A Triarchic Theory of Jensenism: Persistent, Conservative Reductionism

IAN J. DEARY
University of Edinburgh

J. R. CRAWFORD
University of Aberdeen

This response to Jensen's target article principally addresses his contribution to information processing accounts of human intelligence differences. Three characteristics of Jensen's research are commended: his persistence in researching a topic and the thoroughness of his scholarship; his willingness to build a research theme upon existing knowledge and to desist from invoking too many new constructs; and his reductionistic orientation. Of three live questions in intelligence research to which he is contributing—reaction times, correlated vectors and mental speed—we address the method of correlated vectors. Using data from three representative samples tested on the Wechsler Adult Intelligence Scale-Revised and on inspection time, we show that inspection time's correlations with WAIS-R subtests fail to support the usual trend found with the method of correlated vectors.

Researchers on the topic of human intelligence differences can show one or more of a triad of undesirable characteristics,

- **Not that Old Construct Again!** They have a tendency to leave an area of empirical study without having conducted or encouraged a corpus of findings that will decide issues definitively.
- **Forget the Past!** They have a predilection for inventing new, daring theories rather than building upon established findings. To paraphrase the words of Earl Hunt, "unlike researchers in the physical sciences who stand on the shoulders of giants, researchers in intelligence stand on their predecessors' faces."

Direct all correspondence to: Ian J. Deary, Department of Psychology, University of Edinburgh, 7 George Square, Edinburgh EH8 9JZ, Scotland, UK <I.Deary@ed.ac.uk>.

INTELLIGENCE 26(3): 273-282
ISSN: 0160-2896

- **Biology is Boring (or Irrelevant)!** They can be guilty of forgetting that the seat of intelligence is the brain, and that knowledge of the brain's physiology and structural and functional anatomy might be useful in discovering the nature of human intelligence differences.

Our theme is that these three factors may impede the study of human intelligence differences, though they, or their equivalents, apply to many areas of psychological and other sciences. We contest that Arthur Jensen is prey to none of them.

NOT THAT OLD CONSTRUCT AGAIN!

Because aspects of the field of intelligence differences are so controversial, and because ideas in the field are subjected to intense scrutiny beyond the cognoscenti, we need corpora of data to which we may refer when pronouncing on topics. Nothing so unbecomes a scientist as when she/he is obviously describing straws in the wind. Thus, those who question the psychometric structure of human intelligence differences, including doubting the finding of general intelligence, may be referred to Carroll (1993) for a corrective. Those who doubt whether psychometric intelligence differences predict anything that is important about our lives may be referred to the sections on IQ and social class in the *Bell Curve* (Herrnstein & Murray, 1994).

Jensen, too, has the useful trait of corpus-production. He is a formidable scholar; so much so that Jensen's arch-critic and fellow scholar James Flynn is also an avowed and obvious admirer. From the target article in this volume it is clear that, from his early work on serial learning, Jensen was prepared to research a topic unusually thoroughly. Spearman might have called this *w*, or 'persistence of motives', the first trait that emerged after *g* in his studies (Deary, 1996). The thoroughness of Jensen's (1980) *Bias in Mental Testing* shows the lengths to which he is prepared to go to test criticisms of his ideas.

The search for information processing and biological bases of human intelligence is what Jensen calls 'vertical research', and what we have called 'reductionistic validity' (Deary & Caryl, 1997) or 'looking down on human intelligence' (Deary & Stough, 1997). Here, too, Jensen's high *w* trait score has been at work. His large, numerous and detailed studies of the Hick reaction time procedure and its relation to psychometric intelligence (e.g., Jensen, 1987) have established the phenomena and allowed others to explore and criticise them. Long may this trend continue, by Jensen and others.

