Elephantine Intelligence

Craig Holdrege

This article is a section of a monograph on the whole-organism biology of the elephant that we will publish later this year in our new "Nature Institute Monographs" series.

THE ELEPHANT is well known for its intelligent behavior. Let's look at various examples of non-trained elephant behavior:

> If he cannot reach some part of his body that itches with his trunk, he doesn't always rub it against a tree: he may pick up a long stick and give himself a good scratch with that instead. If one stick isn't long enough he will look for one that is. (1, p. 78)

> On many occasions I have watched an elephant pick up a stick in its trunk and use it to remove a tick from between its forelegs. I have also seen elephants pick up a palm frond or similar piece of vegetation and use it as a fly swatter to reach a part of the body that the trunk cannot. (2, p. 139)

> If he pulls up some grass and it comes up by the roots with a lump of earth, he will smack it against his foot until all the earth is shaken off, or if water is handy he will wash it clean before putting it into his mouth. (1, p. 78)

> Elephants have picked up objects in their environments and thrown them directly at me, undertrunk, with surprising, sometimes painful, accuracy. These projectiles have included large stones, sticks, a Kodak film box, my own sandal, and a wildebeest bone.... Elephants have been known to intentionally throw things at each other in the same circumstances: during escalated fights and during play. Elephants have been known to intentionally throw or drop large rocks and logs on the live wires of electric fences, either breaking the wire or loosening it such that it makes contact with the earth wire, thus shorting out the fence. (2, p. 139)

> [In India an] elephant was following a truck and, upon command, was pulling logs out of it to place in pre-dug holes in preparation for a ceremony. The elephant continued to follow his master's commands until they reached one hole where the elephant would not lower the log into the hole but held it in mid-air above the hole. When the mahout [elephant driver] approached the hole to investigate, he found a dog sleeping at the bottom; only after chasing the dog away would the elephant lower the post into the hole. (3, p. 137)

> [In South Africa] it was observed that an elephant, after digging a hole and drinking water, stripped bark from a nearby tree, chewed it into a large ball, plugged the hole, and covered it with sand. Later he removed the sand, unplugged the hole, and had water to drink. (3, p. 137)

> Many young elephants develop the naughty habit of plugging up the wooden bell they wear around their necks with good stodgy mud or clay so that the clappers cannot ring, in order to steal silently into a grove of cultivated bananas at night. There they will have a whale of a time quietly stuffing, eating not only the bunches of bananas but the leaves and indeed the whole tree as well, and they will do this just beside the hut occupied by the owner of the grove, without waking him or any of his family. (1, p.78)

As we can see from these examples, intelligent behavior allows the animal to deal with a concrete situation in a flexible and non-schematic manner. Or as Shoshani and Eisenberg put it, intelligence is "the capacity to meet new and unforeseen situations by rapid and effective adjustment of behavior" (3, p. 134). Intelligence presupposes an ever-present ability to learn. Not unexpectedly, many of these examples show that the elephant's intelligence often manifests through the activity of the trunk: breaking off sticks that are then handled as an extended limb to scratch or swat with; throwing with the trunk; stuffing a bell with the trunk. With such a flexible and dexterous prehensile organ, how could an elephant not be intelligent?

At the same time, these activities involve the whole animal in the coordinated use of different body parts and senses: sight and trunk are used in throwing, while foot and trunk coordination allows cleaning clumps of grass. Raman Sukumar describes a scene that clearly illustrates the elephant's complex behavior:

Figure 1a. An African elephant gouges a tree, loosening the bark.

Figure 1b. The elephant grabs the looosened bark with its trunk and pulls upward.

> Vinay [a solitary adult Asian elephant bull] poked at the *bendai* tree with his left tusk, thrusting it up into the gash and splitting the bark. He grasped a portion with his trunk and tugged expertly with an upward flick, tearing off a four metre long strip. Another tug and the strip broke loose from the tree-trunk and came down. Vinay now began eating the bark, skillfully using his forefeet and trunk to break off small strips before transferring them to his mouth.
>
> After feeding for some ten minutes, Vinay did something that only an elephant can do so effortlessly. He turned towards the tree, and using his fore head and trunk, pushed the tree over. In a minute or so the tree was cleanly uprooted. Vinay tore just one more strip of bark from the tree and then turned away. Almost nonchalantly he began to pluck green grass that sprouted profusely from among burnt clumps. As he wrapped his trunk around a clump and pulled, the tender leaves came off quite easily from their dry bases. Stuffing one trunkful after another into his mouth, Vinay ambled along at a gentle pace. (4, p. 50)

Figure 1c. Enwrapping the strip of bark with its trunk, the elephant pulls downward tearing off the strip.

(Drawings by R.W. "Mike" Carroll, from *Elephant Life* by Irven O. Buss. Copyright 1990 Iowa State University Press, Ames, Iowa 50010; reprinted with permission.)

