CHAPTER EIGHTEEN:
LIMITATIONS ON NONHUMAN THOUGHT

Causes of the wide separation between the abilities and accomplishments of humans and of other animals has been a topic of interest for thousands of years. I don't expect to add anything definitive to that ongoing discussion. But I will make a couple of suggestions about ways in which the representational capacities of humans may differ from those of nonhuman animals, certainly in degree and probably in kind. If correct, these differences could account for at least a portion of the separation.

Although under some circumstances some nonhuman animals are capable of putting somewhat novel chains of behavior together in pursuit of their goals, most animal behavior and also most animal learning is not so flexible. James Gould describes the "rigidly programmed plasticity" (1982, p. 268) characteristic of most animal learning as follows:

> ...learning is adaptively programmed so that specific context, recognized by an animal's neural circuitry on the basis of one or more specific cues, trigger specific learning programs. The programs themselves are constrained to a particular critical period, ... and to a particular subset of possible cues. Nothing is left to chance, yet all the behavioral flexibility which learning makes possible is preserved. (Gould 1982 p. 272.)
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> Learning, even in higher vertebrates, seems less a general quality of intelligence and more a specific, goal-oriented tool of instinct. Bouts of learning such as food avoidance conditioning, imprinting, song learning, and so on, are specialized so as to focus on specific cues --releasers-- during well-defined critical periods in particular contexts. Releasers trigger and direct the learning, and in general the learned material is thereafter used to replace the releaser in directing behavior. As a result animals know what in their busy and confusing world to learn and when, and what to do with the information once it has been acquired. Most learning, then, is as innate and preordained as the most rigid piece of instinctive behavior. (p. 276).

In this preordained way, many animals learn either by trial and error or from conspecifics what to eat and what not to eat. Some learn from others which local species are their predators. The European red squirrel laboriously learns how to open, specifically, hazel nuts. The oyster catcher laboriously learns, specifically, how to open oysters. The chimpanzee laboriously learns, specifically, how to open nuts by using a rock and an anvil. Despite the fact that some animals are capable of some "insight learning" in new, though carefully designed, situations, speaking generally, what animals are capable of learning, hence, it is reasonable to suppose, what they are capable of developing representational systems to support, is closely tied to specific skills or specific ends found to be useful in the past history of the animals' species. Through rigorous and careful step by step training by humans, individuals of many higher species can laboriously be brought to recognize perceptual affordances of kinds quite remote from any they were specifically designed to learn and recognizing these affordances may involve recognizing properties and kinds of objects with no history of relevance to the animal's species. But they seem to be recognized only as things that have proved useful in the individual's previous experience and only as affording those known uses. Nonhuman animals do not learn to recognize objects or kinds for which neither they nor their species has yet found any practical uses.

Similarly, that an animal can collect and later use specific kinds of purely factual information about the space it lives in, or about the temporal order it lives in, has no implications for whether it can represent any other detached facts. That it collects and remembers information about local spaces and temporal contingencies depends on the fact that this kind of information has been useful during its evolutionary history, and useful in entirely specific ways. For example, some species of birds can remember hundreds or even thousands of caching places in which they have left food. It does not follow that they are capable of collecting and remembering any other particular kinds of facts. Nor does it follow that they can use knowledge of these caching places for purposes other than finding food again when they are hungry. Likewise, although it appears that some nonhuman animals can learn something about causal chains, about what can turn into what, the chains that they recognize are not arbitrary chains. They are chains that have at the end something antecedently of interest to the animal. The representations of fact that animals collect always seem to be dedicated in advance to very specific uses, to completing P-P representations of predetermined kinds.

Just as individual animals may collect specified kinds of factual information ahead of having uses for it, they may also collect specified kinds of skills out of the context of serious uses for them. Young mammals, in particular, do a lot of playing. But play in nonhuman animals seems always to be practice for well-defined species-typical adult activities. The detached skills they are learning are always closely related to future uses known, as it were to the species, though not to the individual. The historical experience of the species tells the genes of the young animal what it should practice.

