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Inspection Time and Intelligence: A Meta-Analysis

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A meta-analysis of research on the relationship between inspection time (IT) and intelligence (IQ) was performed to: (1) determine whether a nonzero relationship between IT and IQ exists, (2) estimate the size of this relationship if it exists, and (3) test whether IT is ontogenetically related to *g*. Separate meta-analyses were initially conducted for results of studies using measures of general IQ, performance IQ, and verbal IQ for studies using samples of adults, children, and the mentally retarded. They were first conducted on the published (uncorrected) correlations. Following this, the resultant values were corrected for the extraneous effects of the artifacts (viz., sampling error, error of measurement, and range variation) and the meta-analyses were repeated. Results of these meta-analyses indicate that IT is related (negatively) to IQ, at least with measures of general IQ and performance IQ. For adults, with general measures of IQ, this correlation is about −.54, after correction for the effects of artifactual sources of error (−.30 prior to correction). IT, however, also appears to measure other factors besides *g*, possibly perceptual organization, which is reflected in the higher relationship of IT to performance measures of IQ. Finally, the theory that IT is ontogenetically related to IQ does not receive support. Rather, results of this study suggest that the degree of the IT–IQ relationship is relatively constant across age, at least through the range of ages tested in the literature.

In recent years, the theory that individual differences in intelligence (IQ), or *g*, are integrally related to speed of information processing has received increased attention (see Vernon, 1987). Inspection time (IT) is one of several "mental speed" paradigms used to investigate this relationship. Although research on IT has been traced to James McKeen Cattell in the 1880s (Deary, 1986), contemporary interest in IT stems from the work of Vickers, Nettelbeck, and their colleagues (Nettelbeck, 1973; Nettelbeck & Lally, 1976; Vickers, 1970; Vickers, Nettelbeck, & Willson, 1972; Vickers & Smith, 1986). IT is theorized to reflect "some temporal limitation to the rate at which information is taken in for processing" (Nettelbeck, 1987, p. 295). IT, the only index of mental speed that does not involve either motor (output) components or executive cognitive processes (metaprocesses), is held to tap individual differences in the "speed of apprehen-

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sion," the quickness of the brain to react to external stimuli prior to any conscious thought.

In the typical IT experiment, the subject is presented with two lines of markedly different length in a tachistoscope, followed almost immediately by a backward masking stimulus to limit the amount of processing from stored traces. The subject then judges which line (left or right) is the longer. IT is defined as the minimum exposure duration that is necessary for the subject to reliably discriminate between the two lines. While the vast majority of IT studies have examined visual IT, tactile and auditory IT have also been investigated (Deary, 1980; Edwards, 1984; Irwin, 1984; Nettelbeck & Kirby, 1983; Raz, Willerman, Ingmundson, & Hanlon, 1983).

Several early reviews of the literature found IT to be more highly correlated (negatively) with *g* than any other index of mental speed (Brand, 1981; Brand & Deary, 1982; Nettelbeck, & Kirby, 1983), although Mackintosh (1981) questioned the validity of some of these initial results. These correlations have typically been larger among children and retarded adults than among nonretarded adults. IT has also been found to decrease up to the age of about 11–13, with less marked change thereafter (Nettelbeck & Wilson, 1985). In addition to these findings, data suggesting that IT is related to mental age up to about 11–13 years but not to IQ within age cohorts (Anderson, 1986; Hulme & Turnbull, 1983) support Brand's (1981, 1984) theory that IT is ontogenetically related to the development of IQ. Brand contends that speed of apprehension provides the basis for intellectual development. Throughout development other factors (both genetic and environmental) increasingly account for individual differences in IQ. Brand also conjectures that there may be an IT threshold beyond which high IQ adults may not develop—thereby explaining the larger correlations among children and retarded adults than among nonretarded adults. Hence, "high speed of apprehension may be a sufficient but not a necessary condition for high adult IQ" (Nettelbeck, 1987, p. 301).

More recent reviews of the IT literature, however, have been inconclusive (Lubin & Fernandez, 1986; Nettelbeck, 1987; Vernon, 1986). The factors contributing to this lack of consensus include: many studies with very small sample sizes, an unusually wide range of non-normally distributed IQs, and the use of different IT apparatuses and psychophysical procedures. Two of the most recent reviews are no exception. Lubin & Fernandez (1986), in a brief but comprehensive review, concluded that the "relation between intelligence and IT is not very clear, particularly due to the great variability in results" (p. 656). They further assert that IT is not capable of discriminating between subjects of average intellectual ability. In contrast to their conclusion, Nettelbeck (1987), in perhaps the conceptually clearest and most comprehensive review to date, found IT to be related to measures of both general mental ability and performance ability. Nettelbeck also suggested that the best estimate of the correlation between IT and IQ among normal adults is −.50. Nevertheless, it was unclear whether IT is related to verbal ability independently of *g*.

