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**SELECTION**  
**for**  
**SECONDARY EDUCATION**  
**in**  
**SOUTHERN RHODESIA**

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UNIVERSITY COLLEGE OF  
RHODESIA AND NYASALAND

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## FOREWORD

The Faculty of Education of the University College of Rhodesia and Nyasaland has a responsibility to foster research on the educational needs and tasks of Central Africa; this responsibility is accepted. The three Departments of the Faculty encompass individuals of diverse disciplinary backgrounds, whose thinking and enquiries are enriched by contact and consultation with members of other Faculties of the College; such enrichments are demonstrated in Dr. Irvine's penetrating analysis of selection for secondary education in Southern Rhodesia.

To understand the educational system of the present, and to project its development to the future, it has been necessary to appreciate its past. To understand the attitudes of African peoples to education, it has been necessary to know something of African society in its different forms, and how attitudes have been influenced by rapid social and cultural change. Also, to make possible the fuller utilisation of human resources in agriculture, industry, commerce, the civil service, the various professions, and the like, it has been necessary to identify potential high level manpower, the need for which is stressed by the economist. The fact that Dr. Irvine's research does not lose contact with contributions from disciplines other than his own, is a measure of its stature.

The major conclusions that can be adduced from this research are direct. The pool of talent of the major ethnic group in Southern Rhodesia is only partially tapped; to tap talent efficiently, the most efficient methods of selection for secondary education must be employed; to cater for talent, it is imperative that the upper reaches of the secondary school system, in particular, be expanded. Such conclusions, even though they appear self-evident to some, stand more firmly after scientific demonstration.

This report, couched in non-technical language, is of a kind that is frequently termed "action" research; it deals with an urgent educational problem on which the Ministry of Education, and others wished for dispassionate enquiry. But although it deals with

an immediate problem, the research is founded on tested theoretical principles, and uses rigorous methods of statistical analysis. The implementation of the recommendations to the report will be to the good of education in Southern Rhodesia.

Dr. Irvine's report is the fourth in the Faculty of Education series of occasional papers. These papers, along with other researches published elsewhere, illustrate an important function of the Faculty of Education: to pursue independent enquiry, and to furnish findings without which education cannot be stimulated to further growth.

17th September, 1964.

C. A. ROGERS,  
Dean, Faculty of Education.

## INTRODUCTION

This Report is the first of two. It is a non-technical summary of the main research findings for administrators, policy makers and laymen. It makes suggestions and recommendations based on the technical data that will be presented at some future date in the second part, which it is hoped will be of concern to psychologists and educators. It provides the model on which the research was carried out and summarises the results but, because of lack of time omits much detailed discussion that must await another publication.

The aim in this work, throughout, is to provide a practical demonstration of the use of the tools of the psychologist applied to a problem that will face all developing countries on the continent of Africa. There are also some points of theoretical interest that question assumptions of mental measurement hitherto taken for granted. For the future, much remains to be done. I regret leaving Africa at this time but hope that I shall be able to return to see the completion of a series of experiments which my contact with the University College of Rhodesia and Nyasaland has allowed me to carry out freely under its auspices.

This work was made possible by generous grants to the University College from the Anglo American and Rhodesian Selection Trust Groups of copper companies, from the Ministry of Education, Southern Rhodesia, and by grants from the University College's own Research Fund. During the period of research I was indebted to my colleagues in the Faculty of Education for their help in many practical ways, particularly to Professor Cyril A. Rogers for his counsel, leadership and scholarship. In the field, Mr. E. Ratcliffe-Smith, of the Ministry of Education administered tests with me, and Mr. A. M. O'Brien was concerned, as a Research Assistant under the University College Gilchrist Fund, with the collation of results. Also, Mr. W. A. Bowness, Senior Examinations Officer, and members of the Inspectorate, gave help in the construction of tests and the planning of the Standard 6 Survey.

Others from whom advice and counsel were sought and freely given were Professors Alastair Heron, Alan Milton, Clyde Mitchell, all of the University College of Rhodesia and Nyasaland and Professors Alec Rodger and Philip Vernon of the University of London. A great deal too, is owed to the scientific rigour of Mr. A. O. H. Roberts, head of Psychometrics at the S. African National Institute for Personnel Research, to the co-operation of his staff, and the general counsel on computer analysis of Mr. R. S. Hall and Miss Mary Elder of the Mathematics and Statistics Division of that Institute.

Typing was done by Mrs. J. Miller-Cranko, and the Library of the University College provided photographic services. Post-graduate students of 1962 and 1963 gave clerical assistance at convenient times during the Survey.

I thank all the people associated with this work, which I wish to be regarded as a team project that owed its completion, most of all, to the co-operation of the schools and the staffs and pupils in them during the years 1962 to 1963. My greatest debt, for personal reasons, is to my wife, who shared the burden with me.

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# SELECTION FOR SECONDARY EDUCATION

## Non-Technical Summary

1. Background and Aims
2. Procedures
3. Results
4. Recommendations

## 1. BACKGROUND AND AIMS

This research began late in 1961 with discussions between the Institute of Education of the University College of Rhodesia and Nyasaland and officials of the Ministry of African Education. During these discussions, it was considered appropriate to review the use of the Standard 6 (eight years of education) Leaving Certificate Examination as a selection examination for entry to Secondary school. Ministry officials, while affirming that they would have to continue using the examinations when no alternative existed, were convinced that some independent attempt should be made to evaluate the system of selection. Accordingly the Institute of Education undertook to house and support a study of how well the existing selection system succeeded in identifying pupils able to profit from secondary schooling and at the same time to define the extent to which psychological tests and other scientific measures could be used to supplement existing procedures.

The research problem was then defined as follows:

- (a) to examine the structure of the traditional Standard 6 Leaving Certificate examination with special reference to its predictive efficiency;
- (b) to assess the contribution of scientifically constructed tests of academic aptitude to future selection procedures;
- (c) to make recommendations on the best possible combination of examinations, tests and other appropriate measures for the greatest efficiency in selection.

By March, 1962, sufficient planning and discussion had taken place to break down the three main aims of the research. The operational form of the study was then seen to centre around the following specific questions:

1. What parts of the present Standard 6 Examinations are (a) essential, (b) redundant for prediction of Secondary school success?
2. What tests can be used apart from the Standard 6 tests?
3. What special factors influence the ways in which such tests may be used?

