logically that – let's say – mathematical thoughts are impossible without mathematical language, such a proof might be consigned to irrelevance by the surprising discovery that mathematical intelligence does not depend on being able to have mathematical thoughts so defined!

Consider a few simple questions about chimpanzees: could chimpanzees learn to tend a fire – could they gather firewood, keep it dry, preserve the coals, break the wood, keep the fire size within proper bounds? And if they could not invent these novel activities on their own, could they be trained by human beings to do these things? I wonder. Here's another question. Suppose you imagine something novel – I hereby invite you to imagine a man climbing up a rope with a plastic dustbin over his head. An easy mental task for you. Could a chimpanzee do the same thing in her mind's eye? I wonder. I chose the elements – man, rope, climbing, dustbin, head – as familiar objects in the perceptual and behavioural world of a laboratory chimp, but I wonder whether a chimp could put them together in this novel way – even by accident, as it were. You were provoked to perform your mental act by my suggestion, and probably you often perform similar mental acts on your own in response to verbal suggestions you give yourself – not out loud, but definitely in words. Could it be otherwise? Could a chimpanzee get itself to perform such a mental act without the help of verbal suggestion? I wonder.

These are rather simple questions about chimpanzees, but we don't have the answers – yet. The answers are not impossible to acquire, but not easy either; controlled experiments could yield the answers, which would shed light on the role of language in turning brains into minds like ours. I think it is very likely that every content that has so far passed through my mind and yours, as writer and reader, is strictly off limits to non-language-users, be they apes or dolphins, or even non-signing deaf people. If this is true, it is a striking fact, so striking that it reverses the burden of proof in what otherwise would be a compelling argument: the claim, first advanced by Noam Chomsky, and more recently defended by Jerry Fodor and Colin McGinn, that our minds, like those of all other species, must suffer "cognitive closure" with regard to some topics of inquiry. Spiders can't contemplate the concept of fishing, and birds – some of whom are excellent at fishing – aren't up to thinking about democracy. What is inaccessible to the dog or the dolphin, may be readily grasped by the chimp, but the chimp in turn will be cognitively closed to some domains we human beings have no difficulty thinking about. Chomsky and company ask a rhetorical question: What makes us think we are different? Aren't there bound to be strict limits on what *homo sapiens* may conceive? This presents itself as a biological, naturalistic argument.

I think that on the contrary, it is a pseudo-biological argument, one that by ignoring the actual biological details, misdirects us away from the case that can be made for taking one species – our species – right off the scale of intelligence that ranks the pig above the lizard and the ant above the oyster. Comparing our brains with bird brains or dolphin brains is almost beside the point, because our brains are in effect joined together into a single cognitive system that dwarfs all others. They are joined by one of the innovations that has invaded our brains and no others: language. I am not making the foolish claim that all our brains are knit together by language into one gigantic mind, thinking its transnational thoughts, but rather that each individual human brain, thanks to its communicative links, is the beneficiary of the cognitive labours of the others in a way that gives it unprecedented powers.

Another false trail is to follow what animals can do, rather than what they cannot. If termites can create elaborate, well-ventilated cities of mud, and weaverbirds can weave audaciously engineered hanging nests and beavers can build dams that take months to complete, couldn't chimpanzees tend a simple campfire? This rhetorical question climbs another misleading ladder of abilities. It ignores the independently well-evidenced possibility that there are two profoundly different ways of building dams: the way beavers do and the way we do. The differences are not necessarily in the products, but in the control structures within the brains that create them. A child might study a weaverbird building its nest, and then replicate the nest herself, finding the right pieces of grass, and weaving them in the right order, creating, by the very same series of steps, an identical nest. A film of the two building processes occurring side-by-side might overwhelm us with a sense that we are seeing the same phenomenon twice, but it would be a big mistake to impute to the bird the sort of thought processes we know or imagine to be going on in the child. There could be very little in common between the processes going on in the child's brain and the bird's brain. The bird is (apparently) endowed with a collection of interlocking special-purpose minimalist subroutines, well-designed by evolution according to the notorious "Need to Know Principle" of espionage: give each agent as little information as will suffice for it to accomplish its share of the mission.

Control systems designed under this principle can be astonishingly successful whenever the environment has enough simplicity and regularity, and hence predictability, to favour predesign of the whole system. The system's very design in effect makes a prediction – a wager, in fact – that the environment will be the way it must be for the system to work. When the complexity of encountered environments rises, however, an unpredictability becomes a more severe problem, a different design principle kicks in: the Commando Team principle illustrated by such films as *The Guns of Navarone*: give each agent as much knowledge about the total project as possible, so that the team has a chance of ad libbing appropriately when unanticipated obstacles arise.