Thus, in spite of these recent attempts to cumulate the results of IT research across studies to establish facts, basic questions regarding the relationship between IT and *g* remain.

META-ANALYSIS

One criticism that can be made of all these reviews is that they overlook the possibility of meta-analysis (e.g., Hedges & Olkin, 1988; Hunter, Schmidt, & Jackson, 1982; Light & Pillemer, 1984). Although meta-analysis is but one approach to cumulating data across studies, it is thought to be an improvement on "traditional" review methods, which, relying primarily on the "box score" of the outcomes of significance tests in various studies, have been criticized as overly "subjective" and "scientifically unsound" (Light & Pillemer, 1984). Much of the work on meta-analysis stems from the fact that even if the true (population) correlation (*rho*) is constant across studies bearing on the same relationship, there is likely to be variability among the observed correlations due to sampling error and to various extraneous or "artifactual" sources of error. The correlation coefficient (*r*) is subject to three sources of error that meta-analysis can take into account: (1) sampling error, (2) error of measurement, and (3) range variation. If any of these factors vary across studies, then the observed *r* will also vary for any given value of *rho* in the population. In other words, artifacts reflect statistical processes that are unrelated to *rho*. For example, if *rho* is constant and IT is linearly related to IQ, the observed *r*s between IT and IQ will vary if the standard deviation of IQ differs radically across studies. That is, the variability of the observed *r*s across studies may be entirely due to range variation or other artifacts. It is quite possible, then, that the "great variability" of results in the IT literature may simply reflect the systematic sources of variance in the estimation of *rho*. Fortunately, meta-analysis can eliminate or "correct" for this artifactual variability. In addition to this advantage, pooling the results of individual studies in meta-analysis increases statistical power and enhances the accuracy of the conclusions.

The aim of this study is to do a meta-analysis of the research on the relationship between IT and IQ. It is not our purpose to review the literature in detail, as that has already been done adequately by Nettelbeck (1987). The questions posed for meta-analysis are: (1) Has a nonzero relationship between IT and IQ been shown to exist in the literature?; (2) What is the best estimate of this relationship?; and (3) Is IT related to the development of *g*?

METHOD

Review of the Literature

An exhaustive search of the literature on the relationship between IT and measures of intellectual ability was made, which included a computer search of the PSYCINFO and ERIC data bases as well as a perusal of relevant journals (e.g., *Intelligence* and *Personality and Individual Differences*). Also, as many unpublished studies were obtained as possible, including doctoral dissertations, honors theses, and articles either submitted or in press. When necessary, unpublished results that are reported in the literature were also included.

Several studies bearing on the IT–IQ relationship were excluded from this analysis. First, a study by Cooper, Kline, and Maclaurin-Jones (1986), which examined the relationship between IT and "primary mental abilities," did not fit the method of grouping studies in this analysis. (This is explained below.) Also excluded were those studies with samples comprising both normal *and* mentally retarded subjects (Anderson, 1977; Deary, 1980; Nettelbeck & Lally, 1976), as artificially wide ranges in IQ could spuriously inflate the observed correlations between IT and IQ. It is not possible to extract results for the normal subjects in these studies.

Model of Meta-analysis

Hedges (1988) states that although there are a variety of ways in meta-analysis to correct for the effects of sampling error, measurement error, and sample differences in variance, or range-of-talent, they all attempt to compare an estimation of the variability attributable to these sources of error to the observed variability. If these artifacts are found to account for a significant proportion of the variance between studies, then the corrected r is considered a valid and generalizable estimate of the true relationship between variables. The model of meta-analysis used in this study is the random effects model presented by Hunter et al. (1982). This particular model was chosen primarily because of its accessibility, but also because the degree of bias it has been found to have is slight.

In the random effects model it is assumed that the true (population) correlation between IT and IQ is constant. Each individual study is seen as a sample from a universe of possible values with a sampling distribution characterized by its mean and variance. The best estimate of *rho* is the weighted average of the observed studies' correlations:

$$\bar{r}_{xy} = \frac{\sum (N_i r_i)}{\sum N_i} \tag{1}$$

where r_i is the correlation in study i and N_i is the number of subjects in study i. Random effects models use an estimate of the parameter variance component to quantify the "effect magnitude parameters." The between-study variance is determined by calculated the frequency-weighted average squared error:

$$s_r^2 = \frac{\sum N_i \, [(r_i - r_{xy})^2]}{N_i} \tag{2}$$

These methods of estimating the population values are more appropriate than other methods in that greater weight is given to large studies than to small ones.