We humans, on the other hand, collect and remember facts of kinds for which neither we nor our ancestors have yet found any practical uses. We are capable of learning thousands of facts about what has occurred or is occurring at times and in places to which we have no potential access, let alone past or present practical acquaintance. The non-fiction sections of libraries are repositories, largely, for immense collections of such facts. Some people memorize baseball scores and batting averages or, some of them, time tables for railroads all over the country. We are curious about what will cause what and why, wholly apart from any envisioned practical applications for this knowledge. We may be curious about how things work, where they came from, what properties and dispositions they have, in a completely disinterested way. We notice and remember not just what we can cause, or what causes something we want, but what causes what, quite out of context. We interpret natural signs and also linguistic signs of world affairs that are distant from us both in time and space, quite outside of the realm of our powers of action. We are adept at learning to interpret new kinds of signs, not just human language signs, but signs produced by meters and scopes and a multitude of other instruments. And we make inferences from these various kinds of facts to further disinterested facts, reconstructing large portions of the layout of the world that are hugely distant from us in space, time and magnitude, far removed from the level of perception for which evolution has specifically prepared us.

We also spend energy and time developing skills, both physical and intellectual, for which neither we nor our ancestors knew any practical uses. Children at play practice bouncing balls, juggling, standing on their heads, spinning hula hoops, solving Rubik's cubes, riding skate boards, cracking their knuckles, wiggling their ears, blowing bubbles, whistling through their teeth, spinning around to make themselves dizzy, and so forth. Both children and adults become absorbed in games of all kinds, from sports games through board games to gambling games. Two month old infants provided with a device that allows them to activate a mobile over their cribs by moving their heads keep smiling and cooing, whereas they very soon tire of a mobile that moves independently of their action (Watson 1967). It seems that the development of any sort of skill, the discovery and mastery of affordances with any sort of determinate outcomes, may be of interest to a human child.

It is also interesting to contrast what motivates non-human animals with what motivates humans. The motivations described in Chapters Thirteen through Sixteen all originated either with the perception of affordances in the immediate environment or with the animal's perception of its own current needs. The animal's goals arise out of past experience of having reached those goals in certain ways in the past plus awareness of present relations to things that were involved. Even our most respected and intensively studied relatives, the monkeys and apes, seem to derive their motivation entirely from perception of the current situation. Thus, for example, Merlin Donald summarizes the literature on signing in apes: "...the 'meaning' of an ASL sign to an ape is simply the episodic representation of the events in which it has been rewarded..." (1991, p. 154) and "The use of signing in apes is restricted to situations in which the eliciting stimulus and the reward are clearly specified and present, or at least very close" (p. 152). No non-human animal, I suspect, wonders where its next meal is coming from unless it is already hungry, nor does it wonder how it will cope next winter. Of course, appropriate migrating behaviors are elicited, in certain species, by natural signs that current food sources are running out, various behaviors are elicited by natural signs connected with the immanent approach of winter, and so forth. The indicative facets of the inner P-P representations that are responses to these natural signs concern the future, for these representations will produce behaviors that are appropriate only if certain future events are indeed imminent. But these are present perceptions and they derive directly from the past history of the species. We humans, on the other hand, ardently collect dreams of things we would like someday to do or have done, places we would like someday to go, things we would like someday to build or to have or to be, without necessarily having any notion yet how to fulfill any of these dreams. Certainly these dreams neither reflect currently perceived affordances nor do they originate from currently perceived needs. We store desires that we do not know how to fulfill just as we store facts that we do not know how to use.

Representing irrelevant facts, irrelevant affordances, irrelevant dreams! In short, we appear to be compulsive collectors of all kinds of representational junk. Moreover, we use these representations primarily for the purpose of making more representations of the same kind, moving from one representation to another via inference, filling out our knowledge of places, times and magnitudes far removed from immediate practical experience and activity. But, of course, although most of the individual facts, skills and dreams that we collect may never find uses, the general disposition to collect junk does find uses. If you have enough storage space and a good enough retrieval system, some pieces of that junk may well come in handy sometime, though there was perhaps no way to tell in advance <u>which</u> pieces. Having stored enough tools and materials in the attic over the years, eventually some of it is bound to come in handy, granted one is an inventive enough tinker with ideas. (The adage says you need only wait seven years.)

But I think that a difference between us and the other animals may not be just that we have bigger storage barns than do neighboring species, bigger brains, although that may well be some part of the matter. It may be that we are also peculiar in having what Dennett (1996) likes to call "Popperian" minds, that is, minds that spend a good part of their time "generating and testing," making thought trials and errors, learning by experimenting with inner representations rather than by making false starts in outer behavior. And it may be that to be efficient, Popperian minds need to operate on representations coded in a different kind of representational style than that needed for direct perception of affordances.

