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A twenty-five year follow-up of an extended interview selection procedure in the Royal Navy

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Part II: Multivariate analyses and conclusions

This paper continues the description of a twenty-five year follow-up of the first 269 naval officers to be selected by extended interview. Investigations of data structure by means of principal components analysis, and explorations of the potential value of multiple regression and discriminant techniques in this selection situation are described. An attempt is made through the use of factor models to compare the original and more recent selection situations. The implications of the research for large organisations using the extended interview are discussed in terms of abilities associated with success, probationary service, and judgmental versus mechanical prediction.

INTRODUCTION

THE BACKGROUND to this twenty-five year follow-up study of the first 269 naval officers selected by means of Civil Service Commission examinations and extended interview procedure was reported in Part I of this paper (Gardner and Williams 1973). It was concluded that candidates receiving a high aggregate score at selection were much more likely to succeed in naval training, and were marginally more likely to be promoted to commander twenty years later than were those given a low score. It was also found that relatively good predictions of long-term success were obtainable from early training results. Moreover, it was shown that promising correlations existed between certain biographical and psychometric variables and some of the success criteria, suggesting that some form of mechanical prediction might usefully supplement the evidence available to the selectors. In order to explore this possibility two additional sets of analyses were carried out on the data using multivariate techniques:

1 Several principal component analyses were undertaken to enable ability models to be constructed for the purpose of providing a clearer understanding of the structural relationships existing in the complete correlation matrices derived from the original data.
2 Predictor functions were derived using a technique familiar to selectors (multiple regression analysis) and one which has been relatively unexplored (discriminant analysis).

It has not been possible to cross-validate all long term-predictor functions directly because it was only in the original samples that every officer had an equal opportunity of promotion to commander, and those samples were not large enough to be partitioned; and also because minor changes were made to selection variables from time to time. What was possible, however, was an assessment of the similarity between ability

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structures of the original and more recent samples by means of factor analysis. Once comparability had been established the factor models for the three samples were rotated on to common axes. Predictor functions derived from the factor scores of the original samples were applied to those of the more recent samples to test their stability.

An outline of these various analyses is given below: a more detailed description will be found in Gardner (1971). The final section of this paper is devoted to a discussion of some of the implications of this research for current selection policy and practice, particularly with respect to large enterprises employing the extended interview for the identification of management potential.

INVESTIGATIONS OF DATA STRUCTURE

The basic structure

The sample used in the first principal components analysis included *all* candidates who attended the Admiralty Interview Board during the first six boards. This provided the largest sample possible – a total of 519 observations on the twenty variables relating to the Civil Service Commission examinations, the Senior Psychologist's tests and the board marks. These and other variables mentioned in this paper are listed in Appendix 1. Table 1 shows the loadings of the twenty selection variables on the first three principal components. Complete representation of the structure demands a 20-dimensional model, but since the first three components account for 63 per cent of the total variance, and subsequent components for one tenth of this, or less, the three-dimensional

TABLE 1

PRINCIPAL COMPONENT LOADINGS OF SELECTION VARIABLES – FIRST THREE COMPONENTS

(All selected and rejected candidates; N = 519)

Variables	Principal component loadings		
	Component 1	Component 2	Component 3
Board Marks			
PRES	·31	·16	−·04
DP	·31	·17	−·06
CS	·32	·16	−·03
EO	·31	·13	−·13
SO	·32	·15	−·03
PSYCHO	·31	·10	−·07
TO	·30	·13	−·08
B.MARK	·33	−·16	−·06
Senior Psychologist's Tests			
GT35	·16	·25	·31
SP96	·17	·26	·23
SP21	·07	·16	·27
SP117E	·12	·29	−·28
SP117M	·07	·30	−·28
SP97	·05	·21	−·10
SP160	·11	·32	·25
Civil Service Commission Examinations			
ENGL	·13	·01	·38
GENL	·08	·00	·31
MATH	·09	·21	·04
PHYS	·11	·22	−·03
T.EXAM	·16	·17	·26

structure gives a reasonably good account of the relationships. Examination of Table I shows that the vectors of all board marks are clustered together and those of the written tests and examinations lie in a plane almost orthogonal to the board marks. The Senior Psychologist's tests separate into two distinct clusters, one comprising the verbal-educational tests, the other the spatial-mechanical. Civil Service Commission examinations are distributed according to their relationships to these two clusters. It would clearly be possible to define three meaningful orthogonal axes which might be labelled 'verbal-educational ability' (V:ED), 'spatial-mechanical ability' (K:M), and 'personality' (P) as represented by board marks. The model shows that the interview board generally was little influenced by cognitive abilities, though the psychologist, and to a lesser extent the testing officer and the engineer officer, had small cognitive loadings.