The observed between-study variance is, however, confounded by variation in the sampling distribution of the true correlation and by variation in the sample correlations produced by the three sources of error mentioned above. Therefore, corrections for the artifacts of sampling error, attenuation, and range variation are conducted on the observed mean r and the observed between-study variance to obtain an estimate of the true mean and variance. Hunter et al. recommend a two-step procedure to correct for these effects. The first step consists of using the following formula to correct for the effect of sampling error:

$$\text{est } \sigma_p^2 = s_r^2 - \frac{(1 - \bar{r}_{xy})^2 K}{N} \tag{3}$$

where s_r is the estimate of the variance, K is the number of studies, and $N = \Sigma N_i$. The second step involves the use of a product equation to correct the observed mean r and between-study variance for the effect of measurement error in the independent (r_{xx}) and dependent (r_{yy}) variables and for the effect of restriction of range:

$$\bar{\rho}_{TU} = \frac{r_{xy}}{abc} \tag{4}$$

$$= \frac{\text{est } \sigma_p^2 - \rho_{TU}^2(b^2c^2\sigma_a^2 + a^2c^2\sigma_b^2 + a^2b^2\sigma_c^2)}{a^2b^2c^2} \tag{5}$$

where

$$a = \sqrt{r_{xx}} \tag{6}$$

$$b = \sqrt{r_{yy}} \tag{7}$$

$$c = \frac{u}{\sqrt{(u^2 - 1)\rho_i^2 + 1}} \tag{8}$$

where

$$u = \frac{\text{variance in the study population}}{\text{variance in the reference population}} \tag{9}$$

$$\rho_i^2 = r_{xx} r_{yy} \bar{\rho}_{TU} \tag{10}$$

Missing data for any of the artifacts are estimated through the use of artifact distributions (Hunter et al., 1982). These artifact distributions are based on the available data and are compiled just as information is compiled about the population correlation. Each artifact across studies is seen as a sample from a universe of possible values with a sampling distribution characterized by its mean and variance. Hunter et al. (1982) state that "if the artifacts are independently distributed, these distributional facts can be used to estimate the distribution of the corrected population correlations that is desired" (p. 74).

When conducting a meta-analysis, the typical procedure is to analyze the total sample and then correct the results for the effects of the three artifacts. If large amounts of variance remain after these corrections are made, then the corrected distribution is examined for evidence of "moderator variables." If moderator variables are identified, they are used to group the observed correlations into subsets and the entire process is repeated. Even if the variables are grouped according to moderator variables, it is important to note that it is impossible to correct for the effects of all artifacts. Unsystematic artifacts such as reporting errors, computer program errors, transcriptional errors, and so forth, are beyond the control of meta-analysis. Hence, the corrected mean r and the corrected variance of results may still contain some error.

Another possible source of error over which meta-analysis can have no control is the so-called "file-drawer" effect, that is, supposed studies with nonsignificant results that ended up in researchers' file-drawers and were never reported. But then no conclusion is insured against the possibility of contradictory evidence that remains concealed or unknown. Experimental outcomes and observed correlations gain credence only through the preponderance of evidence from reported data. Skeptics have no legitimate resource but to repeat a published study whose results they doubt, and report their own data.

Criticism of the Random Effects Model

The random effects model of meta-analysis, as exemplified by the approach of Hunter et al. (1982), has recently been critiqued by Hedges (1988), Hedges and Olkin (1986), and James, Demaree, & Mulaik (1988). Their criticisms range from theoretical underpinnings and technical inaccuracies to the interpretation of significant or important results.

A strong assumption of the random effects models with missing data is independence of the correction factors and the population values. Hedges (1988) states that this assumption is "probably" incorrect, partly because the range artifact is functionally related to the population correlation, but also because the correction factors and the population value are computed from the same sample. Nevertheless, Hunter et al. state that simulation studies, such as that conducted by Callender and Osburn (1980), have found the error in making this assumption to be minimal. In order to minimize the impact of this potential violation of the assumption of independence in this meta-analysis, a formula was used for calculating the range correction factor that takes this into account (Callender and Osburn, 1980):

$$c_i = u^2 + (1 - u^2)r_{xy}$$

In addition, the fact that the missing data are treated as a random sample of the artifact distributions is problematic. Researchers finding nonsignificant *r*s may be more inclined to investigate and report artifactual information than those with significant *r*s. If so, the distributions to artifacts used to estimate the values of the missing data are likely to be biased.

