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The purpose of the study was twofold: first, to determine the reliability of a paired-associate (PA) task when used as a test of learning proficiency; and second, to assess the relationship between performance on the PA task and on IQ tests as a function of grade level (kindergarten, first, third) and socioeconomic status (high, low). The reliability of the PA task was acceptably high and the magnitude of the relationship between learning proficiency and intelligence varied with social class membership. Differences related to social class were also detected in rates of development of the two kinds of abilities assessed. (Author)

Socioeconomic Status, Intelligence and Learning Proficiency in Children[1,2,3]

William D. Rohwer, Jr.

Abstract

The purpose of the study was twofold: first, to determine the reliability of a paired-associate (PA) task when used as a test of learning proficiency; and second, to assess the relationship between performance on the PA task and on IQ tests as a function of grade level (Kindergarten, First, Third) and socioeconomic status (High, Low). The reliability of the PA task was acceptably high and the magnitude of the relationship between learning proficiency and intelligence varied with social-class membership. Differences related to social-class were also detected in rates of development of the two kinds of abilities assessed.

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[2] This work was supported, in part, by a contract with the U. S. Office of Economic Opportunity (OEO 2404). The report was prepared at the Institute of Human Learning, which is supported by grants from the National Science Foundation and the National Institutes of Health.

[3] Personnell and students of the Pere's Elementary School, Richmond, California, and of the Sleepy Hollow and Orinda Elementary Schools, Orinda, California, have my deep appreciation for the extraordinary cooperation they extended in bringing this study to completion.

Socioeconomic Status, Intelligence and Learning Proficiency in Children

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Too often, instruction fails to produce learning. But so long as such failure can be blamed on a child's ability or his disposition, it can be treated as a necessary nuisance; it does not demand radical change in the organization of instruction. So long as such failure occurs quietly, in a small proportion of children in any given classroom, just as it does in most middle-class schools, it can be ignored in relative comfort. The children themselves, the ones who fail, may feel enduring pain, as may some of their parents; psychologists, schoolmen, and especially the public and its leaders, however, rarely suffer even so much as a mild unpleasantness. The protective power of the belief in the child's essential responsibility for the success of his own education is remarkably durable. The organization of instruction has changed very little, even though learning failure no longer occurs quietly, except in middle-class schools. There has been little change even though for some groups in our society the average child, not just the rare child, the average child, fails to learn in school.

Why do we continue to nourish systems of instruction that fail to produce learning in a visible number of our children? There are many reasons. Here are three of them. First, a substantial number of children continue to learn in the schools as they are now. Second, such children score higher on intelligence tests than children who fail to learn. This neutral fact allows the conclusion that children who gain no benefit from instruction fail to do so because of a deep-seated, virtually irremediable intellectual deficiency.

Third, we have precious little hard evidence that any appreciable number of the children who fail to learn in school can succeed in learning regardless of the instructional conditions.

Among our aims in conducting the present study was that of producing empirical evidence relevant to these issues. To start, we selected two extreme school populations from which to draw the samples of experimental subjects: on the one hand, a school district serving an upper strata, white, residential area; on the other hand, that portion of a district serving a lower strata, Negro, residential area. At the outset it was clear that the students in these two populations fare very differently in school as judged by any commonly accepted criterion of school success. On standardized achievement tests, for example, children from the upper-white schools, on the average, score well above grade level whereas, children of comparable ages from the lower-Negro school score well below grade level.

Since discrepancies in the degree of academic success between these two kinds of populations seem to emerge very early in the course of schooling, our attention was focussed on young children. But since there is also reason to suspect that the magnitude of the discrepancies changes with grade level, three different ones were sampled: kindergarten (K), first (1) and third (3). A total of 288 children were chosen, 48 from each of the six populations mentioned.

The study was designed to assess the children's comparative performance on three kinds of tests. Each one requires the child to engage in a different kind of activity and each one has been shown previously to relate to success in the learning of school subjects. But no one of these tests measures directly what is taught in particular elementary subject matter courses. The first, the Peabody Picture Vocabulary Test (PPVT), measures a child's

recognition vocabulary using pictorial materials and yields two scores designated as mental age (MA) and IQ. The second kind of test, the children's form of the Raven Progressive Matrices, also was designed to yield a measure of intelligence. The test items require the child to solve problems presented in figural form, each succeeding problem being more difficult than its predecessor. Both the PPVT and the Raven, are, of course, published test instruments that have been used in numerous previous studies. They may both be construed as attempts to measure intellectual ability in a relatively culture fair manner. Ostensibly, however, they each measure quite different properties of the child. The PPVT asks the child to demonstrate his knowledge of the referents of selected words, that is, to give evidence of what he has learned and retained up to the time the test is administered. In contrast, the Raven requires the child to solve problems in the testing session itself, using to be sure whatever knowledge he has acquired that is relevant to the task.

