

## ADAPTATION, STRUCTURE, AND KNOWLEDGE: A BIOLOGICAL PERSPECTIVE

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Man is a kind of animal, a part of a larger ecological system. It is only recently that the public at large, and scientists in particular, have begun to recognize the far-reaching importance of this simple fact. One of the profound implications of this realization is that man is a product of evolution, an organism that carries with it biases and tendencies that were required for survival millions of years ago. This is far from the blank-slate view of man that has been so influential for so long. One sort of bias one might expect of such a product of evolution is toward various kinds of natural stimuli. Forests, flowers, cliffs, flowing water, animals large and small, all of these may have special significance to an animal whose world and hope for survival was defined in such terms until very recent times.

Another sort of bias one might expect in man concerns not specific stimulus patterns but information in general. The unique aspect of man's evolution is the necessity of living by his wits. As a grounded ape of not particularly formidable proportions, man was forced to survive by anticipating danger well in advance. Admittedly the arboreal environment had led to the development of excellent vision and uniquely flexible response capability through the combination of the upright posture and the grasping hand. But a cleverly crafted plan and a cleverly crafted tool in the hand were necessary to take advantage of these natural assets. Anthropologists now recognize that man began as a ground-dwelling ape with a comparatively small brain. It appears that the planning and anticipating required for survival favored the development of a substantially larger information-handling capacity.

In this perspective it is clear that prediction is one of man's most important talents, interests and concerns. Prediction in turn depends on familiarity with the objects and situations characteristic of his environment. One must know what is happening, where one is in one's environment, before one can ascertain what might happen next. To these two basic skills of recognition and prediction must be added the capacity to evaluate possible outcomes and the capacity to select suitable actions. An additional requisite for all these skills is speed; relatively speaking, a good guess was always better than indecision. In order to carry out all these activities with adequate speed, it is

necessary for the organism to store large quantities of information. Further, this storage must allow rapid retrieval despite incomplete information and noisy backgrounds.

An efficient solution to these interlocking problems involves the storage of information about objects and situations into schematic groupings, each representing a class of objects or situations that recurs with reasonable frequency in the environment of the organism. Such representations make possible the rapid recognition of familiar objects and situations. Each representation is associated with other representations; in this way, predictive information is stored. In other words, just as an active representation corresponds to a current environmental situation, the associates of that representation code those situations most likely to happen next. Knowledge of many possible situations and of what leads to what constitutes a cognitive map. Further associations to pleasure and pain units, and to action representations, extend the organism's capability to include evaluation and action.

There are several implications of the proposed approach. First, much of what we know of the way man perceives and knows his environment can be accounted for within a framework based on the adaptive pressures man faced and the biological components available to meet these pressures. Second, since knowledge is essential for survival, its acquisition must be a matter of highest priority. Thus curiosity, exploration, and other expressions of human restlessness when not under pressure play a crucial role in insuring that a wide range of information will be available when needed. Third, man's very survival may depend on these basic information processing mechanisms. Man's capacity to predict and to represent to himself environments not currently present provide a basis for looking ahead, for anticipating the future. A clearer idea of where we are headed, if widely shared, could have an important impact on our adaptive potential.

(Note: The Symposium discussion will be based on a more extensive discussion of these issues, "Cognitive maps in perception and thought," which will appear in R. M. Downs and D. Stea (Eds.), Cognitive mapping: Images of spatial environments. In press.)

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