In highlighting aspects of Jensen's contribution it is important to mention his way of going about his life's work as well as its practical achievements. Whether or not one discovers anything important in science is to a great degree a matter of luck. Like truffle-snuffling pigs, some scientists have nose for the area that is about to deliver, but many more have the fortune merely to be in the right place at the right time. The 'how' of a life in science should be evaluated in addition to the 'what'; that is, one should be Sternbergian enough to acknowledge that styles are important as well as achievements. And it is interesting how one's implicit styles become obvious when one hears others behaving in ways that transgress them. At a meeting of the International Society for the Study of Individual Differences, it was once stated in a presidential lecture that one slightly unattractive feature of the ISSID conferences was the same topics recurring conference after conference as symposia. That was a thunderbolt, for one's way of looking at things was precisely the

opposite. It was a sign of *strength* in a discipline or subdiscipline when the constructs survive subsequent attempts to scrutinize them. We need more Jensenist, terrier-like persistence that will gnaw away at a topic year after year until its nomological net is robust or it has evaporated like Scotch mist. We need fewer bandwagon-jumping, fly-by-night opportunists who embrace each new psychological fashion and conduct single, non-definitive experiments on evanescent constructs.

FORGET THE PAST!

It is surprising that Jensen styles himself as an adventurous scientist and criticizes conservatism. It seems easier to praise him for the latter trait, conservatism. His knowledge of the original works in intelligence seems to inform his research topics: Galton on heritability; Galton and Spearman on elementary cognitive tests and their place in intelligence differences; and Spearman's hypothesis. His major research contributions have continued these natural science approaches to human intelligence. He has refrained from contributing 'Jensen's theory' of intelligence to the many eponymous theories we all know. The coining of 'Jensenism' is a red herring: it reflects the fact that Jensen was a recipient of unparalleled attention and aggression for having summarised and commented on *other* people's research.

It is encouraging to read a scientist in psychology who says that he derived ideas and inspiration from the originators of the field, and to read his account of researching intelligence-reaction time associations when 'everyone knew' that this had been tried and failed. One can tell a similar story with sensory discrimination and intelligence. The historians of intelligence suggested that Galton and McKeen Cattell's ideas about the nature of intelligence lost out to the practicality of Binet's approach; 'everyone knew' that there was no association between intelligence and sensory discrimination. However, a correct account of the literature on sensory discrimination showed that there were significant associations between visual and auditory discrimination and psychometric ability test scores (Deary, 1994).

Jensen found Spearman's hypothesis of the black-white differences in some IQ-type test scores, and did a typical large-scale job of testing it. Similarly, Spearman first anticipated the differentiation effects in intelligence, whereby *g* is stronger—accounts for a greater proportion of the variance—at lower levels of intelligence and there is more differentiation of cognitive ability at higher levels (Deary & Pagliari, 1991; Deary et al., 1996). Jensen extended Spearman's hypothesis to what he now calls the theory of correlated vectors. That is a novel finding, and the number of phenomena that obey the rule—the vector of subtests' *g*-loadings is correlated with the vector of subtests' correlations with the phenomenon in question—makes it impressive. However, our empirical contribution in this piece will be to reveal a phenomenon that does not obey the rule of correlated vectors (see below).

Again, in what has gone above some of the 'what' of Jensen's oeuvre has been discussed. However, let's also look at the 'how' and push home the conservatism of Jensen. From what Jensen says, IJD must be one of the few students in the 1980s who did read Hull. The attraction was the exactness of the formulae within which vague constructs like motivation might be fitted and tested. However, it fell apart when one realized how far ahead of the data such formulizing becomes. Constructs had never been fully operational-

ized nor the interaction of the constructs fully tested. In reading Jensen one never feels far ahead of the data, and the hypothesizing he engages in is usually modest.

BIOLOGY IS BORING (OR IRRELEVANT)!

It seems almost too trite to write: the human brain's structure and functioning impose limits to the possibilities for explaining the nature of human intelligence differences. Therefore, in thinking about the nature as opposed to the psychometric structure of human intelligence, Jensen's emphasis on biology seems necessarily correct. One can envisage way-station constructs between psychometrics and intelligence. Experimental psychology provided working memory, several reaction time procedures, and so forth. Psychophysics has given us inspection time. Yet, even if more work on these constructs—or the kernel constructs within these procedures—were to offer explanatory accounts of intelligence differences, we should still be left with the question of the nature of the experimental and/or psychophysical construct. Ineluctably, we should be drawn to a biological account of intelligence. Biology in this account does not equal genetics: all environmental and genetic effects on the brain are ultimately effects on a biological system. Let us offer support for Jensen and people of this ilk who feel unsatisfied when the psychological account of a phenomenon has not found a biological foundation. It is from Craik (1943), the genius who graduated from Edinburgh and who pursued postgraduate work in Cambridge (the experimental psychology counterweight to the London School's differential psychology in the mid 20th century) before a tragically early death,