Two demands that would be seem to be placed on the representational system used by a Popperian mind suggest this. First is a demand for free inferential interaction among representations regardless of content, for the Popperian mind cannot tell in advance what may need to be put with what in building a useful result. This may require a uniform notation not found on the level of perception, which moves directly from inputs to the various senses to guidance of action, variations in input mapping fairly directly to variations in output. The second concerns the development of representations that have not been tested for accuracy through practical experience.

I will attempt a sketch of how the distinctively cognitive systems, unlike the action-guiding perceptual systems, may employ representations of a different type than any we have discussed so far. These may be representations that are more like sentences than, say, bee dances, in that they are articulated into subject and predicate and are sensitive to an internal negation transformation. Call this the development of theoretical concepts and theoretical knowledge. This development, I will argue, would make it possible to represent time as dated or "historical" rather than as a mere set of ordered conditional probabilities. Representation of historical time, in turn, makes it possible to conceive of, plan and carry out projects that purposefully change the future in unprecedented ways, rather than merely repeating past successes. It allows representation of novel future possibilities which, in turn, uncaps new motivational springs. I will take up these themes in order, the second in Chapter Nineteen.

The argument of Chapter Sixteen suggests that the original code in which perceptions of detached facts and representations of projected goal states are represented is the same as the code in which the descriptive sides of pushmi-pullyu representations are coded. These codes are designed, in the first instance, to perform two functions at once. Transformations of P-P representations must, on the one hand, correspond systematically to transformations of the affairs in the world that they signify, but on the other, must correspond to transformations of the responses they govern such that the responses are adapted to those affairs. The detached representations of fact we have considered, for example, representations of remembered spatial and temporal surrounds of the animal not currently perceived, must also be coded in such a way that they can be joined to representations of the animal's current position in that surround so as to direct the animal's motions immediately. But we are now considering an entirely new kind of representation. We are considering an animal that collects facts for which it has, as yet, no known uses, combining these facts with one another to produce, by inference, more facts with no known uses. The human animal is engaged, much of the time, in constructing large portions of a four dimensional map of a whole dated world in progress, mapping not only things that endure or recur (individuals, places, natural kinds, repeated patterns of events) but also unique occurrences, both in its own locale and in other places. Many of the things represented, moreover, are not things that could possibly guide motions directly, being too small, or too large, or too amorphous or too abstract. All these facts may be represented quite apart from any currently known relevance to the thinker's practical interests. The immediate, even though not the ultimate, use of these representations is merely the efficient production of representations of more and more of the structure of the disinterested objective world. What that project requires primarily is not representations suitable for guiding continuous motions, but representations that are able freely to interact with one another in inference.

Whether or not representations can freely interact in inference does not depend on satisfaction conditions. Nor does it depend, of course, just on their locations in the brain, on whether or not they are physically isolated. Encapsulation of information used for one purpose but unavailable for others will occur whenever incompatible notations are used. Putting things graphically, suppose that the first premise of a would-be inference is stored in a Venn diagram and the second in a circuit diagram, or on a map, or in the notation of Principia Mathematica. No rule of inference could combine these premises directly, without some kind of translation. How the contents of mental representations are articulated and represented, as well as how they are stored and retrieved, is crucial to their interaction. But there seems no reason to suppose that a representational system tailored to safely guide an animal's continuous motions through its immediate environment would also be suitable for encoding and amplifying its theoretical knowledge.

There is a stronger reason to suppose that humans may need to employ a new kind of representational system in order to represent places, times and magnitudes far removed from practical activity and experience. An animal attempting to construct maps of parts of the world that it is not currently using for anything, clearly is at great risk of error. Compare generalization that connects experience to behaviors with generalization that connects experience to idle beliefs about facts. Practical generalization is naturally bridled. Resulting unsuccessful behaviors do not always produce punishment but they do waste time and energy, naturally diverting the animal's responses into other channels. What kind of bridle is there on false generalization in the case of theoretical inference? Humans need somehow to collect evidence for the objective adequacy of their abilities to reidentify objects and properties through diverse appearances independently of using those objects and properties for practical purposes. They need to be able to test their empirical concepts independently of pragmatic successes and failures. When perception is used to guide immediate practical activity, the criterion of correct recognition of affording objects or properties is easy. You are right that this is the same affording object, or kind, or property again if you can successfully deal with it in the same way again. The proof is in the eating. But how does one learn to recognize new objects, new kinds and new properties that have for one, as yet, no practical significance?

