

## INTELLIGENCE AND ACHIEVEMENT IN A DISADVANTAGED POPULATION. A CROSS-LAGGED PANEL ANALYSIS\*

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A test of intelligence (Stanford Binet) and a test of achievement (Preschool Inventory) were administered to children attending a preschool in a disadvantaged area when they were three years old and again when they were five (N 59). Cross-lagged panel correlations between test performances were positive and substantial but did not differ significantly from each other. The findings do not provide evidence of a preponderance in causality one way or the other in the relationship between intelligence and achievement.

The correlation which one normally finds between scores on intelligence tests and scores on achievement tests has led to speculation about the nature of the relationship. Two questions may be asked. Firstly, is one factor the cause of the development of the other and, if so, what is the direction of causation, i.e., does intelligence cause achievement, does achievement cause intelligence or does the causal sequence operate in both directions? In answer to the first question, we may say that there is a wide acceptance of the belief in some sort of causal connection, perhaps because of the almost invariant finding that intelligence and achievement test scores show a close relationship. The answer to the second may be inferred from the character of much of the research on the relationship between the two variables, in such research, intelligence is usually the predictor and attainment the predicted (11). Teachers too would probably tend to agree with the assumption on which such research is based, i.e., that intelligence causes achievement. On the other hand, studies in developmental psychology which indicate that intelligence is based on the acquisition of concrete and specific skills developed through the child's interactions with his environment (1, 8), can be interpreted as indicating that—at some stages in life at any rate—achievement precedes intelligence and so cannot be its effect. In this case, of course, we are using achievement in a broader sense than to mean just the ability to read or write, the term is being

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used to refer to the more concrete and specific skills of behaviour which contrast with the higher-order abstract skills, for which the term intelligence is reserved

Recently, Crano, Kenny and Campbell (4), assuming a causal relationship between intelligence and achievement, have used cross-lagged panel correlations as described by Campbell (3), in an attempt to determine the direction of causation. The approach involves the use of correlational data on measures of intelligence and achievement, both obtained at two points in time. An unlagged synchronous correlation (i.e., the correlation between an intelligence measure and an achievement measure, both taken at the same time) may be regarded as an index of concurrent validity, a lagged auto-correlation (i.e., the correlation between an intelligence measure or an achievement measure taken at two points in time) may be regarded as a reliability measure. However, correlations crossed and lagged (i.e., intelligence at point 1 with achievement at point 2 or achievement at point 1 with intelligence at point 2) may provide information regarding the direction of causation. If change in a variable is consistently followed by change in another variable, then the time-precedence notion of causality is satisfied. Thus if high intelligence test scores at point 1 are consistently followed by high achievement test scores at point 2, but the converse is not true then it can be inferred that the direction of causality is that of intelligence causing achievement. Similarly, if high achievement test scores at point 1 are consistently followed by high intelligence test scores at point 2, but the converse is not true then the direction of causality is that of achievement causing intelligence. This interpretation does not rule out the possibility that causal relations are operating in both directions but if there is a significant difference in the magnitude of the cross-lagged correlations, an index of relative preponderance is obtained.

In the study by Crano *et al* (4), intelligence and achievement test scores were obtained for pupils in grade 4 and again in grade 6. Analysis of the data revealed a significant difference between the cross-lagged correlations obtained which supported the notion of a preponderant causal sequence in the direction of intelligence causing achievement. Since the same causal sequence may not operate in all groups, a separate analysis for disadvantaged children was carried out and this revealed no significant difference between the cross-lagged correlations. However, the relative magnitude of the correlations was

the inverse of those found for the total group, leading the authors to suggest that in the case of disadvantaged children, achievement may be more likely to cause intelligence than intelligence to cause achievement

The present study used data derived from a sample of children in a disadvantaged area to test Crano *et al's* (4) suggestion that a concrete-to-abstract causal sequence predominates for such children. The study differs in a number of ways from that of Crano *et al*: the subjects were younger, the measures of intelligence and achievement were different and the number of cases was very much smaller (59 as against 5,495)

#### METHOD

The Stanford Binet Intelligence Scale and the Preschool Inventory were administered to all children entering a preschool in an inner-city area. The preschool operated a cognitively oriented programme which was designed to prepare children for formal schooling (6). After the children had completed two years in the preschool, all remaining were again tested with the same tests. Ninety-three children took the tests on the first occasion, due to losses from the school, only fifty-nine took the tests on the second occasion. The mean age of the children on the first testing was 44.3 months (SD 3.7), at the second testing the mean age was 67.5 months (SD 4.2).

The Stanford Binet Intelligence Scale, Form L-M (10) is a test designed to measure general intelligence and has been frequently used with disadvantaged children. In the present study, internal consistency coefficients for the test, based on coefficient  $\alpha$ , which is appropriate for tests made up of items stratified on the basis of difficulty (9), were .91 on the first administration and .85 on the second administration.

The Preschool Inventory (2) was designed as a measure of achievement in areas regarded as necessary for success in school (knowledge of the child's own personal world, knowledge of vocabulary, knowledge of concepts relating to numerical relations and knowledge of the sensory attributes of objects). Like the Stanford-Binet test, it also has been used in many studies of disadvantaged children. In the present study, internal consistency coefficients (Kuder-Richardson) for the test were .86 at the first administration and .90 on the second administration.