> The plea for physical explanation does not mean that it is useless or incorrect to give apparently non-physical clinical explanations of psychological phenomena—for instance, to say that an unpleasant experience or shock may *cause* amnesia or suppression. This is a correct statement of the phenomena as far as it goes; but we are entitled to go further if we can. If we then find a more ultimate physical and physiological train of events to be involved 'in between' the shock and the suppression, we should regard this as a more ultimate part of the mechanism, just as it is correct to say that the pressure of one's finger on the self-starter causes the engine to go, but more fundamental to say that the pressure of one's finger causes current to flow in the windings of the starting motor and still more fundamental to give an account of the flow of current and torque exerted by the motor in term of electronic and electro-magnetic theory.

In the biological approach Jensen has contributed nerve conduction studies and, by teaming up with Ed Reed, has given us a lesson in collaboration with biological scientists. We are now at the threshold of a flood of research that will use new functional brain scanning and molecular genetic techniques. Armchair theories of intelligence will be tested by a plethora of putative genetic and brain metabolic associations of human intelligence differences. To keep a hold on these advances we must, as differential psychologists, try to understand the principles and promises of these techniques, and find collaborators willing to apply them in the investigation of individual differences in intelligence.

It is interesting to read Jensen guessing (or hypothesizing) about the loci of individual differences in intelligence. He envisages that they will be found in the basic physiological features of the brain, with NCV just one example of a possible limitation: he names others. In deciding this, he recognizes that the other great question of the nature of human intelligence arises. It is Jensen's guess that we shall not have to wait for the solution to the nature of human intelligence in order to discover what makes one person brighter than another. It

is a moot point, and it is brave to guess to what extent the question of the nature of human intelligence will be tied up with the question of the nature of intelligence differences. Connectionist accounts of mental processes allow both basic features of neurons and features of networks to be related to processing efficiency, so there is no a priori reason to guess that human intelligence differences will be solely at the level of basic physiology.

Reductionism is broader than just biology. There is a section in Jensen's article that deserves to become widely distributed to psychologists,

> My belief was (and still is) that psychology, to develop as a natural science, has to begin by trying to explain the simplest, most universal, and most reproducible behavioral phenomena. Scientific explanation is essentially reductionistic, showing the causal links by which the phenomenon to be explained is related to certain simpler, more elemental, and more general principles. An explanatory hypothesis, invoking simpler mechanisms and general principles, originates from hunches and inductive reasoning based on observations of a phenomenon; certain consequences of the initial hypothesis are then logically deduced from it and are empirically tested for their validity by systematically making new observations and performing controlled experiments. This procedure, if followed properly, gradually builds up a nomothetic network, or general theory, within which an increasing number of related phenomena can be explained. The problem is in discovering the basic and essential elements and their interrelations in a given behavioral domain.

Compare this with Spearman's manifesto in his 1904 'general intelligence' paper, in which he described how he is going to set about discovering the source of individual differences in intelligence,

> As regards the nature of the selected Laboratory Psychics, the guiding principle has been the opposite to that of Binet and Ebbinghaus. The practical advantages proffered by their more complex mental operations have been unreservedly rejected in favour of the theoretical gain promised by the utmost simplicity and unequivocality; there has been no search after the condensed psychological extracts to be on occasion conveniently substituted for regular examinations; regardless of all useful application, that form of physical activity has been chosen which introspectively appeared to me as the simplest and yet pre-eminently intellective. This is the act of distinguishing one sensation from another.

And here is another London School luminary, Burt (1909-10), outlining his reductionistic model of human intelligence,

> all the functions of the human mind, the simplest and most complicated alike, are probably processes within a single system. A process typical of higher psychophysical 'levels' may be connected with a process typical of lower psychophysical 'levels'. Yet, this relatively small correlation is not a disproof, but a consequence of, their inclusive organization within a single integrative system of psychical dispositions or neural arcs. The contrary assumption of a radical dichotomy between "the general mammalian foundation of the central nervous system" and the "specifically human capacity" of General Intelligence—towards which Dr. Archdall Reid and even Professor Thorndike seem to incline,—proves a serious barrier to the advance of the biological standpoint in individual psychology.