Fortunately, we do not have to inspect brain processes directly to get evidence of the degree to which one design principle or the other is operating in a particular organism – although in due course it will be wonderful to get confirmation from neuroscience. In

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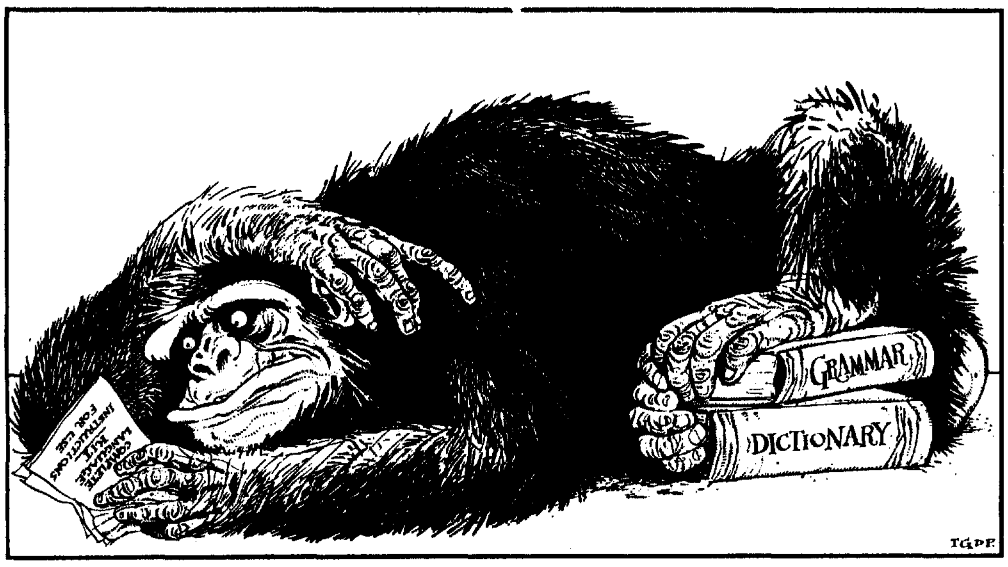
Words and the need to know



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the meantime, we can conduct experiments that reveal the hidden dissimilarities by showing how bird and child respond to abnormal obstacles and opportunities along the way.

My favourite example of such an experiment with beavers is due to Wilsson: It turns out that beavers will cast about frantically for something – anything – that will stop the sound of running water; Wilsson played recordings of running water from loudspeakers, and the beavers responded by plastering the loudspeakers with mud.

Now, I want to propose a framework in which we can place the various design options for brains, to see where their power comes from. It is an outrageously oversimplified structure, but idealisation is the price one should often be willing to pay for synoptic insight. I will call it the Tower of Generate-and-Test.

In the beginning there was Darwinian evolution of species by natural selection. A variety of candidate organisms were blindly generated by more or less arbitrary processes of recombination and mutation of genes. These organisms were field tested, and only the best designs survived. This is the ground floor of the tower. Let us call its inhabitants Darwinian creatures.

This process went through many millions of cycles, and eventually among its novel creations were some designs with the property of phenotypic plasticity. The individual candidate organisms were not wholly designed at birth, or in other words there were elements of their design that could be adjusted by events that occurred during the field tests. Some of these candidates had no way of favouring (selecting for an encore) the behavioural options they were equipped to "try out", but others were fortunate enough to have wired-in "reinforcers" that happened to favour Smart Moves, actions that were better for their agents. These individuals thus confronted the environment by generating a variety of actions, which they tried out, one by one, until they found one that "worked". We may call this subset of Darwinian creatures, Skinnerian creatures, since, as B. F. Skinner was fond of pointing out, operant conditioning is not just analogous to Darwinian natural selection; it is continuous with it.

Skinnerian conditioning is a fine capacity to have, so long as you are not killed by one of your early errors. A better system involves preselection among all the possible behaviours or actions, weeding out the truly stupid options before risking them in the harsh world. We human beings are creatures capable of this third refinement, but we are probably not alone. We may call the beneficiaries of this third story in the Tower Popperian creatures, since as Sir Karl Popper once elegantly put it, this design enhancement "permits our hypotheses to die in in our stead".

But how is this preselection in Popperian agents to be done? Where is the feedback to come from? It must come from a sort of inner environment – an inner something-or-other that is structured in such a way that the surrogate actions it favours are more often than not the very actions the real world would also bless. In short, the inner environment, whatever it is, must contain lots of information about the outer environment and its regularities. Nothing else (except magic) could provide preselection worth having.

