

Preface

Dr. Garfinkle has compared the concordances of 137 MZ and 72 same-sexed DZ twins on the Piagetian Mathematical Concepts Battery (PMCB), which was constructed by her to assess conservation of number, seriation, and classification. Acquisition of these concepts forms the necessary foundation of mathematical skills. The twins were 4 to 8 years old and of white middle-class origin.

The degree of genetic determination ("broad heritability") was estimated by Falconer's (1960) formula: $h^2 = 2(t_{MZ} - t_{DZ})$, where t is the intraclass correlation. The estimated heritability for the PMCB was 0.34 ± 0.18 .

The Peabody Picture Vocabulary Test (PPVT) and the Raven Coloured Progressive Matrices (PM) were also administered. Heritabilities for these tests were 0.34 ± 0.19 for the PPVT and 0.16 ± 0.24 for the PM (the reliability of this test is low). Performances on these two tests correlated 0.36 and 0.41 with the PMCB, demonstrating considerable independence of the Piagetian tasks from conventional psychometric intelligence measures.

No sex differences were found, but correlations of test performance with age were substantial. For that reason the effect of age was removed in all analyses. For this sample, there was no significant effect of age on the relative magnitude of the MZ and DZ correlations.

Environmental influences were assessed independently by the Moos [63] Family Environment Scale (FES); the Attitudes Toward Education (ATE) questionnaire, which was constructed for this study; and parental education and occupation. These variables were found to explain a small but statistically significant amount of variance in PMCB, PPVT, and PM performance.

Genetic and environmental influences, as determined by the methods described above, accounted for about half of the variance on the PMCB after correction for age differences. In comparison, genetic and environmental influences explained 60% of the variance in age-corrected performance on the PPVT and 29% of the variance in age-corrected PM performance. It remains for future research to discover the source(s) of the remaining variance. The comparison of MZ and DZ twins reared together does not permit examination of such possibilities as genotype-environment interaction and correlation.

Some general conclusions can be drawn:

1. The degree of genetic determination for acquisition of Piagetian concepts in this study was of the same order of magnitude as for two psychometric measures of intelligence.
2. Independent measures of environmental influences accounted for considerably less variance, leaving nearly half of the variance in the cognitive measures unexplained.
3. Genotype-environment interaction and/or correlation may account for the remaining variance, but this twin study design did not permit analyses of these possibilities.
4. Better measures of environmental influences must be developed if environmental variables that affect cognitive measures are to be identified.

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