In spite of these and other criticisms, the amount of bias inherent in this model appears to be slight. In addition, by tailoring the meta-analysis to address specific substantive questions and by using confidence intervals stringently, several of these criticisms, namely, rigidity and the interpretation of the nonartifactual variance, may be minimized.

META-ANALYSIS PROCEDURE

The meta-analysis procedure used here differs from the approach recommended by Hunter et al. (1982). The observed *r*s were initially grouped according to the type of mental ability test administered in order to facilitate comparison with other reviews (viz., Lubin & Fernandez, 1986; Nettelbeck, 1987). Thus, meta-analyses were conducted separately for the results of studies using mental tests classed as "general ability," "performance," and "verbal," hence the exclusion of the study by Cooper et al. (1986). For each class of tests, a meta-analysis was initially conducted on the uncorrected values. The resultant values were then corrected for the effects of the artifacts. Following this, separate meta-analyses were conducted within each class of IQ tests for studies based on samples of *adults, children* (subjects less than or equal to 13 years), and the *mentally retarded.* Finally, meta-analyses were conducted for each type of subject sample within each of the mental ability test categories, but this time excluding those studies Nettelbeck (1987) considered methodologically deficient. Thus, the first set of meta-analyses was conducted with all of the reported data. The second set of meta-analyses was conducted to permit direct comparison of the results with previous reviews.

RESULTS

The method of summarizing results was patterned after Lubin and Fernandez (1986) and Nettelbeck (1987), but extended their research reviews to include studies not then available. Tables A-1, A-2, and A-3 in the Appendix display the summary of results for the measures of general IQ, performance IQ, and verbal IQ, respectively. In these tables, in order to preclude the confounding of *r*s and samples for studies reporting more than one *r* per sample, the weighted average of the results is reported. In like manner, the frequency-weighted average squared error is reported for the observed *SD*s.

Table 1 presents the results of the meta-analyses prior to and following correction for the effects of the artifacts, as well as the total sample size (*N*) and number of studies (*K*) used in the meta-analysis. For the uncorrected *r*s, all of the *r*s

TABLE 1
Meta-analysis Results Before and After Correction for Artifact Effects

Mental Test Sample	*N*	*K*	Uncorrected Mean	Uncorrected Var.	Corrected Mean	Corrected Var.
General IQ						
Total	1120	31	−.29	.0317	−.49	.0236
Adults	698	20	−.30	.0315	−.54	.0259
Children	422	11	−.28	.0319	−.47	.0263
Performance IQ						
Total	446	17	−.30	.0460	−.44	.0283
Adults	104	5	−.45	.0551	−.69	.0574
Children	288	8	−.23	.0534	−.32[a]	.0560
Retarded	54	4	−.34	.0288	−.68	.0000
Verbal IQ						
Total	684	19	−.22	.0499	−.32	.0508
Adults	234	8	−.18	.0583	−.27	.0611
Children	450	11	−.22	.0475	−.30	.0459

Note. [a]No range correction.

across mental test categories are in the expected (negative) direction. Moreover, the magnitude of these *r*s is not significantly related to *K* ($r = .17$, $t < 1.00$). Although there is a negative relationship between IT and IQ, the 95% confidence interval (CI) for each of these uncorrected *r*s in Table 4 contains zero. For example, the 95% CIs for general IQ are: Total = −.65 to .07; Adults = −.66 to .05; and Children = −.64 to .08.

Table A-4 in the Appendix displays the means and variances for the artifact effects of attenuation (for both IT and IQ) and restriction of range. Note that for the Children in the performance IQ category, there were not enough available data to compute the correction for the restriction of range. The statistics for the reliability of IT (r_{xx}) were derived from the studies summarized in Table A-5. In this table, the same procedure as that used above was followed to preclude the confounding of *r*s and samples for studies reporting more than one (r_{xx}) per sample. In addition, when two different types of reliabilities were reported in the same study (such as test-retest and split-half measures) the lower of the two was used. Thus, these are conservative estimates of the true IT (r_{xx}). The obtained ITs (r_{xx}) are: Total = .67, Adults = .73, Children = .57, and Retarded = .59. These values are lower than those previously reported (Brand, 1984; Brand & Deary, 1982; Nettelbeck, 1982, 1985, 1987). It is also important to note that this will result in a *higher* corrected *r*. The statistics for the IQ measures were derived from reliability data reported in the respective administration manuals for each population and each test used (e.g., Wechsler, 1974).