4. Are there grounds for including headmasters' and teachers' estimates in the selection procedure?
5. What is the most efficient way to carry out selection, and what machinery, technical and administrative, is necessary to ensure maximum economy?

With these questions to answer, the research was essentially practical and applied, although theoretical contributions to the study of educational psychology were not excluded by the nature of the design, which is now reported.

## 2. PROCEDURES

A design had to be found in order to answer these questions quickly. The period allotted to the research had, therefore, to be as short as possible, but had to include at least one year of follow-up work in the Secondary schools. Follow-up studies alone could provide a true indication of how well tests at Standard 6 level predicted initial Secondary school success. The phases of the research were sketched out as follows:

- Phase 1. A pilot study to investigate the use of psychological tests at Standard 6 level (June-July, 1962).
- Phase 2. A survey of educational abilities at Standard 6 level (September-October, 1962).
- Phase 3. A follow-up study in Form I<sup>1</sup> (September-October, 1963).

Each phase was expected to make a specific contribution to the study, and these planned contributions are outlined below.

*Phase 1—Pilot Study.* This was in the nature of a test-feasibility study. We had to find out if the tests that we considered suitable on the evidence from studies carried out in other African countries were in fact able to be applied to African Standard 6 pupils. There were two main tasks. The first was to devise methods of presenting and administering the tests to the pupils. The second was to find out, when some common method of test administration had been arrived at, if the scores from the tests bore any resemblance to actual school performance. It was possible to relate test scores

1. At the time of going to press, further follow-up studies to Form II level are being completed.

to school marks and teachers' assessments in a preliminary probe into the utility of experimental tests as predictors of current scholastic success.

2.2 *Phase 2—The Mental Abilities Survey 1962.* If certain experimental tests proved feasible, it was then planned to use these tests alongside the Standard 6 Leaving Certificate examination results; to compare side by side both experimental tests and those actually used to decide on Secondary school entry and arrive at some assessment of their relative efficiency.

The Survey had to be carried out during September and October, 1962; and examination of the trends of previous Standard 6 results suggested that Mashonaland was an area that produced Standard 6 results very close to the mean, or average, for the whole country. Mashonaland became the research area, one third of all the schools in the region being tested. The schools were selected at random within the main geographic and administrative regions of Mashonaland province. They corresponded very closely to a representative sample of schools by type and grade, as assessed by school inspectors, and nearly 2,000 pupils were tested. A battery of two tests of general ability (one verbal and one non-verbal), and three tests of English skills (comprehension, vocabulary and spelling) were used after proving them in the Pilot Study. These tests are described in full elsewhere<sup>1</sup> but they are listed here for reference. They are N.I.P.R.<sup>2</sup> *Spiral Nines* (a test of general ability requiring skill in English), *Raven's Progressive Matrices 1938* (a non-verbal estimate of intellectual capacity) and the English Attainment sub-tests of the N.I.P.R. *Normal Battery*.

It will be noticed that the Experimental Tests contained no test of Arithmetic. Such a test was considered unnecessary since the Standard 6 Leaving Certificate already contained three different tests of Arithmetic skills along with two tests of English, and two tests of General Knowledge (History and Current Affairs, Geography and Nature Study).

In addition to the Experimental and Standard 6 Tests, an estimate, provided by the total on a Mock Standard 6 examination, was obtained for each pupil. This estimate was taken as an indication of current educational progress, and it was possible to assess its contribution first as a criterion of Standard 6 success and latterly as a predictor of Form I success.

1. In Appendix A, which contains full descriptions of all tests used at Standard 6 and Form I levels.

2. National Institute for Personnel Research.

The Survey then, was planned to fall into three stages:

- (a) The collection of experimental test results.
- (b) The collation of Standard 6 Test results with those of the experimental tests.
- (c) The evaluation of all results against a concurrent criterion.

2.3 *Phase 3—The Follow-up.* Plans were made to administer, a year after the first tests were given, a further battery of tests. Secondary school headmasters' estimates of potential were also considered essential. The tests had to be confined to subjects that all our follow-up students had in common, since we anticipated that no more than 22 per cent of our Primary school sample would proceed to Form I. Accordingly, tests were constructed, with reference to the syllabus and past examination papers provided by the schools themselves, in English, Arithmetic, Algebra and Geometry. We decided to attempt to predict success not only in total marks for all subjects, but for marks gained in individual subjects. By doing this, the tests given in Standard 6 could show their value at individual school subject predictors, as well as their contribution to assessing the amount of 'general educability' possessed by one person or another.

2.4 *Statistical Procedures.* Every attempt was made in all phases of the research to ensure that the measures used satisfied the requirements for accurate and rapid statistical analysis. Throughout, marking of tests and collation of results were subjected to checks for accuracy. Punched cards were prepared for each pupil and the necessary calculations performed in computers. Briefly, the procedures used were planned to provide (a) indices of the closeness of relationship between sets of scores, estimates of (b) how reliable the various tests were, (c) how well the tests spread out the candidates and (d) how far the tests could be said to measure the sorts of abilities and skills that one normally expects from a formal education.<sup>1</sup>

2.5 *Sample Sizes.* With such a design, 217 pupils were tested in the Pilot Study, this being a one-third random sample of all schoolchildren in Standard 6 in Harare African Township, Salisbury. A further 1,854 were tested in Mashonaland. This sample

1. Appendix B contains the major Standard 6 and the Form I follow-up correlation matrices and two tables summarising the validity, reliability and range of the tests used. The other table gives the norms for the Experimental Tests.

proved representative not only of Mashonaland, but of the whole country in terms of Standard 6 examination passes and the ratio of males and females in the schools. Finally, to ensure stability of examination results, almost every First Form pupil in Mashonaland in 1963 took the follow-up tests, a total of 1,036 pupils being tested, of which, finally, 291 were identified as having completed all tests given in Standard 6 and Form I. Between June, 1962 and October, 1963, a total of 3,107 pupils were tested.

### 3. RESULTS

The results are stated and discussed as answers to the questions raised in section one of this report.

#### *3.1 What parts of the present Standard 6 examinations are (a) essential, (b) redundant for selection purposes?*

At the outset, a distinction should be drawn between what is essential for *selection* as distinct from *educational* purposes. While the Ministry of Education is free to decide what examination is educationally desirable at Standard 6, in order to ensure that the school-leaver has achieved a satisfactory educational level, selection examinations which should be forward-looking, are linked with criteria of success in the Secondary school, and not the Primary school. Hence there is a distinct scientific case for evaluating an examination's selective efficiency, quite apart from its educational worth.