The structure of this three-dimensional model is conceptually similar to that portrayed in Vernon's model of educational ability (Vernon 1950); the 'cognitive plane' may be identified with his 'general intelligence' plane in which 'g' is visualised as a bond between V:ED and K:M, and B.MARK may be identified with his 'x' factor, i.e. personality traits unrelated to 'g'.

A second principal component analysis was aimed at locating the biographical and criteria vectors in an ability/success model. Since these data were not available for rejected candidates the combined sample of selected Seaman, Engineer and Supply officers was used. Some distortion of structure was found to occur as a result of selection (e.g. a positive correlation between V:ED and K:M); nevertheless the clusters of related variables were still readily identifiable and the B.MARK vector was again found to be orthogonal to a plane containing the vectors representing all the Civil Service Commission examinations and Senior Psychologist's tests. For this combined sample the vectors representing both training and career criteria were found to lie close to the cognitive plane.

Difference between samples

Principal component analyses of the separate Seaman, Engineer and Supply samples were also carried out and have been described in full by Gardner (1971). It was found that the various training success vectors tend to lie close to the cognitive plane in all the samples, although the loadings of verbal and mechanical abilities varied from one training course to another. There was less similarity between the samples in terms of long-term success vectors. In the Engineering and the Supply specialisations S.INDA and S.INDB were closely associated with intelligence, but predominantly of the verbal type; indeed, high mechanical ability appears to have been a handicap to long-term success as measured by these criteria. The difference between abilities associated with success at different points in an Engineer officer's training career is worth noting in relation to the changes occurring in his role; training and early career success are dependent upon technical performance, which, in turn, is partly associated with spatial-mechanical ability; in later, more managerial, jobs verbal ability becomes progressively more important. The long-term success of Seaman officers has a substantial 'personality' as well as verbal loading, S.INDA and S.INDB falling between the cognitive plane and B.MARK.

The ability/success models derived from principal component analyses have produced a clearer pattern of the underlying relationships between the many variables used in this study. They reinforce the picture which was emerging from the bivariate

correlational analysis of the potential value of certain raw objective data variables in improving predictive accuracy of the selection process. The differences between the models for three separate samples also highlight the possibility that a candidate may be more likely to succeed in one branch than another and the danger of drawing false conclusions from merged samples. This has been taken into account in the derivation of predictor functions.

DERIVATION OF PREDICTOR FUNCTIONS

In order to explore the possibility that psychometric or mechanical predictor functions might be designed which could be used to supplement the evidence available to the selectors, multiple regression and discriminant analyses were applied to the data. Multiple regression analysis needs no introduction since it is one of the more common methods used in mechanically combining a number of predictor variables in order to maximise the accuracy of prediction. There is, however, little evidence of the use of discriminant analysis in the selection field. It is a technique for predicting the probable membership of different groups on the basis of observed values, and can therefore be used in situations where regression analysis would not be appropriate (e.g. when the criterion is 'promotion/no promotion' rather than some measured variable such as course results). One of the few references to discriminant analysis in the selection field can be found in Cattell *et al.* (1970); theoretical treatment of the technique is presented in Anderson (1958).

Results of multiple regression analyses

Multiple regression functions were derived for each sample for predicting performance in training and in subsequent career from data available at selection and at the end of each preceding stage of training. In cases where many predictor variables are available, as in this study, and where the correlations between some of them are high, it is often possible to derive a variety of functions of almost equal statistical merit. The procedure used in these investigations for selection of the most useful variables for construction of the predictor functions described was a stepwise one which ensured that each coefficient was significantly non-zero in the t-test sense. Typical findings for one of the samples are discussed below.

For Seaman officers (N = 89) the function which best predicted the aggregate score for early training performance (D.TOT) from selection data was:

$$(\text{D.TOT}) = -{\cdot}22\,(\text{B.MARK}) + {\cdot}38\,(\text{T.EXAM}) + {\cdot}45\,(\text{K:M})$$

where observations are expressed in standard score form. The multiple correlation for this function, R = ·58, may be compared with the correlation, r = ·37, between D.TOT and selection aggregate, B.AGG. (Note: B.AGG = B.MARK + T.EXAM.) The function clearly demonstrates the value of a combination of interview board marks with measures of verbal and mechanical ability for prediction of overall performance in early training. (Note that T.EXAM measures something closely akin to V:ED; see Table 1.)