The elephant's behavior flows from one activity to the next, engaging its brawn and dexterity as needed. The key to such actions and their sequence is that they are not automatic and prescribed. Intelligent behavior expresses plasticity–flexible interaction with experience. The elephant

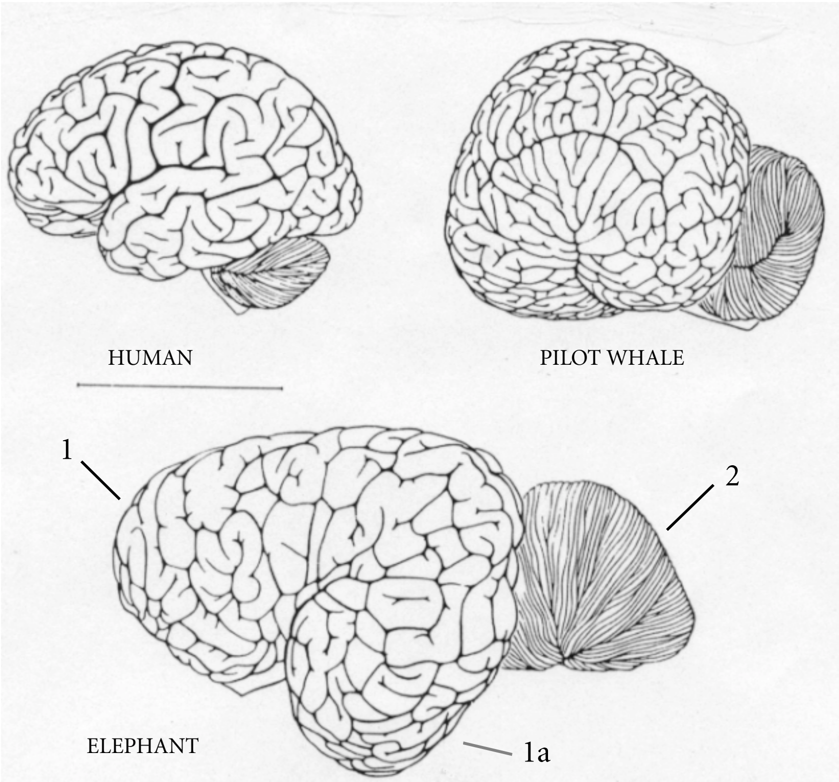

Figure 2. Brains of human being, pilot whale and elephant, viewed from the side. Drawn to scale (bar = 10cm). (1) cerebrum. (1a) temporal lobe of cerebrum. (2) cerebellum.

(From 5. Copyright 1970 by Springer-Verlag. Reprinted by permission.)

cleans off the dirt by smacking the clump of grass against the foot, but if it also perceives water nearby, it can then take the clump and submerge it in water to clean it further. It doesn't just have one "built-in" way to carry out tasks.

All the above examples reveal what we would call purposive behavior. We have to be very careful here not to anthropomorphize an animal's behavior. We'd clearly be anthropomorphizing if we imagined an elephant scheming about how to steal bananas and coming up with the idea of plugging the noisy bell. That's just putting a human mind in elephant skin. Also, in the case of the elephant that did not put the log on the dog, we shouldn't immediately assume that the elephant took pity on the dog or that it had a conscious awareness that it was about to kill the dog. Such caution does not detract from the impressive act itself. Rather, it leaves us more open. We erase the possibility of understanding the elephant's unique kind of intelligence if we too easily read our own experience into it. When we stay close to the perceived situation and hold back with judgments, the unique and fascinating qualities of the animal become *more* vivid than if we imagine it in our own terms. We don't, after all, merely want to mirror ourselves in the animal.

THE SCIENTIST Herbert Haug carried out a detailed comparative study of the anatomy of the elephant, dolphin and human brains to see if he could find out how the brains might relate to the intelligent behavior of these creatures (5). The brains differ distinctly from one another, but all are large (see Figures 2 and 3). The elephant has the largest brain of all land animals; an adult elephant's brain weighs on average between nine and twelve pounds. But, of course, the elephant also has the largest body of all land animals. The elephant's brain makes up about 0.08 percent of the total body weight, while a horse's makes up about 0.25 percent of its total body weight. The human brain weighs three to four pounds and is also relatively large, making up two percent of our body weight (6, p. 108).

The brains of elephant, dolphin, and the human being are all highly convoluted, which increases the surface area of the brain. These brains exemplify the well-known correlation between the degree of brain folding and the degree of intelligent, flexible behavior found in mammals.

But what is specifically elephantine about the elephant's brain? Three areas of the brain are noticeably enlarged (absolutely and relatively): the olfactory lobe, the cerebellum, and the temporal lobe of the cerebrum (see Figure 3). Enlargement of part of the brain usually means that there are more neurons in that part of the brain. These neurons are connected to other parts of the brain and to the rest of the body via nerve fibers. The enlargement of the olfactory lobe is clearly connected to the fine innervation of the sense of smell in the trunk. The cerebellum has been found to be related to muscle coordination in other, better researched mammals. Since the nerve pathways in the elephant are not that well known, Haug can only make the clearly reasonable suggestion that the cerebellum's high degree of development is related to the highly coordinated trunk movements. As the focus of so many of its activities, it is not surprising that the elephant's intelligence-imbued trunk is mirrored in the enlargement of parts of the brain connected to the trunk.