After we get to Popperian creatures, what happens next? How does new information about the outer environment get incorporated into these brains? This is where earlier design decisions – and in particular, choices between Need to Know and Commando Team – come back to haunt the designer; for if a particular species' brain design has already gone down the Need to Know path with regard to some control problem, only minor modifications (fine tuning, you might say) can be readily made to the existing structures, so the only hope of making a major revision of the internal environment to account for new problems, new features of the external environment that matter, is to submerge the old hard-wiring under a new layer of pre-emptive control. It is these higher levels of control that have the potential for vast increases in versatility. And it is at these levels in particular, that we should look for the role of language (when it finally arrives on the scene), in turning our brains into virtuoso pre-selectors.

The successors to mere Popperian creatures are those whose inner environments are informed by the designed portions of the outer environment. We may call this sub-sub-subset of Darwinian creatures Gregorian creatures, since Richard Gregory, is to my mind the pre-eminent theorist of the role of information – or more exactly, what Gregory calls Potential Intelligence – in the creation of Smart Moves – or what Gregory calls Kinetic Intelligence. Gregorian creatures use tools. And tool use is a two-way sign of intelligence; not only does it require intelligence to recognise and maintain a tool (let alone fabricate one), but it confers intelligence on those who are lucky enough to be given the tool. The better designed the tool, the more information is embedded in its fabrication, the more potential intelligence it confers on its user. And among the pre-eminent tools, Gregory reminds, are what he calls mind tools: words. What happens to a human or hominid brain when it becomes equipped with words?

Darwin was convinced that language was the prerequisite for "long trains of thought", and this claim has been differently argued for by several, recent theorists, especially Julian Jaynes and Howard Margolis. Long trains of thought have to be controlled, or they will wander off into delicious if futile woolgathering. These authors suggest, plausibly, that the self-exhortations and reminders made possible by language are actually essential to maintaining the sorts of long-term projects only we human beings engage in (unless, like the beaver, we have a built-in specialist for completing a particular long term project).

This brings me to my final step up the Tower of Generate-and-Test. There is one more embodiment of this wonderful idea, and it is the one that gives our minds their greatest power: once we have language – a bountiful kit of mind tools – we can *use* them in the structure of deliberate, foresightful generate-and-test shown as science.

The soliloquy that accompanies the errors committed by the lowliest Skinnerian creature might be "Well, I mustn't do that again!" and the hardest lesson for any agent to learn, apparently, is how to learn from one's own mistakes. To learn from them, one has to be able to contemplate them, and this is no small matter. The advent of high speed still photography was a revolutionary technological advance for science because it permitted human beings, for the first time, to examine complicated temporal phenomena not in real time, but in their own good time – in leisurely, methodical backtracking analysis of the traces they had created of those complicated events. The advent of language was an exactly parallel boon for human beings, a technology that created a whole new class of objects-to-contemplate, "verbally embodied surrogates that could be reviewed in any order at any pace. And this opened up a new dimension of self-improvement – all one had to do was to learn to savour one's own mistakes.

But science is not just a matter of making mistakes, but of making mistakes in public. Making mistakes for all to see, in the hopes of getting *the others* to help with the corrections. It has been plausibly maintained, by Nicholas Humphrey, David Premack and others, that chimpanzees are natural psychologists – what I would call second-order intentional systems – but if they are, they nevertheless lack a crucial feature shared by all human natural psychologists, folk and professional varieties: they never get to compare notes. They never dispute over attributions, and ask for the grounds for each others' conclusions. No wonder their comprehension is so limited. Ours would be, too, if we had to generate it all on our own.

Let me sum up the results of my rather swift and superficial survey. Our human brains, and only human brains, have been armed by habits and methods, mind tools and information, drawn from millions of other brains to which we are not genetically related. This, amplified by the deliberate use of generate-and-test in science, puts our minds on a different plane from the minds of our nearest relatives among the animals. This species-specific process of enhancement has become so swift and powerful that a single generation of its design improvements can now dwarf the R-and-D efforts of millions of years of evolution by natural selection. So while we cannot rule out the possibility in principle that our minds will be cognitively closed to some domain or other, no good "naturalistic" reason to believe this can be discovered in our animal origins. On the contrary, a proper application of Darwinian thinking suggests that if we survive our current self-induced environmental crises, our capacity to comprehend will continue to grow by increments that are now incomprehensible to us.

The author is director, Center for Cognitive Studies, Tufts University. His book Consciousness Explained *is published this week by Allen Lane.*

This article is based on Professor Dennett's contribution to this year's Darwin Lecture series. A longer version will appear in a book to be published by Cambridge University Press.