This part of the enquiry began by first of all relating results in the Standard 6 examination to results on an examination that was parallel to it. The Headmasters' assessments, based on a mock Standard 6 examination, were first scaled to minimise gross errors, and then related to the actual examination itself. It was found that if scores on the *Second Standard 6 English Paper* (English 2: Comprehension, Vocabulary, Word Usage), the *Mental Arithmetic Paper*, and one of the two *General Knowledge Papers* (History and Current Affairs) were added to an estimate of the quality of Primary School attended by the pupils, an extremely close relationship between these tests and the Mock Standard 6 Total existed. In fact, one could have reproduced the Mock Standard 6 Total marks with almost complete accuracy knowing the results from these three tests.

It was concluded, therefore, that the present content of the Standard 6 Examination could be reproduced by a smaller number

of objectively scored tests involving, at most, three hours of testing time. This compares with the present nine and a quarter hours testing for the Standard 6 examination. *This part of the study showed us, then, that the areas of ability and attainment covered by the present Standard 6 Examination could be tested by fewer tests.* It did not tell us which tests would predict Secondary school success most efficiently.

When the results of relating Standard 6 Tests to Form I tests were completed, it was discovered that the Standard 6 Leaving Certificate Examination Total gave a fair index of association with Form I results. However, there were once more signs that *English 2, Mental Arithmetic* and *Problem Arithmetic* were the strongest individual predictors, and we were convinced that balance could be maintained by the inclusion of a composite *General Knowledge Paper*.

The results showed, indeed, that skill in the use of English was a major contributor to Secondary school success, that numerical reasoning and attainment were not far behind; and that general knowledge of the world round about, and ability to relate that knowledge to the solution of new problems were also useful contributors. Further, the *Standard 6 Total* might be taken as the best interim measure but only because it is part of an already existing system. It is not a very good predictor, however, and there is no room for complacency when it can be hypothesised that the *Standard 6 Total* might well make mistakes in accepting or rejecting erroneously some 28 per cent of all candidates for admission to Secondary schools.

To sum up, the answer to the first question is that objectively scored tests of *English, Arithmetic* and *General Knowledge* are among the most valuable for selection purposes, while the *Standard 6 Total* is a fair *composite* predictor. If one were to consider what tests were redundant, one might single out, for reasons of administrative convenience and because our evidence showed the paper to have low reliability, the Spelling and Dictation, and, possibly, the Composition elements of *Standard 6 English Paper I*; and the mechanical aspects of *Arithmetic Paper 1*, since they appear to be adequately tested by other tests. The educational significance of these tests, however, cannot be judged, since this is another issue entirely. If they are maintained in future, they may be included for reasons other than their selective efficiency.

*3.1.1 The Standard 6 Total.* Some comments on the use of the Standard 6 Total seem to arise from the investigation of the present selection system. *There is strong evidence to suggest that the present awarding of grades of passes in the Standard 6 examination on the basis of the raw score total is statistically indefensible.* Furthermore, the weighting of the parts of the total is likely to fluctuate from year to year. At the moment it appears likely that Arithmetic is exerting too great an influence in the total, and that English and General Knowledge are not being given enough weight. Finally, no account is taken of unreliability in the Standard 6 Total to assess border-zones for entry to Secondary school.

It is therefore recommended that in future, marks for the three areas of the selection examination, namely, English, Arithmetic and General Knowledge be first converted to scores with the same average and spread of marks (standard scores) and then weighted appropriately. It might, for example, be profitable to give English twice the weight of either Arithmetic or General Knowledge; but this would first have to be demonstrated by experiment.

### *3.2 What tests can be used apart from Standard 6 Tests?*

*The evidence suggests that the addition of tests of general ability, specially designed or adapted for use in Africa, can be added to the Standard 6 Tests at present in operation with a consequent increase in prediction.* The best single predictor of all tests was, in fact, the *N.I.P.R. Spiral Nines* test. Using only this test and an estimate of school quality, it was possible to equal the relationship between Standard 6 Total and the Criterion. Also, because of its usefulness in predicting mathematical success, and because it did add a little to all-over prediction, *Raven's Progressive Matrices* would be a possible auxiliary to the main testing programme. These findings, moreover, were largely replicated in Northern Rhodesia (MacArthur, Irvine and Brimble, 1964).

It is therefore recommended that an immediate attempt be made to construct local tests of the same broad general types as these for inclusion in any new system of selection. The success of Brimble's *Special Paper*<sup>1</sup> in Northern Rhodesia (op.cit., p.7) is taken as further evidence to support this recommendation. In our view such tests should be cheap to produce, disposable, and capable of easy, objective scoring.

1. A composite test of verbal and non-verbal relational thinking.

### 3.3 *What special factors influence the way in which such tests may be used?*

3.3.1 *Testing.* There is a wealth of evidence, here and elsewhere in Africa (Macdonald, 1944-45; Schwarz, 1961; Silvey, 1962, 1963; Irvine, 1962, 1963a, b, 1964) to underline that the introduction of such tests must be supervised by trained psychologists. Briefly, it has been found that tests can be invalidated by the way in which they are presented, by the failure of pupils to understand what is required of them, by items that are too easy, too difficult, too novel or too biased culturally.

3.3.2 *Schools.* The next, and possibly the most significant factor influencing all test results, whether experimental or those actually used, was the school attended by the pupil. It was clear that the type and quality of school attended exerted a great deal of influence on both the attainment, particularly in English, and the approach to tests, of the pupil. It was possible to take a simple three point estimate of schools, depending on whether they were rural boarding, rural day or urban schools and gain a useful relationship with Secondary school success and a fairly close relationship with Standard 6 achievement. If this relationship persists over the years until schools offer equal opportunities to learn well, then it is advisable to seek out tests that are independent of such influences as far as possible, and to use the 'school quality' estimate as a useful supplement to existing tests. In short, there is a large source of variation in marks directly attributable to differences in school quality and this tends to blanket individual achievement since it sets limits to individual potential by the amount of knowledge and the types of skills imparted in the classroom.