Neither of these tests demands that the child explicitly engage in learning and, accordingly, neither test directly measures learning proficiency. To fill this gap, we developed a test of paired associate (PA) learning proficiency for use in the study. In the PA test, the child's task is to associate pairs of items together in such a way that when he is later presented with one of the two items from each pair, he can remember the identity of the other one. Furthermore, he must engage in this learning activity during the testing session itself since items are paired intentionally so as to avoid previously learned associations.

Of all the kinds of learning tasks that might have been chosen to assess learning proficiency the PA variety was selected because it has properties that are unusually appropriate for our interests. On its face, a PA task appears to

involve simple rote learning processes. Similarly, most of the learning tasks required of children in the primary school years appear, at least to the child, to involve rote learning. But, it has been demonstrated that efficient performance on PA tasks requires the learner to engage in mental activities that are decidedly not rote in nature. If the learner generates images that link the two items in each pair, or if he constructs sentences that relate the items to one another, his performance improves markedly (Martin, Cox & Boersma, 1965; Reese, 1965; Rohwer, Lynch, Levin & Suzuki, 1967, 1968; Rohwer, Lynch, Suzuki & Levin, 1967). Our assumption is that the use of such mental activities in connection with the learning of school subject matter has similar results, namely, the improvement of learning proficiency. It has also been found that performance on PA tasks correlates substantially with long-term school learning as measured by grades or by scores on achievement tests (Stevenson et al, in press; Otto, Koenke & Cooper, 1968). Finally, in our own previous work, examinations of performance on PA tasks as a function of school strata and age have yielded interesting results. For example, lower-strata Negro children of first-grade or older ages whose school performance is considerably below grade level, demonstrate notable degrees of learning proficiency on individually administered PA tasks. One of the remaining questions is: Under what conditions does this effect hold and under what conditions does it not? Accordingly, one of the purposes of the present study was to isolate some of the answers to this question. In addition, the aim was to determine the test characteristics of the PA task, thereby providing a basis for judging its potential as an assessment instrument.

In fact, each child was administered four, 25-item PA lists. It was planned that total performance on two of these lists would constitute a test score, so that the four lists can be construed as two alternate forms of the PA test.

The two forms were administered during separate testing sessions two days apart. Within each list, five different kinds of PA items were used such that there were five items of each kind per list or ten per test. Time does not permit a full discussion of the reasons for the selection of these particular types of items; a brief description of them will have to suffice. All the materials were recorded on videotape and played through a TV monitor. The basic type of item, Named-Still (NS) consisted of presenting visually a still picture of the two items in a pair along with the aural presentation of the names of the items (e.g., TENT-FLOWER). Of the four remaining conditions, two were designed to retard performance through impoverishing the stimulus support provided in NS while the other two were designed to improve performance through elaborating the stimulus support provided in NS. Among the first two Item Types, one, Named (N) simply involved the aural presentation of the names of the two items in each pair without accompanying pictures of the objects named. The other Item Type, Still (S) consisted of pairs depicted pictorially with no presentation of their names. One of the two elaborated Item Types, Sentence-Still (SS), refers to pairs in which still pictures were accompanied by sentences containing the names of the pair members (e.g., The TENT fell on the FLOWER). Finally, Named-Action (NA) items consisted of the aural presentation of the names of the paired objects concurrently with a pictorial sequence depicting a simple episode involving the two objects (e.g., a moving picture of a TENT falling on a FLOWER).

Within each of the PA lists the order of presentation of the Item Types was random with the restriction that all five Types were presented once before any was repeated. A pairing-test method was used and each list was presented for a total of two complete trials.

All tasks were individually administered during three separate testing sessions: first, Raven; second, PPVT and two PA lists; third, the remaining two PA lists. The tasks were given by two female experimenters, one white and the other Oriental.