This section is a good antidote to purely cognitive theories of intelligence; it keeps our feet on the ground. It encourages us to keep our nerve when we are criticized for studying esoteric little bits of human behavior (serial position effects in Jensen's case, inspection time in ours). It offers a good dose of reality to those who want to be reductionists, but who want a task that looks and feels 'relevant' or 'ecologically valid' as well as one that does the job. But Jensen's account does not tell the whole story. What he does not say is that we aim to articulate, operationalize, and build theories with our low-level constructs in order

to account for variance in much higher-level human regularities. And it is the bridge between these high and low level constructs that gives us so much trouble in psychology. The truth is that a lot of Jensen's efforts on psychometric intelligence have not been reductionist; his scholarly work has often been in articulating the phenotype of intelligence differences and establishing the validity of the description of different levels of mental ability. In understanding the nature of these differences, Jensen's reductionist agenda comes into play. That is, to explain the phenotypic differences in intelligence we may appeal to lower level constructs. As we have said elsewhere, there are several levels that we might appeal to: psychometric, cognitive, psychophysical, physiological, and so forth (Deary, 1999). And we need to be critical of the validity of the supposed lower-level constructs we are appealing to when we make these reductionist accounts.

Live Questions

At the forefront of the information processing approach Jensen may be seen as contributing to at least three live questions.

Reaction Times and Intelligence

The first concerns the association between reaction times—especially the Hick procedure—and psychometric intelligence. There is no doubt that modest associations are found between variables derived from the Hick procedure and mental ability. The problems with these findings are in explaining them. The first wave of enthusiasm for the Hick procedure came from its correlation with intelligence and from the theoretical significance of the slope parameter (the so-called 'rate of gain of information'). It is now well established that the slope parameter does not have the only or the largest correlations with psychometric intelligence scores. Therefore, whereas it is clear that Hick RT parameters do correlate with ability test scores, it is not clear why, and a decision must be made by researchers as to the worth of continuing to pursue this line of inquiry. This decision must be informed by the information about how likely such experimental tasks are to be open to reductionistic explanation. We have argued elsewhere that psychophysical tasks such as inspection time look like a better bet in terms of their tractability than higher-level, reaction time tasks (Deary, 1997).

The Method of Correlated Vectors

The second is the method of correlated vectors. In this procedure Jensen has contributed an interesting general hypothesis. However, with such findings one is not entirely sure what to make of them. They correspond to a remarkable regularity, and seem to attest to the importance of the general factor in intelligence with regard to different correlates of intelligence. One might compare them with Brinley plots of ageing and cognitive performance (Rabbitt, 1996), where an arguably similar regularity has appeared, and which has led some to invoke general mental speed as the source of child intelligence development and the decline of intelligence in old age. However, with neither method is one getting at basic processes directly; these are inferred from some regularity that is rather abstract. And how are we to interpret it if an important phenomenon fails to accord with the method of correlated vectors?

Inspection Time and the Method of Correlated Vectors. It is well established that inspection time has a significant correlation with psychometric intelligence, at between .4 and .5 with performance measures and lower with verbal measures (Kranzler & Jensen, 1989; Deary, 1993). Much work has been done and still needs to be done to understand the association and to understand exactly what is measured by IT. However, for present purposes we have examined whether the pattern of IT's correlations with measures of psychometric intelligence is consistent with Jensen's claims of positively correlated vectors. Correlation matrices from three existing studies were available. The first came from a sample of 134 healthy participants that had undergone a standard visual inspection time procedure and had been administered a full-length WAIS-R (Crawford, Deary, Allan, & Gustafsson, 1998). This sample was representative of the general adult UK population in terms of the distributions of age, sex and social class. The second sample consisted of 87 diabetic patients with a near to normal mean and spread of IQ and who had been administered the same measures, with the exception that the Digit Span and Picture Arrangement subtests of the WAIS-R were omitted (Deary, 1993). Lastly, data from a further sample of 123 healthy participants administered a full-length WAIS-R were available (McGeorge, Crawford, & Kelly, 1996). The speed of processing measure employed with this last sample was the threshold at which tachistoscopically presented words could be identified (established using an adaptive staircase procedure). Note that this last sample performed a verbal speed of processing task, whereas the former two samples completed the standard IT task involving a spatial judgement. Full descriptions of the subject samples, procedures used and results obtained are to be found in the three articles cited above. The following analyses are novel, employing Jensen's method of correlated vectors.

