



**Analysis of methodological variables underlying
correlations between elementary cognitive tasks and
IQ**

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Abstract

A series of experiments is reported in which the relationships are measured between, on the one hand, IQ, measured by the Wechsler Adult Intelligence Scale Revised (WAIS-R) and the Raven Advanced Progressive Matrices (APM) and, on the other, three commonly employed elementary cognitive tasks (ECTs), Inspection Time (IT), Hick Reaction Time (RT) and Averaged Evoked Potentials (AEPs). The dissertation examines the effects of several methodological variables on the relationship between IT, RT, AEPs and IQ.

Eight chapters are presented. Chapter 1 serves as an introduction to the work presented in the subsequent chapters. In this Chapter, it is argued that although a purely psychometric approach has provided significant information on the nature of intelligence, future information requires a theoretical framework. One such framework has been described by Eysenck (1988) and his model of intelligence is described.

Chapter 2 investigates a methodological issue relating to the measurement of decision time (DT) and movement time (MT) from the Jensen-Hick paradigm. The possibility that subjects have employed a cognitive strategy in previous Hick RT-IQ experiments is examined by comparing RTs to masked and unmasked stimuli, on the assumption that the former condition removes or at least substantially reduces opportunities for developing strategies. Results suggested that in the unmasked RT condition, subjects employed a strategy in which additional decision time is gained during the movement component of RT. In order to address whether this strategy determined the negative DT-IQ correlation reported in previous experiments by Jensen, Vernon and others,

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the relationship between IQ and both DT and MT variables under masked and unmasked conditions was assessed. As significant negative correlations were obtained between DT and MT variables with IQ variables, under both masked and unmasked conditions, it is concluded that the use of this type of strategy did not determine the correlation between DT and IQ. There was some evidence that suggested the correlation between DT and IQ was reduced in the masked condition compared to the unmasked condition. Means and SDs for DT and MT were generally reliable after 12 months. The effects of trial size and order effects on the relationship between RT and IQ are also discussed. MT-IQ correlations were not significantly different from DT-IQ correlations and DT slope-IQ correlations were nonsignificant, suggesting that the Jensen information processing model of intelligence should be revised or abandoned.

Chapter 3 describes previous experiments that have been concerned with the relationship between parameters of the AEP and IQ, focusing on research that has attempted to link the complexity of the AEP waveform (Hendrickson paradigm) with IQ test performance. Despite previous inconclusive results, Experiment 2 provides significant and substantial correlations between the string length measure and IQ variables. Nonsignificant correlations were obtained between the variance measure and IQ measures, suggesting that previous explanations of the string length-IQ relationship in terms of errors in cortical processing were untenable. The significant correlations between string length and IQ are interpreted within an attentional framework which offers the most plausible attempt at reconciling previous research on this relationship. It is also argued that the Hendrickson methodology is inadequate to provide reliable AEP measures before 100 msec has elapsed from the presentation of the stimulus. Preliminary reliability data are presented for the string length measure of AEP complexity.

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Experiment 3 addresses the attentional model proposed in Chapter 3. The Bates and Eysenck (1983) hypothesis that the focus of attention may reverse the sign of the correlation between the string length measure of AEP waveform complexity and IQ is examined. Recording AEPs to a task requiring focussed attention demonstrated that subjects with high IQ recorded significantly longer string lengths than low IQ subjects. Because Bates and Eysenck employed a PEST procedure, differences in parameters of the AEP may be attributable to differences in stimulus intensity (low IQ subjects were administered trials of longer duration than high IQ subjects). It is concluded that the results of Experiment 2 and 3 are both consistent with the hypothesis that high IQ subjects allocate more attentional resources to the task than low IQ subjects.

Experiment 4 was designed to investigate whether high IQ subjects allocate more attentional resources to information processing tasks than low IQ subjects, employing a classical Picton and Hillyard "selective attention" AEP procedure in which the relationship between the amplitude of the N1 component of the AEP waveform to attended and unattended competing auditory tones was measured. This experiment also tests the Hunt (1980) and Macintosh (1986) hypothesis that differences in IQ are determined by attentional resource allocation. Results did not support the allocation of attention model proposed in Chapter 3. High IQ subjects did not allocate more attentional resources than low IQ subjects, but performed significantly better on the information processing task. Therefore, this result is not consistent with the Hunt or Macintosh hypothesis.