Results and Discussion

Group Comparisons

For the purpose of making comparisons among the various groups defined by the factors of Strata and Grade Level, analyses of variance were performed on each of the dependent measures resulting from the three principal tasks. The results in terms of PPVT MA, PPVT IQ, Raven raw score, and PA mean number correct per list are displayed graphically in Figure 1. The results of the statistical analyses are consistent with those suggested by the figure.

PPVT MA. The main effects of Strata ($F = 308.76$, $df = 1/144$, $p < .01$) and of Grades ($F = 155.14$, $df = 2/144$, $p < .01$) were significant such that the mean upper-strata MA was greater than that of lower-strata Ss and the MA of third-grade Ss was greater than that of first-grade Ss which, in turn, was greater than that of kindergarten Ss. The interaction of Strata and Grades was also significant ($F = 15.70$, $df = 2/144$, $p < .01$); the Strata difference was significantly greater in the third-grade than in the first-grade and kindergarten samples.

PPVT IQ. The main effect of Strata was again significant ($F = 301.69$, $df = 1/144$, $p < .01$) and, of course, that of Grades was not ($F = 1.12$, $df = 2/144$, $p > .05$). Even though the interaction of Strata and Grades was not significant ($F = 2.53$, $df = 2/144$, $.10 > p > .05$) an application of the Scheffé method revealed that the Strata difference between third-grade samples was larger than that between the kindergarten and first grade samples combined.

Raven Raw Score. Once again, Strata (F = 142.52, df = 1/144, $p < .01$) and Grades (F = 104.77, df = 2/144, $p < .01$) were significant sources of variance. Upper-strata children scored higher than lower-strata children; third-grade performance was better than first-grade performance which, in turn, was better than kindergarten performance. The interaction of Strata with Grades was also significant (F = 21.33, df = 2/144, $p < .01$). Within the interaction, an application of the Scheffé method revealed that the difference between strata was progressively larger, the higher the grade level of the Ss.

In summary, it is imposingly clear that the intellectual development of upper-strata white children, as measured by the PPVT and the Raven, is pronouncedly more rapid than that of lower-strata Negro children. Whatever the interpretation of this fact, it is clearly discouraging for the hope that successful academic learning can be promoted in lower-strata Negro children drawn from populations like the one sampled in the present study.

These results are discouraging but they do not necessarily imply that the hope is futile. The PPVT and the Raven measure what children have learned and what they have learned to do, respectively. They may also measure what a child is capable of learning; but, then again, they may not. It is often said that we cannot discount the possibility of achieving successful school learning in lower-strata Negro children until we have committed our best resources to the production of an equal, or an optimal educational system. There are two major problems with this assertion, even though it is true in an important sense. The first is that we simply do not know what the components of such an instructional system are. There are numerous guesses abroad in the land but knowledge, that is, assertions having evidential support, is extremely rare. Second, in the absence of such knowledge, making a total commitment of resources in an effort

to answer the question, to provide the evidence, is fraught with risk. The probability of failure is high and if it is failure that ensues, it may be construed to mean that the hope is wrong.

The alternative is to demonstrate the viability of the hope on a smaller scale. This strategy is being followed. Instances are easy to come by in the large number of "experimental" programs now operating in the schools. The intent of the present research was to assess the justification for hopefulness on a still smaller scale, namely, in terms of performance on the traditional laboratory task of PA learning.

The overall results are depicted in Figure 1. The main effects of Strata ($\underline{F}$ = 19.71, $\underline{df}$ = 1/282, $\underline{p} < .01$) and Grades ($\underline{F}$ = 64.09, $\underline{df}$ = 2/282, $\underline{p} < .01$) were again significant but the interaction was not ($\underline{F}$ = 1.44, $\underline{df}$ = 2/282, $\underline{p} > .05$). Indeed, pairwise comparisons of the two strata within each grade confirm what an inspection of Figure 1 suggests: the Strata difference was only significant in the Kindergarten samples. That is to say, these results suggest that in the development of the kind of learning ability assessed by the PA test, the discrepancy between upper-strata white children and lower-strata Negro children progressively narrows with succeeding grade levels. This is in marked contrast with the results obtained with the PPVT and the Raven.