#### RESULTS

Mean scores and standard deviations obtained for the intelligence

and achievement tests for the two occasions on which they were administered are presented in Table 1. The intelligence test scores are mental ages, the achievement test scores are raw scores.

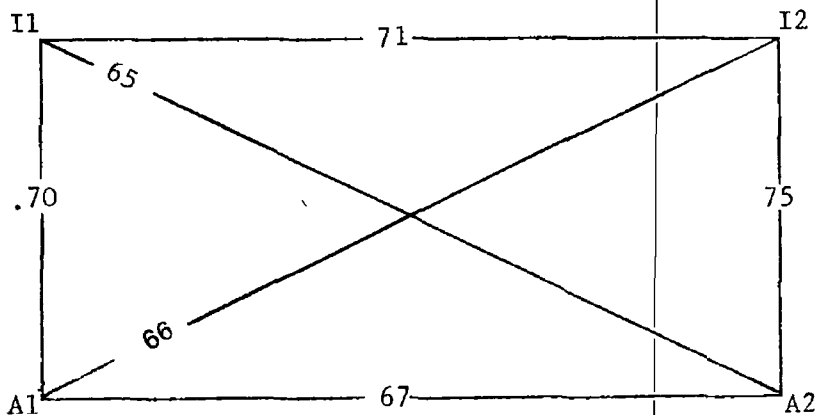
TABLE 1  
INTELLIGENCE AND ACHIEVEMENT TESTS MEANS AND SDs

	Stanford-Binet MA		Preschool Inventory	
	M	SD	M	SD
1st testing	41.87	6.46	23.48	8.66
2nd testing	67.04	8.45	60.95	10.56

Inter-correlations between tests are presented in Figure 1. For a sample of 59, all correlations greater than .34 are significant at the .01 level. It will be noted that all correlations in the figure are significant at this level. The significance of differences between correlations was tested using the *t*-test corrected to take into account the indirect correlation between the arrays under comparison which are modified by the four other relevant values (7, p. 185).

An assumption of the cross-lagged panel technique is that of stationarity, i.e., that the common factor structure of the tests employed at both points in time remains constant. A consequence of this assumption is that the synchronous correlations should be equal at both points in time. In Figure 1, the relevant correlations are .70 and .75 which do not differ significantly from each other. It will be noted that reliability

FIGURE 1  
INTERCORRELATIONS BETWEEN INTELLIGENCE AND ACHIEVEMENT MEASURES  
ON FIRST AND SECOND TESTINGS



measures both in terms of internal consistency and re-test were satisfactory

The cross lagged correlations (.65 and .66) are the most crucial to the present study. The difference between these two correlations is not statistically significant.

#### DISCUSSION

Our findings support those of Crano *et al* (4) in that for disadvantaged children we found no evidence of a preponderance in causality one way or the other in the relationship between intelligence and achievement. However, as we saw, Crano *et al*, while finding no significant causal relations in their disadvantaged group, did find that the direction of causality, as inferred from the magnitude of correlation coefficients, differed for normal and disadvantaged subjects. This led them to suggest that while intelligence tends to cause achievement in non-disadvantaged groups, the opposite may be the case for disadvantaged children. Our findings, while not statistically significant, point in the same direction, since the correlation  $r_{A1I2}$  was found to be greater than  $r_{I1A2}$ . However, the size of the difference between the two correlations does not permit any confidence in the view that the predominant causal sequence for disadvantaged children is one in which achievement causes later intelligence.

Our findings however (using different measures of intelligence and attainment and younger subjects) do provide support for the view expressed by Crano *et al* (4) that the relationship between intelligence and achievement is not the same for disadvantaged children as it is for non-disadvantaged children. The positive and substantial nature of the cross-lagged correlations reported suggests a feed-back system in which both intelligence and achievement affect one another to a considerable extent. This is so in the case of both advantaged and disadvantaged children. However, in the case of the former, intelligence seems to play a more important role than in the case of the latter in future attainments. In other words, the ability measured by intelligence (to employ abstractions, complex rules and schemata) is more likely to result in the learning of more concrete information and skills in the case of advantaged than in the case of disadvantaged children.

Since the data on which our conclusions are based differ from those of Crano *et al*, our findings cannot unequivocally be accepted as confirming theirs. True, in both studies, the absence of a predominant

causal relationship between intelligence and attainment was observed in the case of disadvantaged children. However, our subjects were younger than those of Crano *et al* and we have no comparative data for advantaged children of the same age as our sample. It may be that the direction of causal relationship is not the same for preschool as for school-aged children. Further study with samples of preschool children from differing backgrounds is required to throw light on this relationship.

If it is found that disadvantaged preschool children do indeed differ from advantaged ones in their ability to apply their intelligence in the areas normally subsumed under the heading achievement, then it would seem that other factors are intervening to produce a pattern of cognitive development which differs from that of advantaged children and, as is known all too well from other sources (eg, 5), results in poor school achievement. Greater understanding of the relationship between intelligence and achievement in both advantaged and disadvantaged children should provide a sounder basis than is available at present for the design of intervention procedures which will be effective in fostering the development of disadvantaged children.

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