

explained not by lower additive genetic variation but by the other sources of variation contributing to trait heritability. In the final analysis, fitness traits actually have higher additive genetic variation than other traits.

The essence of life-history study comes in chapter 4 and involves an understanding of the optimal allocation of resources in two or more traits. Studies of trade-offs use mainly genetic-correlation experiments or phenotype manipulations. The former method has been viewed as the more appropriate. But Stearns clearly considers phenotype manipulations as having a vital role and cites studies such as clutch-size experiments as outstanding accomplishments in life-history research.

Stearns admits that he excludes important topics, particularly modular organisms (such as clonal invertebrates) and complex life cycles. It seems fair, however, to view these topics as a 'next step up' from the solid foundation that this book builds. □

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## Multiple minds

*Ian J. Deary*

**Intelligence and Development: A Cognitive Theory.** By Mike Anderson. *Blackwell: 1992. Pp. 256. £40, \$44.95 (hbk); £11.95, \$19.95 (pbk).*

IN his presidential address to the American Psychological Association in 1957, Lee Cronbach called for psychology's two scientific disciplines to recognize their different strengths and their need to integrate. The integration has been a long time coming; the relationship between differential and cognitive (née experimental) psychology is still characterized by much mutual ignorance and occasional antagonism.

Mike Anderson is an integrationist, and he has written a rich, multi-dimensional book about human intelligence. Material from differential psychology, developmental psychology, psychobiology and neuropsychology is used to build an original theory of the structure and development of human intelligence. He writes with a strong, clear voice and often addresses the reader directly, in a style reminiscent of Freud's *Introductory Lectures*. The reader is warned when things are likely to become technical, at times advised to skip sections if already happy to accept a proposition, and steered away from

metaphors that might seem too fanciful. (Intelligence attracts probably more metaphors than any other psychological phenomenon, with memory as a likely runner-up; nevertheless, Anderson's diverting account of intelligence as a law firm was new to me.) Adopting such a style must have been a calculated risk, inviting charges of flippancy. In fact, rigour of argument and quality of presentation do not suffer and, whereas some will find the style intrusive and annoying, most will find it engaging.

Evidence is gathered to support the following propositions about human cognitive abilities: cognitive abilities increase with development; individual differences are stable during development; cognitive abilities co-vary; there are specific cognitive abilities; and there are cognitive mechanisms that are universal for humans and which show no individual differences. All but the last of these is established satisfactorily and, black box by black box, a "minimal cognitive architecture" is sketched to link them. The theoretical centrepiece is a box labelled "knowledge". Apparently, there are two routes to it. First, knowledge is generated by running one of a number (which might be two) of "specific processors" on a "basic processing mechanism". Second, knowledge may be given directly by a number of dedicated processors that typically contain information that has been important during evolution. In contrast to the more customary rectangles that fence in the model's other components, these so-called "modules" are drawn with rather organic, potato-shaped outlines and contain labels such as "perception of three-dimensional space", "phonological encoding", "syntactic parsing" and "theory of mind".

The theory has merit, without necessarily being true. It brings together diverse information about human mental abilities and provides a clear organization. In addition, the theory generates at least one interesting hypothesis: that individuals with higher levels of general intelligence will show more cognitive differentiation. Some parts of the theory lack adequate evidence. Anderson says that there are no individual differences in the modules, yet this is never established, and it seems unlikely that there are no individual differences in, say, syntactic parsing. The modules and the specific processors are posited largely because of the existence of individuals with specific cognitive deficits and of idiots savant. Later, by tautology, Anderson argues that damage to the inferred structures explains these disorders. At times the theory is too fluid and imprecise, and leans too heavily on weak evidence. For instance, the cause of the basic processing mechanism's in-

tersubject variance seems sometimes to be speed, at other times efficiency and at still others capacity. In a daring prediction, its speed is hypothesized not to change during cognitive maturation; but to establish this, Anderson has to explain away good evidence to the contrary, and the only positive evidence would seem to be a single study where the key datum was a nonsignificant difference between two weak correlations.

The basic processing mechanism, the main source of individual differences in the theory, is no more than a reification of Spearman's *g*: "The basic processing mechanism represents a knowledge-free biological constraint on thought, and is responsible for the phenomenon psychometricians know as general intelligence." It is progress, however, to see a cognitive psychologist frame this psychometric discovery in a prominent box in the theory. The specific processors too, although their mechanism of interaction with the basic processing mechanism is novel, are no more or less than spatial and verbal ability, the two long-recognized prominent group factors in human ability. Here, as in other parts of the theory, the hard work is done by neuropsychology and differential psychology, which provide the evidence for the components, yet cognitive psychology gets the credit. The specific processors are brought in on the back of factor-analytical and clinical neuropsychology studies, yet they are said to be 'computational' of a nature that, although unknown, is not isomorphic with the types of ability that index them.

This is a symptom of the book's most poignant aspect. Anderson states at one point that the theory is "avowedly cognitive", yet later he has to confess that "[a]lthough computational in spirit, the theory does not, as yet, embody a computational model. That is to say, the theory could not be used at the moment to explain precisely how someone solves even the simplest of problems." Such a comprehensive failure of cognitive psychology to contribute anything much to this 'cognitive' theory is presaged earlier in the book when the reader is informed that "it would be a brave cognitive psychologist who would claim to have worked out, even in the broadest terms, an uncontentious processing theory of any significant cognitive ability". But this doesn't really matter. Anderson's faith that a cognitive account of his various components will eventually turn up does not prevent his doing a good job with what is to hand. And, who knows, his theory might even prove to be correct. □

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