Chapter 5 investigates the relationship between IT and IQ variables. Experiment 5 examines Howe's (1989) hypothesis that IT and IQ are meaningfully correlated only in samples with intellectually disabled subjects and in samples of less than 40 subjects. Correlations of the order of $-.5$ were

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observed, consistent with both Nettelbeck's (1987) and Kranzler and Jensen's (1989) meta-analysis of this relation, and therefore inconsistent with Howe's (1989) hypothesis. In a large sample (N=67), verbal IQ (VIQ)-IT correlations were not significantly different to performance IQ (PIQ)-IT correlations. Chapter 5 also examines two other methodological issues relating to the measurement of IT and to the relationship between It and IQ. Pilot study 1 examines the difference between IT estimates derived from tachistoscope and Hercules graphics monitor administration. This study specifically examined whether previous inconsistent results could be explained in terms of the apparatus to administer the IT task. Similar IT-IQ correlations were observed in both tachistoscope and monochrome computer monitor conditions, with ITs from both administrations correlating at a moderate level. Experiment 6 evaluates the apparent motion effect reported by Mackenzie and Bingham (1985). Three different backward visual masks were examined in relation to their effect on performance and to their effect on IT-IQ correlations. Results suggested that the standard mask used in nearly all previous IT experiments allows substantial use of apparent motion compared to a lines and lightning mask. The new lines mask prevents nearly all use of apparent motion. Nonetheless, there was no evidence to suggest that the magnitude of the correlation between IT and IQ were different in any of the masking conditions. The latter result was consistent with the view that the use of apparent motion cues in the IT procedure does not determine the correlation between IT and IQ.

Chapter 6 describes experiments examining the relationship between personality and temperament variables and IT, RT, AEPs, and IQ. Experiment 7 examines the relationship between personality and temperament variables with IT, RT, AEPs, and IQ, and on the correlation between the ECTs and IQ; and tests the hypothesis that correlations between IT, RT, AEPs and IQ are mediated or determined by personality and temperament variables. Thus

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Chapter 6, is primarily concerned with the suggestions by Howe (1989) and by Brody (1985), that correlations between IQ test performance and ECTs may only reflect characteristics of personality and temperament rather than biological characteristics constraining the development of knowledge. On the whole, personality and temperament variables did not mediate correlations between the ECTs and IQ. The Robinson (1989) hypothesis that ambiverts may have an advantage for IQ test performance and for speed of information processing is assessed. Results were consistent with this hypothesis although other possibilities are discussed.

Chapter 7 examines the inter-relationship among IT, RT, AEPs and IQ. Correlations reflected the independent measurement of each variable and not concurrent measurement. Factor analysis, stepwise regression and correlation indicated that a substantial part of the WAIS-R IQ variance could be accounted for by the IT, RT and AEP tasks. This result suggests that the Juhel (1991) view, that the relationship between IT, RT, AEPs and IQ may be too small to be of practical significance, could not be supported. The result was difficult to dismiss in terms of subject strategies inherent in all tasks.

Chapter 8 summarises the results of the preceding chapters, highlighting some problems with the experimental work presented, and outlines some implications of the results for a theory of intelligence. Flynn's (1987) view that validating new measures of intelligence (e.g., ECTs) with IQ may be problematical given that there have been large increases in IQ scores over the last two generations is discussed. In Chapter 1 it is noted that IQ tests have been validated as a measure of intelligence in terms of predicting scholastic and organizational success or qualities which are normally regarded or accepted to relate to "intelligence". Experiment 8 addresses whether one of the ECTs employed in this dissertation (IT) possesses high criterion validity by

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correlating scholastic performance, IQ and IT scores. Results indicated that IT significantly predicted both final year secondary school exam performance and IQ. The result was consistent with the hypothesis that individual differences in ITs relate to basic differences in the ability to acquire information. Future research is outlined.