quite likely that they will achieve similar results.

An important but neglected study of twins by Claridge *et al.*[2] seems to have avoided at least some of the methodological difficulties which faced the National Children's Bureau study. Claridge's study compared 44 MZ and 51 DZ twin pairs, aged 16–55, resident in Glasgow. Zygosity was established through comparative blood grouping. Among the battery of tests completed by the subjects were the Progressive Matrices and the Mill Hill vocabulary test, well-established and validated measures of mental ability, individually administered.

The intraclass correlations for MZ pairs on the Progessive Matrices was 0.68, and for the DZ pairs it was 0.46. On the Mill Hill vocabulary test, the intraclass correlation in MZ pairs was 0.85, compared with 0.68 in the DZ pairs. For both tests, the intraclass correlation was significantly higher in MZ pairs. Although the authors do not discuss the implications which these results have for models of the inheritance of 'intelligence', it is clear that these results imply that at least some of the variance in mental abilities in this adult Scottish sample is due to inheritance.

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1 Adams, B., Ghodsian, M. & Richardson, K. *Nature* 263, 314–316 (1976).
2 Claridge, G., Canter, S. & Hume, W. *Personality Differences and Biological Variations: A Study of Twins* (Pergamon, Oxford, 1973).

THE report by Adams *et al.*[1] of correlations between mental test scores of MZ and DZ twins raises questions about the variance of obtained correlations in twin studies which were not discussed by the authors. Instead, they used their data to suggest the dismissal of previous estimates of heritability; but if the figures are considered in relation to other findings more complex issues emerge. These are the questions of how the various samplings stand as bases for estimating the same population parameter, and of what other features of the testing and sampling (apart from the well known difficulties of mental testing and the identification of twin types) may contribute to the variance of sample correlations.

The picture of twin study findings is represented in Table 1, where Adams' figures are compared with corresponding results from an earlier well-founded report[2], and with others from the review by Erlenmeyer-Kimling and Jarvik[3] which gave figures from 34 studies concerned with twins. The Adams figure for MZ twins lies at the lower limit of previous studies, while the figure for DZ twins lies in the upper part of the range. Thus that particular sampling must yield one of the smallest, if not the smallest, difference between such correlations in the whole series of studies. Table 2 shows the statistical significance of the differences. While the Newman figures are not exceptional in this respect, the Adams figures clearly are.

Table 1 Correlation coefficients in the mental testing of twins

Source	MZ		DZ Same sex		DZ Opp. sex		All	
	r	N	r	N	r	N	r	N
Adams *et al.* (non-verbal group test, 1969)	0.762	41	0.604	55	0.487	40	0.594	95
Newman *et al.* (group test, 1937)	0.992	50	—	—		—	0.621	51
Erlenmeyer-Kimling *et al.* (median values of 34 studies, 1963)	0.87	1082 (in 14 studies)	0.53	11 studies	0.53	9 studies	0.53	2052 (in 20 studies)
Erlenmeyer-Kimling *et al.* (1963) upper limit	0.92		0.87		0.63		0.87	
Erlenmeyer-Kimling *et al.* (1963) low limit	0.76		0.45		0.37		0.37	

Twin type (all reared together)

Table 2 Differences between correlations for MZ and DZ twins

Statistic	Adams MZ	Adams DZ	Newman MZ	Newman DZ	Erlenmeyer-Kimling MZ	Erlenmeyer-Kimling DZ
r	0.762	0.594	0.922	0.621	0.87	0.53
Fisher z difference	1.000–0.683		1.605–0.727		1.333–0.590	
$\sigma_z$difference	0.193		0.205		0.037	
Ratio	1.642		4.283		20.081	
Significance level	Not sig.		0.01		0.01	

In Table 3, figures are compared across the studies for both kinds of twins. For DZ twins none of the differences are statistically significant, even at the 0.05 level, and the samples could be treated as coming from the same population of such twins; but for the MZs the pattern is such that, whereas the Newman and Erlenmeyer-Kimling samples could be treated as bases for the estimation of the same population correlation, it is doubtful whether the Adams sample can be so regarded.

Table 3 Differences between corresponding correlations in different studies

Statistic	Newman–Adams MZ	Newman–Adams DZ	Newman–Erlenmeyer-Kimling MZ	Newman–Erlenmeyer-Kimling DZ	Erlenmeyer-Kimling–Adams MZ	Erlenmeyer-Kimling–Adams DZ
Fisher z difference	0.605	0.044	0.272	0.137	0.333	0.093
σ_z difference	0.218	0.178	0.149	0.146	0.165	0.107
Ratio	2.775	0.247	1.825	0.938	2.018	0.869
Significance level	0.01	Not sig.	Not sig.	Not sig.	0.05	Not sig.

This being so, it seems that Adams and his colleagues may have been hasty in offering their findings simply as evidence for a low heritability estimate, for their study is likely to be either a rather extreme sampling or evidence of a change in a population characteristic. Rather than discussing the implications for estimates of heritability it is important therefore to consider the possibility of change in the population correlation figure for MZ twins. Since available twin studies span a considerable time, during which advice has been given to parents to treat identical twins as individual persons, this may have had the effect of increasing the within-pair variance. More sampling is necessary to test the present position further, as is a thorough analysis of data to test the hypothesis of a trend over time.

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1 Adams, B., Ghodsian, M. & Richardson, K. *Nature* 263, 314–316 (1976).
2 Newman, H. H. *et al. Twins: A Study of Heredity and Environment* (University of Chicago, 1937).
3 Erlenmeyer-Kimling, L. & Jarvik, L. F. *Science* 142, 1477–1478 (1963).