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Memory: A matter of fitness

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Only one look through a microscope at a silver-stained section of a rat's or pigeon's brain is necessary to convince someone that there must be more than a few Ss, arrows and Rs to the explanation of behavior. There is nothing mentalistic about the several million neurons times the several thousand synapses that make up the nervous system of these animals. Neither are they just decorative frills for the anatomist to wonder at; evolution, that harsh judge, will have seen to it that they are involved in some very useful, fitness-promoting operations. In any case, physiologists have not taken long to find out that the function of these neurons is information-processing. By any measure a pigeon's or rat's brain still far outclasses even the fanciest of man-made computers. These computers again show us that without large amounts of well-organized memory nothing much can be done to make them behave adaptively. When they do, they are inevitably said to model, to represent the environment on which they operate. It is inconceivable that biological computers can function differently. One cannot but agree with Roitblat that a representation of environmental and self-generated events in animal memory must now be accepted as an incontrovertible fact.

The theoretical framework that Roitblat presents by defining a number of terms is no doubt useful in providing an orderly series of conceptual pegs on which one can hang a fair range of empirical facts – as Roitblat does. Because these pegs are kept quite general one can hardly quarrel with them. The processing components, however, would seem to require more emphasis and differentiation, with at least a subdivision into a storage and a retrieval phase. When discussing concrete evidence Roitblat certainly plays down the intricacies of recall that are really the main practical source of indeterminacy when one wants to identify the contents of memory. Performance on a particular recall task may only reveal the minimal amount of information that is actually represented in memory.

This leads to the question of whether we can ever expect to proceed from a metatheory to a general theory of representation in memory. Take the case of the rats that collected food tidbits in a radial maze. If they were suddenly chased by a terrier, would other memory contents surface, perhaps, than if they had carried on feeding? Would one obtain the same recall performance if the arms of the maze were baited with large food-chunks – or water, or even sexual mates – instead of tidbits? More generally, memory operations have not evolved according to a grand, highly rational plan; they have come about by a tortuous, chance-driven historical process whose sole criterion is the maximization of gene survival. Any realistic theory of animal memory will have to pay due regard to arguments about optimal function in evolutionary terms.

Is Roitblat's metatheory perhaps too restricted by categories of human speech? It is somewhat equivocal to say that images are not pictures in the head but that it is practical to describe them in picture-like terms. For example, the properties of such a visual image with respect to retrieval processing may be significantly affected by whether they are stored in the frequency-phase or in the spatial correlation domain. A map may be easily distinguished from a list in the realm of semantics but that need not necessarily be so in the context of associative networks.

Could the metatheory not cramp the style of researchers? For example, to say that it is convenient in cognitive science to avoid being concrete about the physical instantiations of representations begs the question "Convenient to whom?" Let us be fair. Some of us cannot be bothered with understanding the physiology of neuronal synapses or the mathematics of associative networks, but assertions that they are provisionally irrelevant may be shortsighted. Rather, it seems likely that progress in the understanding of animal memory, as in the case of most other biological phenomena, will come about through a scientific free-for-all, catch-as-catch-can. After all, why should the brain's handling of information storage and readout be so fundamentally different in this respect from the genome's handling of information storage and readout? The latter we now positively know to be a process that does not conform to any neat theory, although it doubtless performs an exceedingly neat function.

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