Additional evidence relevant to the issue of lower-strata Negro learning proficiency is shown in Figure 2. Performance on the PA test varies markedly across the five different Item Types. First, note that the main effect for Item Types is substantial ($\underline{F}$ = 1781.08, $\underline{df}$ = 4/1128, $\underline{p} < .01$). These specific variations in the manner that materials are presented for learning make for substantial differences in how much is learned. Secondly, note that the performance of the upper-strata white children is superior to that of the

lower-strata Negro children for Item Types N, S, SS, and NA but not for NC. Statistically, the interaction of Strata and Conditions is significant ($F = 8.82$, $df = 4/1128$, $p < .01$). Clearly, there are conditions under which lower-strata Negro children can learn quite efficiently, some in which they learn as efficiently as upper-strata white children. The implication is that such conditions, if consistently implemented, could produce successful learning in children from a population in which present instructional conditions are associated, on the average, with a relative failure of learning. In thinking about this implication, consider the fact that in the present analysis, the factor of Item Types, that is, the conditions of learning, accounted for 40% of the total variation observed while the Strata Factor accounted for less than 1% (0.7%).

Correlational Results

The initial matter of concern is to appraise the utility of the PA test. We have already seen that it reveals the importance for children of the specific character of the conditions under which materials are presented for learning. But what of the reliability of the test and what of its relationship with other measures of intellectual ability?

It is possible to calculate the reliability of the PA test in a variety of ways given the kinds of data yielded by the present study. One of the most useful of these possible methods of estimating reliability is given by the correlation between alternate forms of the test. You will recall that each form is defined as a combination of two of the PA lists presented. Table 1 displays the reliability estimates obtained. Although these estimates are not quite high enough to justify the use of the test in its present form for the purpose of individual assessment, they are high enough to suggest that further refinement will produce a test that is appropriate for such use.

Finally, consider the correlations between PA performance, PPVT MA, PPVT IQ, and Raven raw scores. These statistics are presented in Table 2. Two properties of the results of the correlational analysis seem clear. First, in the samples tested, the three kinds of tests are indexing more than a single ability. Second, and most significant, the PA test bears some considerable relation to the kinds of abilities indexed by the PPVT and the Raven, in both strata, even though mean performance differences between strata are quite small for the PA test and quite large for the PPVT and the Raven. Although the correlational results deserve more detailed discussion, time will not allow it here.

In conclusion, permit me a selected interpretation and extrapolation of the results I have reviewed. Upper-strata white and lower-strata Negro differences in intelligence test performance are large and, for educational goals, they are profoundly worrisome. But, the immediate objectives of school instruction are <u>not</u> to erase individual or group differences in intelligence or even in intelligence test performance. Rather, the objective of schooling is to promote the maximum amount of learning in children regardless of group membership, through the arrangement of appropriate instructional conditions. The results obtained with the PA test indicate that lower-strata Negro children are perfectly capable of proficient learning under the proper conditions, despite the deficits in their performance on intelligence tests. If these results hold for the learning of school subjects as well, and the indications are that in many cases they will, the conclusion is inescapable: there are many good reasons for the pervasive failure of large numbers of children to learn in school, but there is no justification for allowing such massive failure to continue.

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Table 1

Equivalent Forms Reliability Estimates for the PA Test as a Function of Strata and Item Types

	Item Types					
Strata	N	S	NS	SS	NA	Total
Lower	.54	.68	.60	.72	.75	.85
Upper	.53	.63	.51	.65	.65	.85

Table 2

Intercorrelations among CA, PPVT, Raven and

PA-Test Scores as a Function of Strata

Strata	Score	CA	PPVT MA	PPVT IQ	Raven Raw Score	N	S	NS	SS	NA	PA Total
	CA	---	.59	-.21	.47	.30	.42	.40	.46	.47	.52
	MA	.59	---	.63	.56	.38	.47	.48	.56	.62	.64
	IQ	-.21	.63	---	.20	.16	.16	.20	.23	.31	.27
	R	.47	.56	.20	---	.25	.35	.32	.40	.42	.44
Lower	N	.30	.38	.16	.25	---	.30	.45	.40	.45	.55
	S	.42	.47	.16	.35	.30	---	.54	.55	.56	.70
	NS	.40	.48	.20	.32	.45	.54	---	.63	.65	.77
	SS	.46	.56	.23	.40	.40	.55	.63	---	.75	.82
	NA	.47	.62	.31	.42	.45	.56	.65	.75	---	.84
PA Total		.52	.64	.27	.44	.55	.70	.77	.82	.84	---