This finding, accompanied by the lack of local evidence to support the hypothesis that external factors such as socio-economic status and family size influenced scores might well be taken, educationally, as a spur to the equalisation of educational standards throughout the country. For selection purposes it is more than useful, since it presents a cheap and convenient extra dimension for adding to predictive efficiency. It must be warned, however, that it is a dimension subject to change with the education system itself and will have to be watched carefully.

Other factors found to influence test scores were (a) the sex of the pupil, (b) the age of the pupil and (c) whether the pupil had repeated Standard 6 or not.

3.3.3 *Sex.* In general, boys did better than girls in all tests involving the use of words, while in abstract tests there were no significant differences between the sexes. This finding partially reverses the results of educational studies in Western societies, where at the end of Primary school girls perform better than boys in verbal tests, while in abstract tests boys in general exceed the scores of girls. This factor may be of some educational significance and the Ministry might well have to consider, in view of the shortage of educated girls and women in Africa as a whole, if some special allowances are to be made for girls in open competition. This is a policy decision, naturally. As far as selection is concerned, it is at present possible to predict that boys will gain proportionately more places in Secondary schools than girls.

3.3.3 *Age.* As far as can be ascertained from the evidence provided from official ages recorded in school registers, pupils who are reputed to be older, in general do slightly less well than pupils reputed to be younger, even after the number of years of completed schooling is held constant. This is an important result, since it means that the accepted notions of giving age allowances by standardising tests within age groups would in fact penalise the younger pupils. Hence tests cannot be standardised in this way at present in Southern Rhodesia. It is suggested that tests will have to be standardised by educational grades or standards and allowances given, if necessary, in terms of the number of years of education received. This gives an advantage to the pupil who has accelerated through the standards and penalises the repeater. Moreover, the two items of information required, number of years schooling and educational standard presently achieved, appear much more accurate than ages in countries where births are not all registered. Consequently, the notion of the Intelligence or Achievement Quotient dependent on age allowance, is incorrectly applied in Africa where conditions similar to those found in Southern Rhodesia exist. It is recommended, therefore, that no attempt be made at present to construct and validate tests by age-ranges but that other criteria be found for the standardisation of tests. Finally, the standardisation of scores in terms of ages, or their interpretation in terms of norms based on ages, has no accurate base at present and cannot be recommended.

3.3.5 *Repeaters.* It was found that pupils repeating at Standard 6 level did considerably better than non-repeaters, particularly in Arithmetic, and in general had a ten-point advantage in

the Standard 6 Total. While repetition exists, there is a clear case for (a) discovering what sort of pupil is allowed a second chance, and (b) treating this group separately for selection purposes so as to minimise the possibility that their advantage is a consequence of an extra year's drilling and not a reflection of their ability.

It is understood that the Ministry's policy is to abolish repetition by automatic promotion through the Primary system. It is recommended, in order to reduce the costs of selection, that this policy be implemented immediately. There is further evidence to support this recommendation in the finding that pupils who take longer to reach Standard 6, among non-repeaters in that Standard, do less well than those who proceed normally. In other words, repetition achieves no useful increase in attainment in general up to Standard 6. Repetition at that level, however, present problems for the selection system, probably because the repeaters are a carefully chosen group.

#### *3.4 Are there grounds for including headmasters' and teachers' estimates in the selection system?*

Results indicate that the estimates given by the headmasters of Primary schools, in the form of a Mock Standard 6 Total, predicted Secondary school success in Form I only slightly less well than the Standard 6 Total. In combination with individual tests they were a valuable source of additional information about the pupil's educability at this stage. There are, then, strong statistical grounds for their inclusion in any revised selection system. Undoubtedly, however, in a situation where only between 20 and 25 per cent of pupils can find Secondary schooling of any kind, the pressures on headmasters will tend to become severe. Estimates freely given in an experimental situation may be different in kind from that given in actual selection systems, especially when the majority are to receive no further formal schooling. Hence a great deal of caution would have to be exercised in ensuring that Headmasters gave their assessments willingly and accurately; and the conditions under which they were to be used would have to be a matter for full and frank discussion between the authorities responsible for selection and the Primary school headmasters. It is therefore recommended that headmasters' assessments be initially incorporated into the selection system but be subject to periodic review based on carefully designed follow-up studies.

3.5 *Which is the most efficient way to carry out selection, and what machinery, technical and administrative, is necessary to ensure maximum economy?*

The discussion that follows is qualified by our knowledge that selection systems change as the schools and pupils do. Hence, what may be appropriate for one year may be unsuitable for another if the populations tested and the schools in the system undergo changes that cannot be foreseen. Hence it is re-emphasised that suggestions are being put forward as the results of only one year of following up pupils. Much research has yet to be done to prove the system.

It is, however, considered essential to make the maximum use of all available information about pupils' past records and present achievement in selection for secondary education. Such information should be easy to obtain, cheap to process and lead to the minimum errors possible within the proposed framework.

3.5.1 *Type of Information Necessary.* Of the sorts of information required to enable accurate prediction to be made, the following appear most readily available at low cost.

1. A cumulative record of the pupil's progress through the upper Primary school, giving class positions.
2. A Headmaster's estimate based on a Mock Standard 6 examination.
3. Results on the following types of tests:
  - (a) A test like the present Standard 6 English, but slightly longer.
  - (b) A test like the present Standard 6 Mental Arithmetic but three or four times as long.
  - (c) A General Knowledge test that combines the elements of the present Standard 6 History and Current Affairs and Geography and Nature Study.
  - (d) A scientifically constructed test of general ability through the medium of English.
  - (e) A scientifically constructed test of general ability not dependent on ability in English.
4. Further useful information would include
  - (a) An estimate of the quality of the school attended by the candidate.

- (b) The results of a medical examination or record card indicating the physical fitness of the pupil and stating any ailments such as bilharzia, malaria, defects of eyesight and hearing likely to require remedial treatment.

Such information, in our view, is essential to ensure that every pupil has been given the maximum opportunity to prove his ability to profit from a full Secondary school course. How it might be used is outlined below.

*3.5.2 A Common Entrance Examination.* The present system of collating Standard 6 examination results at the end of the Primary school year and then leaving the pupils to apply to the schools of their choice means that Secondary school headmasters are virtually working a system that is, at best, *laissez-faire*, and at worst, completely unco-ordinated. Very little time is available to fill the available places in the schools, let alone treat the results scientifically. It then appears essential, in view of the results presented so far, to move the selection examination forward in time and to dissociate the present Standard 6 examination from it. In this way the Standard 6 examination can become a regional, rather than a national affair, and can resume its original status as a certificate indicating that the Primary school course has been completed. The actual Common Entrance can be seen as part of a selection system, and not all of it. It should be planned as an examination extending over one day, for reasons of test security and administration. If it consisted of tests such as those already outlined, it should occupy no more than four hours of testing time. The Common Entrance could take its place in a sequential system of selection seen as follows.

