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EFFICIENCY, VERSATILITY, COGNITIVE MAPS AND LANGUAGE

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A COMMENT ON

THE COMPARATIVE PSYCHOLOGY OF INTELLIGENCE

BY EUAN MACPHAIL

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Macphail's stimulating article evokes the following responses from one who is interested in the function of the cerebral cortex and other so-called higher centres.

Efficiency. It doesn't make sense to conclude that there are no "quantitative intellectual differences amongst non-human vertebrates" (p23 line 42), because there is not yet any generally agreed definition of intelligence that enables a quantitative scale to be defined for it; therefore it cannot justifiably be said that quantitative differences either do, or do not, exist. Perhaps he means that quantitative intellectual differences have not been demonstrated, but that would be a substantially different conclusion.

Unlike his book (Macphail 1982), his article has a welcome new emphasis on association formation and the reason for its central importance, namely that it can uncover the causal links in the environment. This not only reduces the gap between his views and those of other writers on learning (eg. Dickinson 1980; Mackintosh 1983), but it also fits some current views on the function of the cerebral cortex (Phillips, Zeki and Barlow 1984, Barlow 1983,1986), and furthermore it leads to a quantitative scale for one aspect of intelligence, though it is a scale that has not yet been used.

Since the decision whether two events are associated is a definable statistical task, the Fisherian measure of efficiency (Fisher 1925) can be applied to it. The principle is to find how many instances are needed to establish the

association with a known degree of reliability, and to compare this with the minimum number of instances that would theoretically be required; the nearer the first figure is to the second, the higher is the efficiency with which the brain uses the evidence available about the association. Since Tanner and Birdsall (1958) introduced the measure to psychology it has been applied to many aspects of sensation and perception, including the detection of symmetry (Barlow and Reeves 1979), which is in a sense an associative task, but I do not think it has yet been used for assessing the ability to detect associations in a learning experiment. Surely it is potentially a big step forward to be able to reduce this one aspect of intelligence to a definable, objectively measurable, operation.

Versatility. It is easy to talk associationism, but hard to come to grips with the "numbers explosion" that associationism leads to. There are so many possibilities to be considered by any association-detecting system handling the large range of events used in psychological experiments that there are certain to be limitations: some of the possible associations will not be detectable. Hence versatility is bound to be at least as important a criterion for intelligence as the efficiency defined above, and it is less easily quantified. It is surely absurd to suppose that all sub-human species are equally versatile at association-detection, and as before Macphail presumably means that qualitative differences are unproven, rather than non-existent. I suspect he should be challenged about them being unproven, for some of the evidence looks pretty convincing.

Cognitive maps. Judson Herrick (1924) likened the cerebral cortex to the filing cabinets in government offices, and the stored knowledge, cognitive maps (Tolman 1932), and working models (Craik 1943)) in an animal's brain must be crucially important for intellectual behaviour. This aspect of intelligence is not very well tested in most learning studies, since experimenters understandably want to keep relevant aspects of their subjects' experience under their direct control, and hence avoid testing knowledge that the animals brings with them to their tests. In contrast anecdotal evidence claiming to demonstrate animal intelligence very often implies that they understand some aspect of the environment better than might have been suspected. Whether or not such claims are right, the adequacy of the cognitive map an animal builds from its experience cannot be ignored in judging its intelligence, and I do not think Macphail pays enough attention to this.

Language With regard to the crucial importance of language Macphail is more likely to be believed, but his conclusion should provoke some questioning here too. Wouldn't you expect talking and listening to convey just information? How then does it engender mankind's pre-eminent intelligence? Now language is a versatile representational scheme for the environment we live in, and perhaps the major benefit it confers lies in the filing system it makes our brains adopt, rather than the information placed in that sytem through its use. This filing system has been evolved quite recently by our local tribe of con-specifics to suit our current surroundings, and it has the further

advantage of being standardised, at least locally. It should be an enormous improvement on any ontogenetically determined filing system, particularly under conditions when the environment is changing rapidly.

To summarise, Macphail's article is a powerful irritant, and it is to be hoped that the reactions it provokes will lead in the end to more sensible conclusions. Among these might be the recognition that association-formation is a measurable operation, that its versatility as well as its efficiency is important for intelligence, and that language aids the efficient and versatile formation of associations through the representaional scheme it confers, not simply through the communication it makes possible.

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