	Score	C	MA	IQ	R	N	S	NS	SS	NA	PA Total
	CA	---	.72	-.02	.74	.28	.46	.28	.49	.46	.52
	MA	.72	---	.65	.71	.30	.44	.27	.54	.44	.52
	IQ	-.02	.65	---	.24	.11	.17	.08	.29	.16	.22
	R	.74	.71	.24	---	.20	.40	.14	.43	.38	.41
Upper	N	.28	.30	.11	.20	---	.37	.40	.34	.32	.57
	S	.46	.44	.17	.40	.37	---	.50	.52	.53	.72
	NS	.28	.27	.08	.14	.40	.50	---	.46	.50	.70
	SS	.49	.54	.29	.43	.34	.52	.46	---	.62	.74
	NA	.46	.44	.16	.38	.32	.53	.50	.62	---	.74
PA Total		.52	.52	.22	.41	.57	.72	.70	.74	.74	---

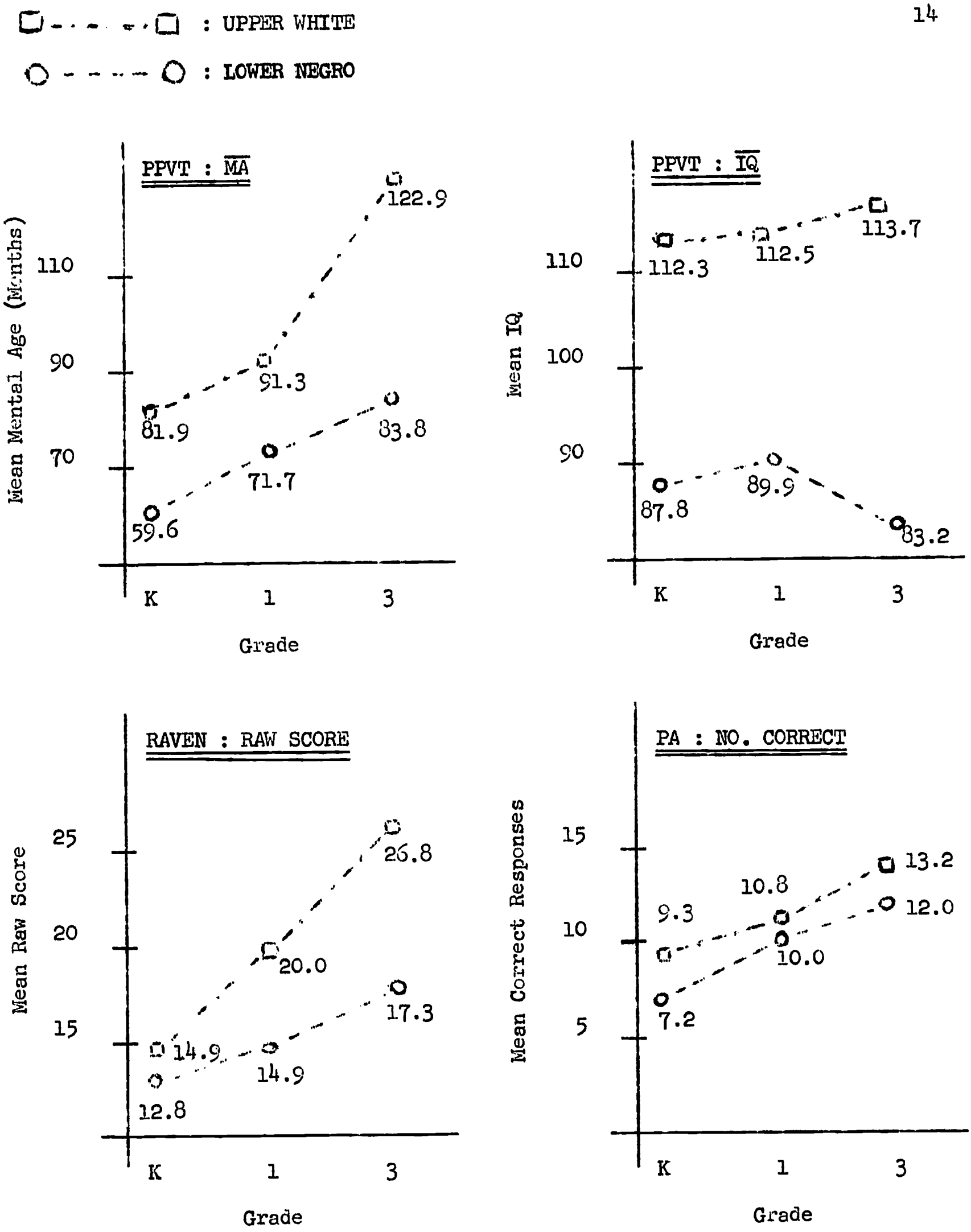

Figure 1

Performance as a Function of Strata, Grades and Task

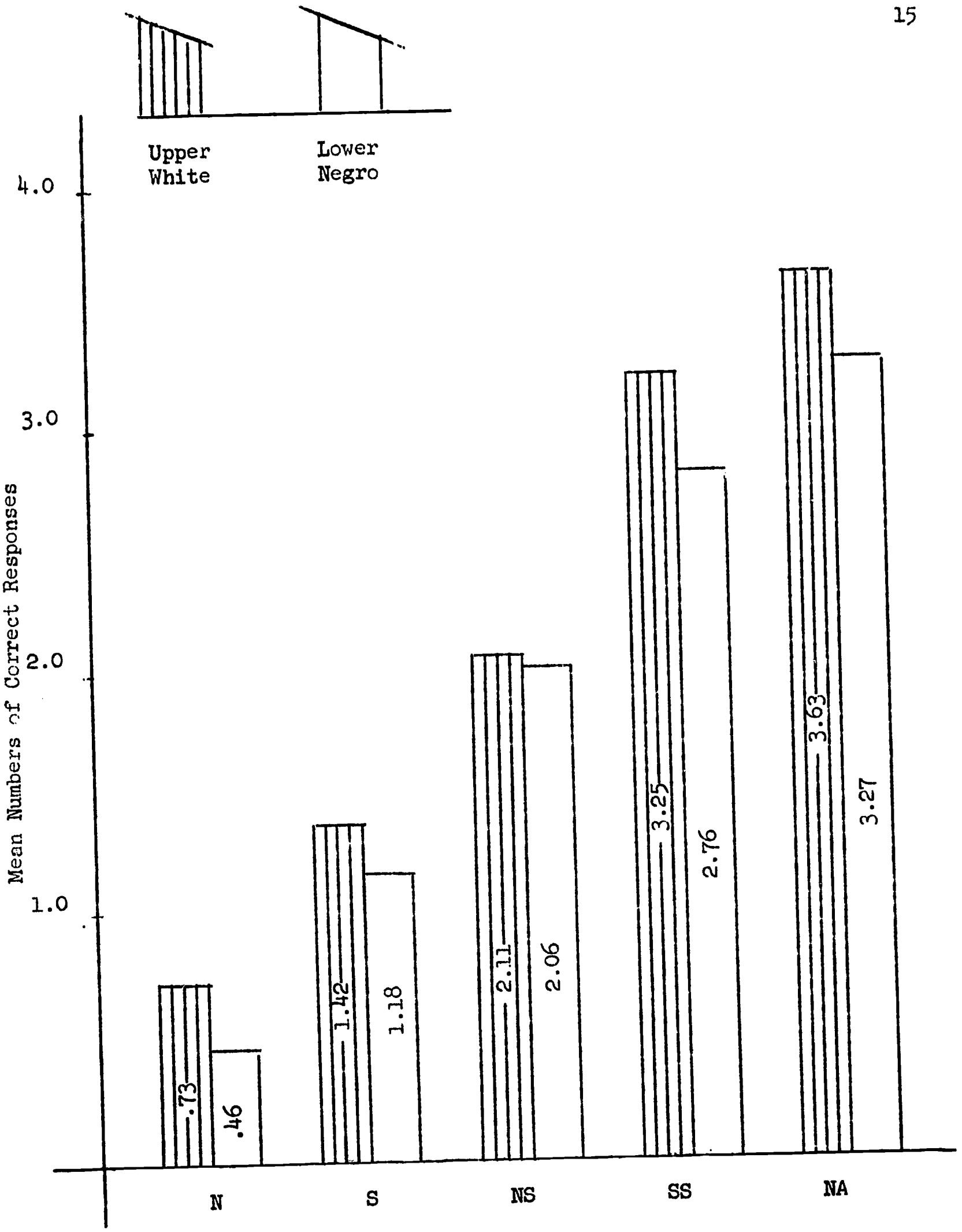

Figure 2

PA Performance as a Function of Conditions and Strata