*Stage 1.* All cumulative records and Headmasters' estimates submitted by June each year.

*Stage 2.* Common Entrance Examination at the end of June. Results prepared and estimates scaled for submission to area meetings of Secondary school Headmasters held in the vacation between terms 2 and 3. Secondary school headmasters confer and fix the provisional acceptance of the top X per cent of candidates as decided by the examination results of candidates in their regions. When doubt exists, either as a consequence of examination results or estimates as provided by headmasters,

the next Y per cent of places resolved by considering both together.

*Stage 3.* In November-December, the remaining Z per cent of places are filled by considering Standard 6 Results along with all previous information. This, once more, requires a meeting of Secondary headmasters by area.

In our view, only a small percentage of places should be filled by examination, and most of the first stage will be decided by previous record plus examination results. All places, especially the last Z per cent, would be subject to satisfactory performance in the Standard 6 Leaving Certificate examination.

*3.5.3 The Mechanics of the System.* Although the locally constructed psychological tests are not yet available, there seems no reason why this system should not be introduced quickly, making do with such achievement tests as can be constructed at present. Every attempt should be made to fill Secondary school places at first regionally, in order to hasten the time when each region will have parity of educational opportunity and to discourage the practice of applying all over the country for the places available. Such an exercise requires the co-operation of all Voluntary Agency schools so that encouragement be given to the formation of Regional Examination Boards whose main purpose is to ensure that the interests of local communities are served first. This is not to say that denominational considerations are to be disregarded. Only, however, when regions have autonomy in their educational affairs and various agencies come together on crucial issues can there be achieved a feeling of local educational development springing from the requirements of the people in the regions themselves.

Apart from meetings to decide who shall be admitted to Secondary schools, a service to the headmasters is necessary. This service lies in the provision of accurate information about each qualifying candidate based on the accumulation of relevant data. This information must be provided by a specialist service to the schools. Moreover, new tests are urgently needed. It therefore appears necessary to consider setting up in the country a Centre for Educational Measurement. At present, personnel for the Centre cannot be found in Government departments because of the shortage of psychologists in the country. Other factors indeed, among them the feeling by Ministry officials, headmasters and teachers that an independent unit would create confidence in the minds of the

parents and pupils, would reinforce the recommendation that it be independent, but for research purposes should be closely linked with the University College. With this College's growing postgraduate school of studies in Education, it seems likely that suitably-trained personnel could be found to provide technical and research services under direction from senior personnel.

Setting up such a unit requires initial capital and some considerable recurrent expenditure. What is the return likely to be educationally? The results we have show that the errors made in selection could be reduced by different selection procedures by just over 5 per cent at present, if hypothetical success at Junior Certificate is taken as the criterion. In other words, in a possible Junior Certificate population of 4,000, we could predict 200 more passes than actually exist now. At a cost of £100 per year per pupil, this represents the successful, as distinct from unsuccessful expenditure of £20,000 per year. This is a considerable investment also, since the attainment of Junior Certificate is the springboard to first stage business, apprenticeship and teacher training. There can be little doubt that continued validation of the selection system would bring about further improvements. The Centre for Educational Measurement is a logical step, when scientific procedures are contemplated. Moreover, it should eventually give advice on Occupational Selection and Vocational Guidance, once it is established and provision for the appropriate specialist personnel has been made.

To sum up, the answer to the question on efficient and economical prediction is as follows.

1. Relevant information about past record, present performance on tests, school quality and health would doubtless improve the chances of successful prediction.
2. A sequential system of selection involving review of all data in regional meetings by Secondary school headmasters is recommended.
3. In order to devise new tests, continue validation and research, while providing specialist services to the schools, the setting up of a Centre for Educational Measurement is recommended.

#### 4. RECOMMENDATIONS

Recommendations are as follows:

1. The present grade pass system in the Standard 6 examination should be reviewed following attempts to standardise the scores made each year.
2. The weights assigned to various subjects must be decided *after* each has been reduced to the same average and spread of scores.
3. A Common Entrance examination should be held in July of each year and be dissociated from the award of the Standard 6 Certificate. The Certificate, however, should be a requirement for entry to Secondary school.
4. The Common Entrance should be seen as part of a sequential system of selection involving co-operation between all Secondary school headmasters within the various regions of the country.
5. A Centre for Educational Measurement should be set up with the following main functions:
  - (a) Constructing tests and centrally collating all information for Secondary school selection to enable headmasters to make the best use of relevant data.
  - (b) Investigating the use of tests in selection for academic and technical training.
  - (c) Engaging in fundamental and applied research to evaluate constantly the use of such tests.
  - (d) Controlling the disposal and use of psychological tests to ensuring their scientific and ethical use within the country.

## APPENDIX A

### DESCRIPTION OF TESTS AND MEASURES USED

#### *A Note on the use of Psychological Tests*

It must be borne in mind that test suppliers will not give tests to personnel unqualified to use them. Many suppliers insist that a training period be spent with them before allowing the tests to be used. This is necessary to ensure their professional and ethical use and to maintain test security, which is even more essential in Africa than in other countries because of the small number of tests available.

## APPENDIX A

### THE TESTS AND OTHER MEASURES USED

The main task of the investigation was the assessment of tests against agreed criteria. Decisions had to be made about the sorts of tests to test apart from those already in use as instruments of selection. Also, other types of assessment, such as headmasters' assessments had to be formalised and fitted into the experimental design. Finally, the criteria themselves had to be fixed. How and why these various decisions were taken are matters for other parts of the investigation. This section merely sets out to describe the measures and tests used, giving the necessary technical data about them. This will provide a reference section about the tests.

#### SCIENTIFICALLY CONSTRUCTED TESTS

A number of tests, constructed scientifically and having test-construction data available, were used in various parts of the study. They can be categorised as tests of non-verbal general ability, tests of general ability dependent on facility in English, tests of English attainment, and tests of numerical ability.