Table 1 shows the results of correcting the *r*s for the effects of sampling error, attenuation, and range restriction. As can be seen in this table, all of the mean *r*s

TABLE 2
Meta-analysis Results Before and After Correction for Artifact Effects: Excluding Criticized Studies

Mental Test Sample	*N*	*K*	Uncorrected		Corrected	
			Mean	Var.	Mean	Var.
General IQ						
Adults	633	17	−.31	.0360	−.56	.0451
Children	242	8	−.37	.0307	−.59	.0148
Performance IQ						
Adults	88	4	−.49	.0633	−.74	.0839
Children	230	7	−.32	.0110	−.47[a]	.0000
Verbal IQ						
Adults	218	7	−.26	.0528	−.38	.0526
Children	248	8	−.29	.0258	−.41	.0000

Note. [a]No range correction.

increased substantially after correction. It is important to note that the only corrected *r* for the measures of general IQ and performance IQ that contains zero in the 95% CI is for the Children with performance IQ measures. However, this was the sole case in which there were not enough data to compute the correction for the restriction of range. It should also be noted that for the studies using retarded subjects, the correction for the effect of sampling error accounts for all of the variance between studies. Finally, in contrast to these results, for the measures of verbal IQ, even after correction for the effects of the artifacts, all of the 95% CIs for the *r*s contain zero.

Results of the meta-analyses following the exclusion of those studies that Nettelbeck (1987) considered to have serious methodological deficiencies (viz., Irwin, 1984; Mackenzie & Bingham, 1985; Mackenzie & Cumming, 1986; Sen & Goswami, 1983; Smith & Stanley, 1983) are displayed in Table 2. In Table A-6 of the Appendix the means and variances of the artifact effects of attenuation (for both IT and IQ) and restriction of range are presented. Note that for the Children for performance IQ and verbal IQ, there were not enough *SD*s reported to compute the correction for the restriction of range. In Table 2 it can be seen that, following exclusion of these studies, the *r*s are larger than before exclusion of the studies in every case. The 95% CIs for the *r*s for the Children in both the general IQ and performance IQ measures do not contain zero. However, for the Adults across all of the classes of IQ measures and for Children with the verbal IQ measures this is not the case. Again, these *r*s are not related to *K* ($r = .43$, $t < 1.00$).

Table 2 also shows the results after correction of the *r*s for the artifact effects. Again, all of the mean *r*s increase substantially. Note that for the performance IQ measures no correction for the range restriction artifact was possible. Lastly, for the verbal IQ, in spite of the fact that the *r*s also increased markedly following correction for the artifacts, the 95% CI for the r of the Adults contains zero. The 95% CI for the Children, however, does not contain zero, even though no range restriction correction was possible.

DISCUSSION

The results of this study show a nonzero relationship between IT and IQ. The findings for general IQ and performance IQ clearly support this conclusion. This is not true, however, for the verbal IQ measures. Even after the exclusion of several deficient studies for adults, the relationship between IT and *verbal* measures of IQ is surprisingly low (about −.40), considering that verbal IQ tests are generally quite highly loaded on g. Yet, the best estimate of the relationship between IT and IQ, at least for adults with measures of general IQ, is −.54—only slightly higher than Nettelbeck's (1987) estimate of −.50.

Furthermore, it is interesting to note that the results for both children and adults across IQ measures appear to follow the same pattern. For both groups, the relationship between IT and IQ seems to be strongest for the measures of performance IQ and weakest for the measures of verbal IQ, with the measures of general IQ in between. This finding is less clear for children, because the data are insufficient to allow correction for sampling error in the performance IQ measures. The discrepancy between the IT rs for verbal and performance IQs suggests that factors other than g play a role in the degree of association between IT and IQ, assuming that verbal and performance IQs are about equally g-loaded. It could be argued that the relative speededness of the performance IQ measures used accounts for this stronger relationship, but this seems unlikely in view of studies of the correlation between IQ and mental speed which found that choice reaction time is unrelated to whether IQ tests are timed or untimed (Vernon & Kantor, 1986; Vernon, Nador, & Kantor, 1985). A more likely possibility may be that, in addition to g, both IT and performance IQ measures tap abilities related to "perceptual organization."

Another interesting finding of this study is the comparable magnitude of the results between adults and children, both before and after correction for the effects of the artifacts. This does not support Brand's (1981, 1984) theory that IT is ontogenetically related to the development of intelligence. While this meta-analysis did not address the question of the increase in the speed of IT with chronological age, the results of this analysis clearly indicate that the degree of relationship between IT and IQ is not related to growth in mental age. This is also true for the results of the mentally retarded adults. In fact, the results of this meta-analysis are often in the opposite direction that Brand would predict. Thus, the IT–IQ relationship does not appear to increase with development or to be associated more with lower IQ in adult samples.