Principal components analyses were conducted on the three WAIS-R subtest correlation matrices to obtain the loadings of the subtests on the first unrotated principal component (*g*). These subtest loadings were then corrected for attenuation by dividing them by the square root of the subtest reliability coefficients. The reliability coefficients were obtained from Table 10 of the WAIS-R manual (Wechsler, 1981). The vectors of correlations between the WAIS-R subtests and the speed of processing measure (IT or Word Identification Threshold) were also corrected for attenuation. The two vectors obtained from each of the three samples are presented in Table 1. Linear regression analyses were conducted with the vector of g loadings as the independent variable and the correlation vector as the dependent variable. The correlation between the vectors and the intercept and slope of the regression line relating them to each other are also presented in Table 1. It can be seen that, for all three samples, the vector of g loadings was *negatively* correlated with the vector of subtest-speed of processing correlations. Thus the trend was for those subtests with the highest *g* loadings to have the lowest correlation with speed of processing. To our knowledge these are the first sets of results to run counter to Jensen's observed regularity of a moderate to strong positive correlation between the g loadings of psychometric tests and their correlations with biological markers or measures of low-level speed of processing. What should one make of this exception to Jensen's hypothesised regularity, especially given that it was observed with differing measures of speed of processing (IT/Word Identification) and in samples differing in health status (healthy/diabetic)?

Table 1. Attenuation corrected *g* loadings and correlations with speed of processing measures (IT and Word Identification) for WAIS-R subtests in three studies

	Crawford, Deary, Allan & Gustafsson (1998)		*Deary (1993)*		*McGeorge, Crawford & Kelly (1996)*	
	g loading	*r with IT*	*g loading*	*r with IT*	*g loading*	*r with SOP*
Information	.792	.190	.903	.177	.825	.157
Digit Span	.584	.148	-	-	.622	.102
Vocabulary	.802	.127	.874	.220	.775	.094
Arithmetic	.765	.115	.840	.163	.740	.241
Comprehension	.812	.097	.903	.197	.755	.148
Similarities	.855	.177	.865	.154	.826	.384
Picture Completion	.803	.160	.731	.341	.723	.297
Picture Arrangement	.842	.252	-	-	.671	.425
Block Design	.716	.306	.742	.322	.738	.408
Object Assembly	.734	.393	.844	.314	.709	.534
Digit Symbol	.526	.351	.697	.370	.561	481
r between vectors		**-0.411**		**-0.849**		**-0.315**
intercept (*a*)		0.505		1.011		0.745
slope (*b*)		-0.394		-0.924		-0.619

1. It might be said that the WAIS-R is an insufficiently large or appropriately distributed battery for a test of the correlated vectors hypothesis. Yet Jensen makes no such caveats and refers to the WAIS-R in his own findings. However, perhaps there might be a more rigorous stipulation about the number and composition of subtests for the method of correlated vectors and further empirical investigations of its potential vulnerability to the make-up of the battery.
2. It might be the case that IT is more closely related to a group factor than to general intelligence. If there were some valid reason for accepting that deviations from the correlated vectors hypothesis were informative, then our present results could indicate that it is principally at the group ability factor level rather than at the level of general intelligence that IT has explanatory value. This would be consistent with our recent study in which competing models of the relationship between IT and general and group ability factors were tested using confirmatory factor analytic methods (Crawford, Deary, Allan, & Gustafsson, 1998).

Mental speed and intelligence

The third live question that Jensen is contributing to is that of whether some form of mental speed is partly causal to individual differences in intelligence. Increasingly, 'mental speed' a term that opposes rather than enhances the clear discussion of intelligence differences. It had the initial advantage that the idea that some form of quickness is basic to intelligence has a venerable history. Also, the term loosely corrals a variety of related research on intelligence. However, the use of the term is so loose and gives rise to so much needless misunderstanding that it might better be dropped and replaced with a more operationally-oriented description of our techniques in the vertical study of intelligence. It might be acceptable at some level to state that inspection time and reaction time correlations with intelligence both indicate that some forms of mental speed is a factor in intelligence. However, such a statement begs the questions of whether: a) there are common ingredients from both tasks that relate to intelligence; b) the basic biological construct underlying successful performance is speed. What appears to be speeded performance at the psychological level can be subserved by physical mechanisms that are not essentially speed-based.