##### *Tests of Non-Verbal General Ability*

Two such tests were used, *Raven's Progressive Matrices* (1938) and *J. R. Morrisby's Compound Series* (1955). In future these tests will be referred to as *Raven 38* and *Compound Series*.

The *Raven 38* is a 60 item tests described by its author, J. C. Raven (1960) p.l. as "a test of a person's capacity at the time of the test to apprehend meaningless figures presented for his observation, conceive the nature of the figure completing each system of relations, and by so doing, develop a systematic method of reasoning." Raven also reports (ibid., p.2) re-test reliabilities varying from .83 to .93, a 'g' loading of .82 and a correlation of .86 with the Terman-Merrill scale. The same source gives a full bibliography of the test's use.

In general this test can be said to be one of the most flexible of non-verbal tests, to have had considerable cross-cultural use, to have a high general ability content as measured by western standards and to lend itself to ease of administration.

*Compound Series*. This paper and pencil group or individual test is described by its author, Morrisby (1955 b, p.1.) as providing "a

measure of pure intelligence . . . The term 'pure' in this context is taken to mean that the test avoids the use of material or processes which are largely dependent on acquired knowledge or skill." The test consists of adding two to a series of beads, printed in colour, the beads varying in shape, size, colour and in their order of presentation. The person tested is expected to find the code to the series by observation and to choose two from eight possible responses. The chance of a correct response by guessing is therefore one in sixty-four, since each time one out of eight has to be made and the same choice can be made for both parts of the answer. The time limit is 30 minutes and there are 60 items. Split-half reliability was quoted as .984, standard deviation as 10.53, while re-test reliability on 305 ten and eleven year old children at three months interval was .930 (ibid, p.2).

#### *Tests of General Ability—Verbal*

Two tests of general ability that depend on the ability to read English and to understand instructions in English were used. Both have been constructed for use with African groups by the National Institute for Personnel Research, Johannesburg, South Africa. They are the *Spiral Nines* and *Mental Alertness Tests*. In the text they are referred to as *Spiral Nines* and *NB Mental Alertness*, the prefix indicating that the latter test is part of the *N.I.P.R. Normal Battery*.

*Spiral Nines*. The description of this test is taken from the N.I.P.R. Catalogue of Test Materials (1962). It is intended as a pencil and paper group test of general intelligence, printed in step-cut form, with a separate machine-scored answer sheet and having five possible answers to each item, of which the person tested has to choose one. It contains 54 items, nine each of spatial perception (completing squares), number series, vocabulary, spelling, arithmetic and verbal reasoning. It was originally designed to provide a rough estimate of general ability and to be standardised on nine ascending spirals of difficulty arranged in stanines. A person gaining the first six items correct could be classed as stanine one within the population. A person with twelve items correct would be stanine two, and so on. The total score divided by six would give a stanine scale for the individual.

The tests used in the study were parallel forms of the same test. *Spiral Nines C* was used in the Pilot Study and *Spiral Nines A*, the most refined of all the forms, in the Standard 6 survey proper.

Reliabilities (K.R.21) for various studies were reported to be in

the region of .7, standard deviations about 6, and validity with current criteria of scholastic success around .5 or .4.<sup>1</sup> The A form of the test gave a mean item discrimination value of 28.19, and a mean item difficulty index of 45.48, using the Davis method, and its reliability on the group of Basutoland Standard 6 children on which it was standardised was .73

*NB Mental Alertness.* The N.I.P.R. Catalogue (1962) reports this as a paper and pencil test of 54 five-choice items in step-cut form with separate answer sheet containing items of Verbal and Numerical Reasoning, Number and Letter Series, Codes and Analogies and Similarities. It has a time limit of 50 minutes. It is designed for the educational range eight to ten years of education and is part of the N.I.P.R. Normal Battery. Its reliability coefficient on 304 African bursary applicants and Civil Service candidates was reported as .86 (K.R.21). Validity studies were being carried out at the time of decision to use the test.

Both the Spiral Nines and NB Mental Alertness can be described as verbal intelligence tests of traditional mould, requiring knowledge of simple English structure, carefully designed to make administration easy but needing trained test administrators to ensure that the procedure for ensuring correct responses is understood fully.

### *Tests of English Attainment*

The tests described now are all part of the *N.I.P.R. Normal Battery*. They were used in the *Standard 6 Survey only*. They are the *Comprehension*, *Vocabulary* and *Spelling* sub-tests of the *Normal Battery* and in the text are prefixed by the symbol NB.

*NB Comprehension.* This test contains four graduated passages in English, each with five questions having five possible answers to each question. The answers are recorded in the separate answer sheet which is machine or hand scored. It is timed at 25 minutes. Like the *Mental Alertness* test it is intended for use at the Standard 6 to Form II levels. Its reliability (K.R.21) was, on 304 African clerks and bursary applicants, .80. Used in conjunction with the *Mental Alertness* test it is easily administered if the principles of

1. These figures from personal communications from Mr. A. O. H. Roberts of the Psychometric Division, N.I.P.R., and from Mr. J. H. Vent, Aptitude Testing Unit, Nairobi.

recording answers have been clearly explained for *Mental Alertness*, but requires care if one has to begin in the middle of the test booklet to administer it separately. These remarks also hold for the *NB Vocabulary* and *NB Spelling* Tests.

*NB Vocabulary*. This test contains 36 five-choice items and is timed at 15 minutes. Like the other tests of the *Normal Battery* answers are recorded on a separate answer sheet and the test is step-cut. Its reliability, on the same standardisation sample reported above, was .73 (K.R.21).

*NB Spelling*. This is an eighteen item spelling test, the person tested being required to identify the correct spelling of a word from five choices. Its time limit is 10 minutes and its reliability reported, for the group detailed above, as .48 (K.R.21).

The English attainment tests of the N.I.P.R. Normal Battery can be summarised as tests which together could give a profile of English skills that depend on reading and recognition. They have been prepared particularly for use with African populations in the educational range 8-10 years of education.

#### *A Test of Numerical Ability*

Morrisby's (1955) *Test of Numerical Ability*, referred to hereafter as *Numerical Ability* consists of three parts. The first has alternate addition and multiplication sums and is speeded. The second is a number series and the third a number matrix test. All the tests must be said to be for African children, highly speeded, with limits of 5, 12 and 12 minutes respectively. The scores are weighted in that the first part is scored  $\frac{1}{2}(R-W)$  and the other two parts are scored 2R. Reliability is quoted by the Manual as being well over .9 for various groups.