Various functions were derived for prediction of the synthetic long-term success criterion (S.INDB) from data available at selection. For Seaman officers multiple correlations around R = ·35 were obtained. This may be compared with r = ·15 between S.INDB and B.AGG. These functions also illustrated the value of cognitive test data and of biographical data for long-term prediction, but it must be noted that use of such functions in practice demands an assumption of stability of the criterion and of the predictor/criterion relationship which might be difficult to justify in view of the

long period involved, about 25 years in this case.

Inclusion of early training results in the available predictors raises the value of R to 0·48, the optimum function being:

$$(\text{S.INDB}) = \cdot 20\,(\text{B.SD}) + \cdot 29\,(\text{ENGG}) + \cdot 33\,(\text{OLQ})$$

where observations are expressed in standard score form. The usefulness of B.SD in this function is particularly interesting, since it is a measure of the difference of markings of a candidate among selection board members. Those candidates over whom there was greatest difference of opinion at selection tended to do best in the long-term. The variables ENGG and OLQ both refer to scores awarded at the end of the early training period in the cadet training cruiser, HMS Devonshire, the former being a measure of performance in engineering training and the latter a mark for 'officer-like qualities'.

Results of discriminant analyses

In its simplest terms, long-term success can be considered as a categorical variable, individuals being classified as 'promoted' or 'not promoted'. The technique best suited to prediction of a categorical variable is discriminant analysis, in which a linear function is derived, enabling a discriminant score to be calculated for each individual. This estimated score may then be used to determine probability of membership of one group or the other. The technique may be extended to the prediction of more than two categories and in such a case a set of linear discriminant functions is derived, one less in total than the number of categories.

An obvious advantage of using a categorical criterion is the avoidance of the need to create a synthetic continuous measure of success. A set of analyses was completed for each sample, (Seaman, Engineering and Supply groups), using a 'promotion'/'no promotion' classification and using data available at selection and on completion of various stages of training. These analyses led to the conclusion that the 'no promotion' category might usefully be split into two parts. Three-group analyses were therefore completed using the following classification:

1 Promoted to commander.
2 Not promoted but still serving after reaching top of promotion zone.
3 Not promoted, left service before reaching top of promotion zone.

The results of one of these analyses, using selection data for Supply officers, are summarised in Table 2. The table shows which predictor variables provide the most

TABLE 2

DISCRIMINANT ANALYSIS OF SUPPLY OFFICER SELECTION DATA: MOST SIGNIFICANT POSITIVE AND NEGATIVE PREDICTOR CONTRIBUTIONS TO DISCRIMINANT SCORES

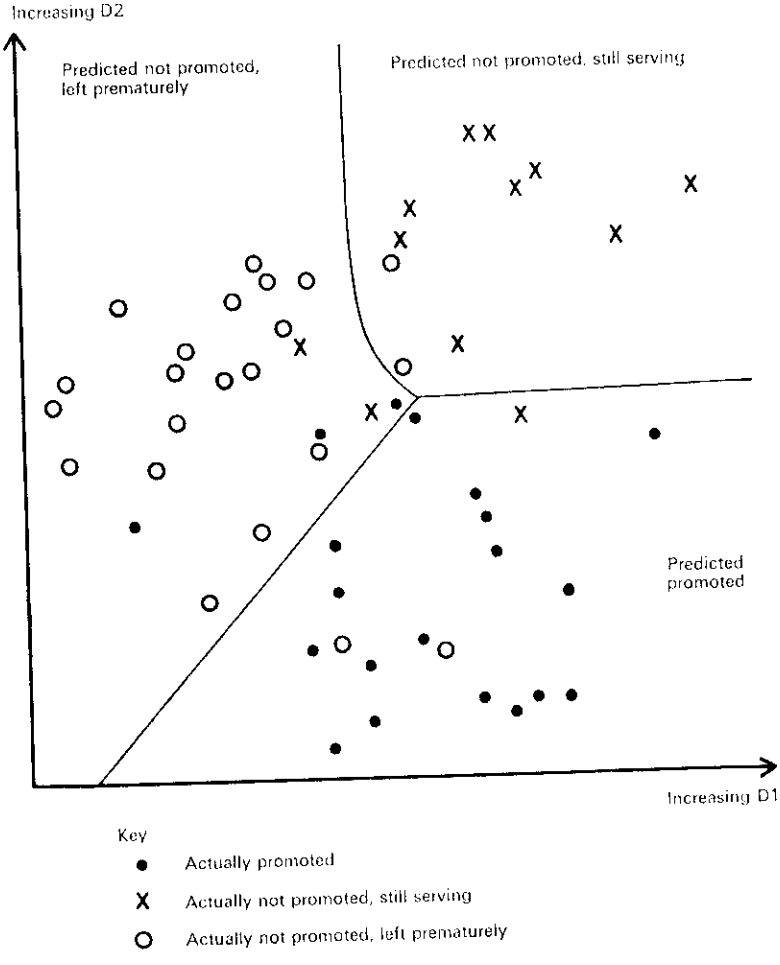
Predictor	Discriminant D1		Discriminant D2	
	+	−	+	−
GT35	x			x
SP96		x	x	
SP21	x			
T.EXAM	x		x	
F.OCC		x		
A.AIB			x	
GAMES				x
PREF	x			x