Recall what is involved for an animal that needs to be adept at recognizing local signs of some object or objective property or relation. The difficulty is that local signs of the same thing are manifested through many diverse media, under a wide variety of conditions, and transmitted through a number of different sensory modalities. We are generally unaware of the enormous complexity of the task of interpretation required here. It is accomplished by a complex neural machinery of which we have no knowledge and less control. But the complexity is such that despite intensive study by neurologists and psychologists, only a sketchy knowledge of small parts of these mechanisms is yet available. The perceptual task of interpretation is enormously demanding. How does the organism know that it is doing it right? Or if some part of these abilities have been built in by processes of selection during the evolution of the species, what life supporting effects of their use were being selected for?

Start by thinking about how the organism tells that it is perceiving distances correctly. What IS it for an organism to have represented a distance correctly in perception? Where is the perceptual dictionary written that tells what rule is the correct correspondence rule between a certain objective distance and some mental or neural trait that is required to represent that distance perceptually? The question has no sense. Perceiving spatial relations correctly just IS knowing how to be guided by them during action. The correct representation is whatever one the action systems can read. Correctly perceiving where an object is simply equals knowing how to reach one's hand to it, how to kick it, how to walk to it or away from it, how to throw something to hit it, and so forth. For the animal engaged in practical activities, that is absolutely all there is to correctly representing spatial relations. This follows immediately from (1) the assumption that the primary kind of spatial perception is perception of spatially defined affordances, (2) the assumption that perceptions of affordances are pushmi-pullyu representations plus (3) the description that has been given of intentional pushmi-pullyu representation. There is no distinction to be drawn between wrong perceptual recognition of spatial relations and wrong behavioral responses. When you put on a new pair of glasses so that the floor now looks like a small wavy hill in front of you, what is it that needs to be corrected, how your perceptual systems represent the floor or how your walking, and so forth, are guided by the new representation produced? Frith et al (2000) remark that patients who suffer from optic ataxia such that the arm fails to extend properly in space, the wrist fails to rotate to match the orientation of the object to be grasped and the hand fails to open properly in anticipation of grasping often attribute their difficulty to a problem with vision. But this is perfectly natural, given that in the normal case there is no distinction between seeing things wrong and reaching and grasping for them wrong. For normal persons, which faculty it is that requires recalibration is an empty issue.

Exactly similarly, for the animal whose only criteria of identity are practical, correctly recognizing the object that is just over there in such and such direction, simply equals knowing how to respond to or use that object, given this or that context of practical concern. If what is seen is an affordance, the criterion of correctness for the descriptive side is that it match the directive side, and vice versa. By the criterion of practice, if two objects function the same way when used the same way, they are the same; if they function differently or must be used differently, then they are different. For example, I imagine that for our cat, all dogs are roughly the same thing again, with the exception of our own dog, Thistle, who is the cat's friend and interacts with the cat entirely differently than other dogs do. So far as the cat is concerned, Thistle is of a totally different practical kind from other dogs. Thistle is not a (practical) dog. Similarly, I imagine that although birds are not mice for the cat, the differences among mice, voles, shrews, chipmunks and other small ground mammals are not noticed, because these differences are of no practical concern. What is the same as what, when you have met the same thing again, is entirely a practical matter for the practical animal, perhaps for all animals except humans. For these animals perceive the world only as a subject of practical concern, not as a subject of theoretical judgment. Objects that offer the same affordances will count as the same object, despite wide diversity in all kinds of properties we humans find important for theoretical purposes.

More radical, for the animal that tells when it has encountered the same thing again merely by practical tests, there will be no need to distinguish clearly among representations of individuals, practical kinds, practical stuffs and practical properties. If all one needs to understand is how to treat the same when one encounters it again, there will be no fundamental practical differences among learning how to treat Thistle again, how to treat mouse again, or water again, or cold outside again, or hot underfoot again, or being wet and cold again. For practical purposes, each of these things merely returns again, sometimes in one place, sometimes in another, sometimes in more than one place at once. What use, for example, would the cat have for distinguishing between the mouse it caught yesterday and the mouse it catches today? Why should it be any more a different versus the same mouse for the cat than the sun that rose yesterday and again today? Whether it's individuals, kinds, or properties, all show some differences, of course, from occasion to occasion of meeting. But only the practical overall similarities matter.[1]

FOOTNOTES

1. The similarities and dissimilarities among concepts of individuals, natural kinds and natural stuffs are explored in detail in (Millikan 2000).