This test is not so much a test of attainment as of number ability. It was used *in the pilot study only*. It has been categorised separately since it is neither a pure attainment test nor a test of general ability.

#### SCIENTIFICALLY CONSTRUCTED TESTS—CONCLUSIONS

In this enquiry, eight different tests which can be said to have undergone construction according to scientific principles were tried. Five, *Raven 38*, *Spiral Nines* and *NB Comprehension, Vocabulary* and *Spelling*, were used in the Survey proper for predictive purposes. All but one had been constructed for African use and all were

relatively simple to administer by trained personnel. The reliabilities reported were not uniformly high, but this was a factor that could not be avoided, since there were criteria other than reliability to weigh at the time of choosing tests for trial. It was considered more important, for example, that the tests should have been used with African populations, and designed for their use, than that they should be absolutely reliable. Being constructed for use in African contexts, we considered, the psychological meaning of the test scores would be more easily identified and the chances of validity in context would be greater than for tests primarily constructed for non-African use.

#### THE STANDARD 6 QUALIFYING EXAMINATION TESTS

The tests for this examination, which is referred to as the Std. 6 examination, consist of two tests in English (*English 1 and English 2*), three tests in Arithmetic (*Arithmetic 1, Arithmetic 2 and Mental*) and two tests of general information (*History and Current Affairs (H.C.A.) and Geography and Nature Study (G.N.S.)*). In addition, a test of proficiency in the vernacular is included in the *Standard 6 Total*.<sup>1</sup> The vernacular test has been omitted because of the great difficulty of equating its marks from school to school (see footnote).

These tests are all constructed by experienced examiners and detailed marking sheets are issued to the marking boards, which are held throughout the country under the supervision of an inspector. Teachers are used for the marking teams and marks are monitored by the inspectors locally and a final monitoring is usually carried out by the Regional Inspector and his staff at the regional offices.

No previous reliability figures are available, but the detailed marking sheets would suggest that in all but English I variance due to difference in examiners' judgments should be minimised. There now follows a short description of each of the tests.

*English I.* This is a two-part test of written English. The first is a dictation and spelling section (15 minutes) and the second a composition section, involving letter and essay writing (75 minutes). This test was, in 1962, marked by European examiners and monitored by the Regional Inspector. It carried a total of 55 marks.

1. The Std. 6 Total is out of 400 possible marks. 350 of these came from the sum of the two English Tests (125), the average of the two Arithmetic Tests plus Mental (125), the sum of half of each of the scores made on the general information tests (100). The remaining 50 marks came from the Vernacular test which is marked at the schools and is thereby subject to much variation. The vernacular test has been excluded, for this reason, from the experiments of the survey, although its influence is carried in the *Standard 6 Total*.

*English 2.* Analysis of this paper shows it to be cast in such a way as to be almost completely objective in its marking scheme. It consists of (a) a *comprehension* test carrying 15 marks, five of which were given for correct expression; (b) a variety of tests of *language usage* requiring knowledge of Masculine/Feminines, Singulars/Plurals, Punctuation, Reported Speech, Identification of Subjects and Verbs, Pronouns, Verb usage and transposition from third to first person. Each of these eight sub-tests carried five marks, giving a total for this section of 40. The last section of the tests could be called a 'word ability' sub-test since it involved finding the odd one out of a group of five words, naming a description of a word of western origin and arranging words in alphabetical order (word series). This section carried 15 marks. The test is therefore weighted towards language usage and vocabulary content, and could be termed an objective test of English attainment that could be turned into completely objective form very easily. It has a generous time limit of 105 minutes.

*Arithmetic 1.* This test can best be described as a mixture of arithmetic processes, spread over 20 items, each of which carry five marks. It covers all the basic tasks of arithmetic in a more or less mechanical frame and involves fractions, decimals, proportion, area, capacity weight and money. It also includes such 'old-fashioned' exercises as finding lowest common multiple and highest common factor. The time limit is 80 minutes. The detailed marking scheme makes it as objective as possible to mark.

*Arithmetic 2.* The test contains 10 problems and covers all the basic processes of Arithmetic 1 in applied form. Each problem carries 10 marks and is subject to detailed marking. The time limit is 90 minutes.

*Mental Arithmetic.* There are 25 items to be answered without working. They apparently increase in difficulty and again make use of all the basic processes. Time 30 minutes.

*History and Current Affairs (H.C.A).* This is a test cast in objective form and contains 100 items of general information about historical events and current affairs. It depends to some extent on picture identification (recognition) and recall, and has a variety of items including sentence completion and multiple choice. All items are based on the syllabus text-books. Time limit is 75 minutes.

*Geography and Nature Study (G.N.S.).* This test contains 100

items constructed in similar fashion to those in the H.C.A. test outlined above. It is completely objective, based on the text-books and has a 75 minutes time-limit.

#### STANDARD 6 TESTS—CONCLUSIONS

The tests reviewed together make up a battery lasting, in all, nine hours and five minutes. The examination is spread over a week. Hence one might conclude, assuming that all areas of the syllabus have been represented, that the Standard 6 examination is a traditional qualifying battery that has, as far as is possible, been subjected to rigorous control of marking. Because of its length, it is unlikely that the reliability of this examination is less than .7, this figure being a fair approximation for lengthy tests of this nature. In fact, if one assumes that the mock Standard 6 examination given by all schools at the end of the second term is a parallel form of the same test, their correlation would indicate a reliability estimate based on parallel forms. A knowledge of school conditions would support this assumption and the figure we quote is .837.

#### FORM I TESTS

The previous tests were all used at Standard 6 level. Some means had to be used for testing success in Form 1. It was decided, for reasons given in the discussion of the follow up design, to construct objectively scored tests in English and Arithmetic, these being the core subjects of the secondary school syllabus. The tests are described below.

*English.* The English test consisted of tests of vocabulary, language usage and comprehension. A time limit of 90 minutes was given, and it was found that this was ample. Most children finished in an hour, and all were finished, usually, by 75 minutes. The test contained 116 items and was intended to test English attainment in a broad spectrum, omitting actual written composition, but testing its elements.

*Algebra.* This test consisted of 60 items, planned to test the basic processes of collecting terms, substitution and coding, addition, subtraction, multiplication and division, equations and factorisation. There were six sub-tests of ten basic items. Each item corresponded on a page position with an item of similar type, so that it could also be used as a diagnostic tool. The test was timed at 45 minutes.