In sum, the results of this meta-analysis indicate that IT is related (negatively) to IQ, especially with measures of general IQ and performance IQ. For adults with general measures of IQ, this relationship is best represented by a correlation of −.54. IT, however, also appears to tap more than g, possibly perceptual organization, which is reflected in the higher relationship of IT to performance IQ than to verbal IQ. Finally, the theory that IT is ontogenetically related to IQ is not supported. Rather, results of this study suggest that the degree of the IT–IQ relationship is relatively constant, at least throughout the range of mental and chronological ages reported in the literature.

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Note: Appendix Tables on pp. 341–347 contain citations to sources also in references listed above.

APPENDIX

TABLE A-1
Summary of Results for General IQ Measures

Author		*N*	Ages (years)	IT Task	Test	IQ[a] Mean,(*SD*)	Corr. IT–IQ
Nettelbeck (1973)[b]		40	17–28	Visual	ACER-AL/AQ[c]	125,(−)	−.13
Grieve (1979)		10	16–28	Visual	Cattell Culture Fair	103,(7)	−.61
Hosie (1979)		12	4	Visual	Colored Progressive Matrices	110,(9)	−.78
Jensen (1982)		25	c.20	Visual	Advanced Progressive Matrices	>115,(−)	−.31
Nettelbeck (1982)		46	19–48	Visual	Advanced Progressive Matrices	127,(−)	−.20
Hulme & Turnbull (1983)		65	6–7	Visual	WISC-R FSIQ	117,(17)	−.20
Nettelbeck & Kirby (1983)	1.	59	24,(7)	Visual/Tactile	Advanced Progressive Matrices	124,(7)	−.19
	2.	82	18,(2)	Visual/Tactile	Standard Progressive Matrices	109,(10)	−.22
Raz et al. (1983)		20	19,(−)	Auditory	Cattell Culture Fair	——,(−)	−.45
Smith & Stanley (1983)		107	12–13	Visual	Cattell Culture Fair	101,(11)	−.12

(*continued*)

TABLE A-1 (*Continued*)

Author		N	Ages (years)	IT Task	Test	IQ[a] Mean,(SD)	Corr. IT–IQ
Vernon (1983)		50	18–34	Visual	WAIS FSIQ	121,(9)	+.10
Brand (1984)		20	—	Visual	AFQT	90–115	−.48
Edwards (1984)		30	20–40	Visual/ Auditory	Advanced Progressive Matrices	121,(8)	−.36
Irwin (1984, #1)		48	11–13	Visual	Standard Progressive Matrices	100,(14)	−.27
Irwin (1984, #2)		25	11–13	Visual	Standard Progressive Matrices	97,(8)	−.06
Irwin (1984, #3)		27	17–52	Visual	Advanced Progressive Matrices	120,(8)	−.17
Sharp (1984)		24	14–16	Visual	Standard Progressive Matrices	103,(12)	−.54
Cooper et al. (1985)[d]		45	15–16	Visual	Cattell Culture Fair	——,(−)	−.44
Mackenzie &	1.	16[e]	18–48	Visual	WAIS FSIQ	118,(9)	−.08
Bingham (1985)	2.	13			WAIS FSIQ	115,(8)	−.52
Anderson (1986)	1.	17	6	Visual	WISC-R	111,(14)	−.32
	2.	12	8	Visual	WISC-R	108,(18)	−.21
	3.	13	10	Visual	WISC-R	104,(10)	−.76
Longstreth et al. (1986)		81	—	Visual	Cattell Culture Fair	113,(13)	−.44
Mackenzie & Cumming (1986)	1.	22[c]	16–27	Visual	Advanced Progressive Matrices	——,(−)	−.19
	2.	15		Visual	Advanced Progressive Matrices	——,(−)	−.66
Nettelbeck et al. (1986, #1)		30	20–40	Visual/ Auditory	Advanced Progressive Matrices	121,(8)	−.40
Nettelbeck et al. (1986, #2)		43	17–40	Visual	WAIS-R FSIQ	117,(14)	−.43
Ridgers (1986)[d]	1.	38	12	Visual	WISC-R	——,(−)	−.42
	2.	38	8	Visual	WISC-R	——,(−)	−.28
Nettelbeck & Young (in press)		47	6–7	Visual	WISC-R	113,(10)	−.50

Note. [a]Wechsler Intelligence Scale equivalents (Mean = 100, *SD* = 15).
[b]Reported in Nettelbeck (1982).
[c]Australian Council for Educational Research—Verbal & Number reasoning tests.
[d]Reported in Nettelbeck (1987).
[e]1. Strategy users 2. Strategy nonusers.