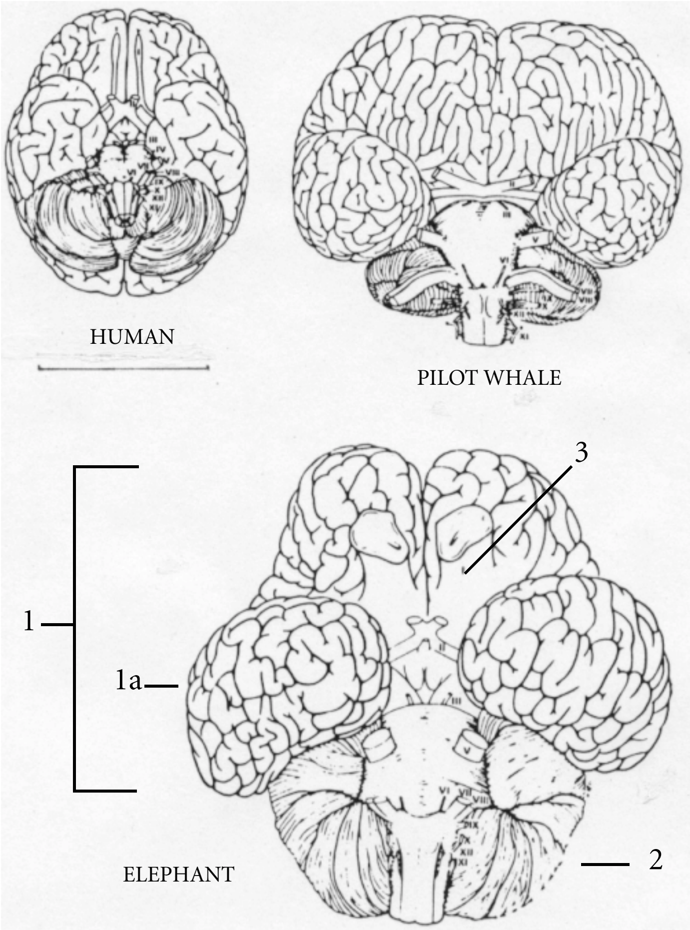

Figure 3. Brains of human being, pilot whale, and elephant, viewed from below. Drawn to scale (bar = 10 cm). Note the very large temporal lobe (1a) of the elephant brain. Roman numerals indicate cranial nerves. The olfactory nerves leading to the trunk (3) are especially developed in the elephant. (1) cerebrum. (2) cerebellum.

Why the temporal lobes are so large (proportionately larger than in any other mammal), remains a riddle. The temporal lobes are generally related to hearing in mammals (and speech in the human being), so it seems reasonable to conjecture that the elephant's ability to distinguish and communicate through a variety of sounds (including infrasound) may well be connected to the differentiation of the temporal lobes.

Haug's study led him to be skeptical about any claims that correlate intelligence and the brain too closely:

> From a qualitative point of view, the human being does not possess—compared to elephants and dolphins—a particularly high grade of cerebral differentiation that would provide the morphological basis for such a great difference in intelligence as is actually present.... The question must be asked, whether brain differentiation must necessarily be equated with human productive intelligence" (5, p. 56).

There is a strong tendency in our times to want to localize intelligence — and other capacities — in the brain. It's a very unorganismic way of viewing that leads us to seek for a "command center" in the brain. Intelligence resides just as little (or just as much) in the brain as it resides in the elephant's trunk. It would be just as correct (or incorrect) to say that the elephant has its center of intelligence in the trunk as it would be to say that it's in the brain. If the elephant's trunk becomes lame, some of its intelligent behavior will be missing, just as when part of its brain is dysfunctional. In either case it could compensate for such injuries to a certain degree by engaging other body and brain parts. Intelligence resides everywhere and nowhere. Perhaps it's best to say we discover it in the intelligent activity itself, which is carried out and made possible by the *whole* animal. And in the elephant this whole is most vividly embodied in the use of the trunk.

References

1. Williams, J. H. (1950). *Elephant Bill*. Garden City, NY: Doubleday & Company.
2. Poole, J. (1996). *Coming of Age with Elephants*. New York: Hyperion.
3. Shoshani, J. (ed.) (1992). *Elephants*. Emmaus, PA: Rodale Press.
4. Sukumar, R. (1994) *Elephant Days and Nights*. Delhi: Oxford University Press.
5. Haug, H. (1970). *Der Makroskopische Aufbau des Grosshirns*. Berlin: Springer-Verlag.
6. Flindt, R. (1986). *Biologie in Zahlen*. Stuttgart: Gustav Fischer Verlag.