*Arithmetic.* This was a 60 item test of arithmetic processes and

day schools. Hence schools all had three independent assessments of their general quality as educational establishments. These grades were recorded on the record cards of individual pupils within each school. The purpose of these gradings was to assess the influence of different schools on present and future performance.

Schools were also 'typed' according to whether or not they were voluntary agency, rural or reserve, or urban or 'new' schools, for the purpose of sampling each type of school adequately.

*Examination Centre.* The Standard 6 examination centres were entered on the record card to allow analysis of variance on tests subject to examiner variance.

#### *Remaining Data*

The remaining data was coded numerically as appropriate. Such data included family size and position, sex (male high) age and language group, which was used to indicate whether a pupil was compelled to use more than one language apart from English, in daily use, the common language being Shona. Hence if a pupil used a language other than Shona in the home, this was taken as indicating more than bi-lingualism.

## APPENDIX B

### MAIN TABLES

#### *A Note on the Tables in Appendix B*

Tables have been confined to the minimum necessary for understanding the basis on which this Report has been written. Hence only two correlation matrices, two summary tables on tests statistics and one table of norms has been included. The whole research is available in thesis form under the title "A Psychological Study of Selection Problems at the End of Primary Schooling in Southern Rhodesia". Copies are held in the Libraries of the University College of Rhodesia and Nyasaland and the University of London (Irvine 1964).

APPENDIX B  
TABLE 1  
PSYCHOLOGICAL TESTS : RESULTS SUMMARY

TESTS	Spiral Nines Verbal	Spiral Nines Abstr.	Spiral Nines Total	Raven	NB Compr.	NB Vocabs.	NB Spell.
a. Items	27	27	54	60	20	36	18
b. Time Limit (Mins.)	—	—	40	30	25	15	10
c. Mean	16.77	16.69	34.03	27.80	11.79	19.12	8.95
d. S.D.	2.94	2.90	4.93	9.88	3.07	4.15	2.28
e. Reliability Est.	.41	.39	.58	.88	.60	.60	.34
f. Factorial Reliability	.48	.45	—	.39	.37	.50	.29
g. 'g' Loading	.51	.63	—	.60	.35	.52	.20
h. English Loading	.45	.12	—	.06	.43	.43	.49
j. Concurrent Validity	.53	.43	.57	.37	.42	.55	.37
k. Range 50-65 percentile	1	1	2	5	1	2	} 2
l. Range 65-75 percentile	1	1	2	2	1	1	
m. Range 75-85 percentile	1	1	1	3	1	1	
n. Range 85-95 percentile	1	2	3	4	1	2	1

Notes: Rows a and b state number of items and time limits.  
 Rows c, d and e show mean, standard deviation and Kuder-Richardson (K.R. 20) estimates of reliability from the formula  $R_{tt} = 1 - .19K/V$  where K = no. of items and V = variance.  
 Row f gives factorial reliability based on the assumption that the reliability of a test cannot be less than its communality.  
 Rows g, h and j give the loadings on the two main factors and concurrent validity.  
 Rows k, l, m, n show ranges in raw scores between certain percentile limits.

APPENDIX B  
TABLE 2  
STANDARD 6 TESTS 1962. RESULTS SUMMARY

	Std.6 Eng.1	Std.6 Eng.2	Std.6 Arith.1	Std.6 Arith.2	Std.6 Mental Arith.	Std.6 H.C.A.	Std.6 G.N.S.	Std.6 TOTAL.
a. Items (Total Marks)	4(55)	12(70)	20(100)	10(100)	25(25)	100(50)	100(50)	— (400)
b. Time Limit (Mins.)	90	105	80	90	30	75	75	
c. Mean	25.59	45.75	67.02	43.38	15.69	31.84	31.84	238.25
d. S.D.	6.76	7.68	16.48	17.99	4.31	6.72	6.26	38.36
e. Reliability Est.	.55*	.73*	.69*	.69*	.75	.89	.88	.84
f. Factorial Reliability	.41	.61	.52	.55	.58	.75	.65	.81
g. 'g' Loading	.25	.52	.21	.24	.36	.50	.47	.43
h. English Loading	.57	.52	.40	.37	.40	.47	.39	.65
j. Concurrent Validity	.56	.66	.54	.56	.63	.67	.67	.84
k. Range 50-65 percentile	3	4	7	8	2.5	3	3	13
l. Range 65-75 percentile	2	2	5	6	1	2	1	10
m. Range 75-85 percentile	2	2	5	4	1	2	2	15
n. Range 85-95 percentile	5	4	7	5	2	3	2	21

Notes: The layout for this table is the same as for the previous one, except that in row e all reliabilities asterisked \* are split half, calculated on the formula  $R_{11} = 2(1 - (S^2a + S^2b)/S^2t)$  where Sa, Sb are S.Ds of half tests, and St the S.D. of the whole. The other reliabilities are K.R. 20 estimates, except for the test under Std. 6 Total. This is an estimate based on the correlation between the total and mock examination results which parallel the actual test.

APPENDIX B

TABLE 3—STANINE NORMS FOR EXPERIMENTAL TESTS. S. RHODESIA 1962

STANINE	RAW SCORES								STANINE
	S. Nines Verbal	S. Nines Abstract	S. Nines Total N=371	Raven	N. Battery Compr.	N. Battery Vocabs.	N. Battery Spell	Mental Alertness (N=209)	
1	0—11	0—10	0—24	0—10	0—6	0—12	0—4	0—9	1
2	12—13	12—13	25—27	11—13	7	13—14	5	10—12	2
3	14	14	28—30	14—18	8—9	15—16	6	13—15	3
4	15—16	15—16	31—32	19—25	10—11	17—18	7	16—18	4
5	17	17	33—35	26—31	12	19—20	8—9	19—22	5
6	18—19	18	36—38	32—35	13—14	21—22	10	23—25	6
7	20	19—20	39—40	35—39	15	23	11	26—29	7
8	21	21	41—42	40—42	16	24—25	12	30—33	8
9	22—27	22—27	43—54	43—60	17—20	26—36	13—18	34—59	9

Notes: N for all except Mental Alertness and Spiral Nines Total 1,842. Mental Alertness Norms based on urban sample and can be used for similar urban samples. Spiral Nines Total on random population sample.

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