TABLE A-2
Summary of Results for Performance IQ Measures

Author		N	Ages (years)	IT Task	Test	IQ[a] M,(SD)	Corr. IT–IQ
Lally & Nettelbeck (1977)	1.	16	17–24	Visual	WAIS PIQ	120,(6)	−.17
	2.	16	17–22			106,(6)	−.54
Nettelbeck et al. (1979)		14[b]	18–30	Visual	WAIS PIQ	75,(10)	−.24
Lally & Nettelbeck (1980)		20[b]	17–25	Visual	WAIS PIQ	69,(8)	−.46
Hulme & Turnbull (1983)	1.	65	6–7	Visual	WISC-R PIQ[c]	114,(18)	−.29
	2.	8[b]	22–44		WAIS PIQ[c]	64,(13)	−.71
Smith & Stanley (1983)		58	12	Visual	WISC-R PIQ[c]	——,(−)	+.12
Mackenzie & Bingham (1985)	1.	16[d]	18–48	Visual	WAIS PIQ	114,(9)	−.20
	2.	13				114,(10)	−.72
Anderson (1986)	1.	17	6	Visual	WISC-R PIQ	——,(−)	−.20
	2.	12	8	Visual	WISC-R PIQ	——,(−)	−.15
	3.	13	10	Visual	WISC-R PIQ	——,(−)	−.58
Kirby & McConaghy (1986)		12[b]	18	Visual	WAIS PIQ	78,(−)	−.39
Nettelbeck et al. (1986, #2)		43	17–40	Visual	WAIS-R PIQ	114,(15)	−.52
Ridgers (1986)[e]	1.	38	8	Visual	WISC-R PIQ	——,(−)	−.46
	2.	38	12	Visual	WISC-R PIQ	——,(−)	−.25
Nettelbeck & Young (in press)		47	6–7	Visual	WISC-R PIQ	——,(−)	−.31

Note. [a]Wechsler Intelligence Scales equivalents.
[b]Retarded adults.
[c]Short-form of the WISC-R.
[d]1. Strategy users 2. Strategy nonusers.
[e]Reported in Nettelbeck and Young (in press).

TABLE A-3
Summary of Results for Verbal IQ Measures

Author		*N*	Ages (years)	IT Task	Test	IQ[a] Mean,(*SD*)	Corr. IT–IQ
Hartnoll (1978)[b]		18	11–12	Visual	Verbal Score[c]	——,(−)	−.17
Grieve (1979)		10	16–28	Visual	Mill Hill Vocabulary	101,(15)	−.88
Nettelbeck (1982)		45	19–48	Visual	ACER-AL	127,(−)	−.34
Sharp (1982)		12	15–36	Visual	AH4 Vocabulary	——,(−)	−.69
Hulme & Turnbull (1983)		65	6–7	Visual	WISC-R VIQ[d]	116,(18)	−.08
Sen & Goswami (1983)[b]		48	6–11	Visual	PPVT	——,(−)	−.52
Smith & Stanley (1983)		107	12–13	Visual	Verbal Score	——,(−)	+.08
Vernon (1983)		50	18–34	Visual	WAIS VIQ	122,(9)	+.02
Irwin (1984)		47	11–13	Visual/ Auditory	Mill Hill Vocabulary	99,(11)	−.21
Cooper et al. (1986)[b]		45	15–16	Visual	Vocabulary	——,(−)	−.17
Mackenzie & Bingham (1985)	1.	16	18–48	Visual	WAIS VIQ	118,(9)	+.06
	2.	13	18–48	Visual	WAIS VIQ	117,(9)	−.18
Ridgers (1986)	1.	38	8	Visual	WISC-R VIQ	——,(−)	−.26
	2.	38	12	Visual	WISC-R VIQ	——,(−)	−.32
Nettlebeck et al. (1986, #2)		43	17–40	Visual	WAIS-R VIQ	117,(14)	−.36
Anderson (1986)	1.	17	6	Visual	WISC-R VIQ	——,(—)	−.37
	2.	12	8	Visual	WISC-R VIQ	——,(—)	−.25
	3.	13	10	Visual	WISC-R VIQ	——,(—)	−.54
Nettelbeck & Young (in press)		47	6–7	Visual	WISC-R VIQ	——,(—)	−.51

Note. [a]Wechsler Intelligence Scales equivalents.
[b]Reported in Nettelbeck (1987).
[c]Includes vocabulary, verbal reasoning, and verbal fluency.
[d]Short-form of the WISC-R.
[e]1. Strategy users 2. Strategy nonusers.