Conclusion

The above view of Jensenism differs, in all likelihood, from other contributors here. When our interest in intelligence was kindled Jensen was the author of *Bias*, and a harbinger, along with Earl Hunt, Robert Sternberg and Hans Eysenck and others of the information processing approach to intelligence research. His scholarship as devoted to other aspects of intelligence emerged from reading his intelligence back catalogue, at first through the dark glass of Gould and Kamin, and the even-handed scholarship of Flynn, and then from the horse's mouth. The scientist of intelligence we have described is not a natural grandstander; Jensen's detailed critique of Gould's well-known *Mismeasure of Man* was published in a relatively obscure outlet. In the field of information processing approaches to intelligence Jensen provides a model of dedicated, cumulative, sober 'normal' science: more please.

REFERENCES

Burt, C. (1909–10). Experimental tests of general intelligence. *British Journal of Psychology, 3*, 94–177.

Carroll, J.B. (1993). *Human Cognitive Abilities: A Survey of Factor–Analytic Studies*. Cambridge: Cambridge University Press.

Craik, K. (1943). *The Nature of Explanation*. Cambridge: Cambridge University Press.

Crawford, J.R., Deary, I.J., Allan, K.M., & Gustafsson, J.–E. (1998). Evaluating competing models of the relationship between inspection time and psychometric intelligence. *Intelligence, 26*, 27–42.

Deary, I.J. (1993). Inspection time and WAIS–R IQ subtypes: A confirmatory factor analysis study. *Intelligence, 17*, 223–236.

Deary, I.J. (1994). Sensory discrimination and intelligence: Postmortem or resurrection? *American Journal of Psychology, 107*, 95-115.

Deary, I.J. (1996). A (latent) big five personality model in 1915?: A re–analysis of Webb's data. *Journal of Personality and Social Psychology, 71*, 992–1005.

Deary, I.J. (1997). Intelligence and information processing. In H. Nyborg (Ed.), *The Scientific Study of Human Nature: Tribute to Hans J. Eysenck at Eighty*. New York: Pergamon.

Deary, I.J. (1999). Intelligence and visual and auditory information processing. In Ackerman, P., Kyllonen, P., & Roberts, R. (Eds.), *Learning and Individual Differences*. Washington: American Psychological Association.

Deary, I.J., & Caryl, P.G. (1997). Neuroscience and human intelligence differences. *Trends in Neurosciences, 20*, 365–371.

Deary, I.J., Egan, V., Gibson, G.J., Brand, C.R., Austin, E., & Kellaghan, T. (1996). Intelligence and the differentiation hypothesis. *Intelligence, 23*, 105–132.

Deary, I.J., & Pagliari, C. (1991). The strength of g at different levels of ability: have Detterman and Daniel rediscovered Spearman's 'Law of Diminishing Returns'. Intelligence, 15, 247–250.

Deary, I.J., & Stough, C. (1997). Looking down on human intelligence. *American Psychologist, 52*, 1148–1150.

Herrnstein, R.J., & Murray, C. (1994). *The Bell Curve*. New York: Free Press.

Jensen, A.R. (1980). *Bias in Mental Testing*. London: Methuen.

Jensen, A.R. (1982). The debunking of scientific fossils and straw persons. *Contemporary Education Review, 1*, 121–135.

Jensen, A.R. (1987). Individual differences in the Hick paradigm. In P.A. Vernon (Ed.), *Speed of information - processing and intelligence* (pp. 101–175). Norwood, NJ: Ablex.

Kranzler, J.H., & Jensen, A.R. (1989). Inspection time and intelligence: A meta–analysis. *Intelligence, 13*, 329–347.

McGeorge, P., Crawford J.R., & Kelly, S.W. (1996). The relationship between WAIS–R abilities and speed of processing in a word identification task. *Intelligence, 23*, 175–190.

Rabbitt, P. (1996). Do individual differences in speed reflect "global" or "local" differences in mental abilities? *Intelligence, 22*, 69–88.

Spearman, C. (1904). General intelligence, objectively determined and measured. American *Journal of Psychology, 15*, 201–293.

Wechlser, D. (1981). *Manual of the Wechlser Adult Intelligence Scale–Revised*. New York: Psychological Corporation.