TABLE A-4
Artifact Distribution Within Type of IQ Measure

Mental Test Sample	*M* a	Var. a	*M* b	Var. b	*M* c	Var. c
General IQ						
Total	.8181	.0102	.9476	.0331	.7642	.0297
Adults	.8530	.0066	.9422	.0308	.6955	.0169
Children	.7512	.0101	.9455	.0458	.8466	.0324
Performance IQ						
Total	.8181	.0102	.9557	.0049	.8705	.1025
Adults	.8181	.0066	.9600	.0000	.7915	.0340
Children	.7512	.0101	.9500	.0000	—	—
Retarded	.7615	.0145	.9600	.0000	.6881	.0088
Verbal IQ						
Total	.8181	.0102	.9700	.0100	.8755	.0465
Adults	.8530	.0066	.9740	.0120	.7894	.0269
Children	.7512	.0101	.9671	.0070	1.0220	.0468

Note. a is r_{XX} of the inspection time apparatus.
b is r_{YY} of the IQ measures.
c is range correction.

TABLE A-5
Summary of Inspection Time Reliability Estimates

Author	N	IT Task	r_{XX}	Subjects\Comment
Vickers et al. (1972)	10	Visual	.80	University students\Test-retest.
Nettelbeck (1973)	24	Visual	.78	University students\Test-retest.
Nettelbeck (1980)[a]	56	Visual	.62	University students\Different target level accuracies.
Lally & Nettelbeck (1980, #1)	20	Visual	.64	Retarded adults
	8		.80	University students\1-2 hand comparison.
Nettelbeck et al. (1982)	10	Visual	.84	Retarded adults
	10	Visual	.41	University students\Test-retest.
Raz et al. (1983)	17	Auditory	.91	University students\Test-retest.
Sen & Goswami (1983)	48	Visual	.57	Children 6–11 years\Two conditions involving change to orientation lines.
Vernon (1983)	50	Visual	.80	University students\Test-retest.
Irwin (1984, #2)	25	Visual	.78	Children 11–12 years\Test-retest.
Irwin (1984, #3)	27	Visual	.87	University students\Split-half.
Nettelbeck et al. (1984, #1)	6	Visual	.88	University students
	6		.21	Retarded adults\Dichoptic/Binocular comparison.
Nettelbeck et al. (1984, #2)	8	Visual	.60	University students
	8		.47	Retarded adults\Four ISI conditions.
Nettelbeck & McLean (1984, #1)	16	Visual	.59	University students
	16		.59	Retarded adults\Mean of six successive measures.
Mackenzie & Bingham (1985)	29	Visual	.66	University students\Test-retest.
Nettelbeck & Wilson (1985, #1)	10	Visual	.67	Children 7–8 years
	10		.62	Children 11–12 years
	10		.80	University students\Mean of six Dichoptic\Binocular comparisons.
Nettelbeck & Wilson (1985, #3)	10	Visual	.87	Children 7–8 years
	10		.87	Children 11–12 years
	10		.87	University students\Test-retest.

TABLE A-5 (*Continued*)

Author	*N*	IT Task	r_{XX}	Subjects\Comment
Anderson (1986)	40	Visual	.43	Children 6–10 years\Test-retest. Mean of two psychophysical procedures.
Kirby & McConaghy (1986)	12 12	Visual	.61 .67	University students Retarded & nonretarded adults\Test-retest.
Longstreth et al. (1986)	81	Visual	.75	University students\Test-retest.
Mackenzie & Cumming (1986)	38	Visual	.87	University students & nonretarded adults\ Split-half.
Nettelbeck et al. (1986, #1)	30	Visual/ Auditory	.39	University students & nonretarded adults\ Visual-Auditory comparison.
Nettelbeck et al. (1986, #2)	40	Visual	.80	University students & nonretarded adults\ Different psychophysical procedures.
Nettelbeck & Young (in press)	42	Visual	.42	Children 6–7 years\Split-half.

Note. [a]Reported in Nettelbeck (1982).
[b]Reported in Nettelbeck (1985).

TABLE A-6
Artifact Distributions Within Type of IQ Measure: Excluding Criticized Studies

Mental Test Sample	*M* a	Var. a	*M* b	Var. b	*M* c	Var. c
General IQ						
Adults	.8400	.0063	.9387	.0320	.7044	.0167
Children	.7226	.0117	.9688	.0298	.8933	.0255
Performance IQ						
Adults	.8400	.0063	.9600	.0000	.8200	.0337
Children	.7226	.0117	.9500	.0000	———	———
Verbal IQ						
Adults	.8400	.0063	.9725	.0130	.8408	.0269
Children	.7226	.0117	.9700	.0000	———	———

Note. a is r_{XX} of the inspection time apparatus.
b is r_{YY} of the IQ measures.
c is range correction.