significant positive and negative contributions to each of the two discriminants D1 and D2.

An identification routine was completed on the parent observations and the results are illustrated in Figure 1, in which the D1 and D2 axes represent the two discriminant vectors. Each prediction produces a pair of D1, D2 scores, enabling the point to be plotted in the two-dimensional discriminant space. Each point, corresponding to one individual, has been plotted in such a way that discrepancies between forecast and reality can be seen. Solid lines indicate the boundaries of equal probability of membership, thus defining the forecast groups. As might be expected there are some prediction errors at the boundaries, but there are few cases where major differences between forecast and reality have occurred. Prediction accuracy may be expressed in terms of hits and misses. For the 55 individuals in the parent sample the total hit rate was 45, or 82 per cent.

Inspection of Figure 1 and Table 2 shows that membership of the 'promoted'

FIGURE 1



category is associated with high D1 and low D2 scores, i.e. with high verbal reasoning ability and clerical aptitude as measured by GT35 and SP21, and with positions of responsibility at school, particularly games official and prefect.

Similarly, membership of the 'not-promoted, still serving' category is associated with high D1 and D2 scores, i.e. with high CSC examination score, T.EXAM, with high clerical aptitude score, SP21, and with high age at selection, A.AIB.

Membership of the 'not promoted, left prematurely' category is associated with low D1 scores, i.e. with high verbal comprehension score SP96, and with high F.OCC score.

Again it must be emphasised that use of these functions for practical prediction would imply an assumption of stability of parameters and relationships over a period of some twenty-five years. Such an assumption would be difficult to test objectively.

Conclusions drawn from multiple regression and discriminant analyses

The analyses summarised above are typical of a large number reported by Gardner (1971). The following are among the conclusions which can be drawn from these studies:

1 Psychometric functions appear potentially valuable for both short-term and long-term prediction provided their stability over relevant periods can be assumed. Derivation of optimum predictors, cross-validation, and a critical examination of the stability question would be well worthwhile.
2 The Senior Psychologist's tests provide valuable contributions to both short-term and long-term predictors. Loadings differ considerably in the various samples, confirming the findings from the principal components analyses that there are significant differences in the qualities associated with success in the various branches. A number of biographical variables are useful predictors, especially the indicators of positions of leadership at school (CORPS, SOCS, GAMES, and PREF).
3 Forecasts of long-term career outcome can be substantially improved when data become available from early training results.
4 Discriminant analysis can be a powerful technique where it is more appropriate to describe career outcome in categorical terms than in the form of a continuous linear variable.

COMPARATIVE STUDIES OF ORIGINAL AND LATER SAMPLES

The samples

Three samples were involved: Group A was the original group, consisting of the 519 candidates of the first six of the new selection boards held between 1947 and 1949 (of whom 269 were accepted); Group B consisted of 252 candidates who appeared before selection boards 7 to 10 in 1950 and 1951 (of these 90 were accepted); Group C consisted of 227 candidates who appeared before selection boards in 1969/70 (89 were accepted). Some minor differences existed between certain variables in the three samples, for example some of the cognitive tests had been modified and the range of board marks was progressively increased. Other differences between Group C and Groups A and B were: the age range of the candidates was considerably greater; the competitive CSC examination was replaced by a minimum 'A' level requirement, and therefore the sole contribution to selection ranking was the judgmental board mark; biographical information was not available.

The procedure Principal components analyses were carried out which indicated that

the structure of the selection data in each of the three groups was essentially similar, and that in each case a three dimensional model was likely to give a good account of the data. Three dimensional models were therefore derived for each group using factor analysis. The three models were aligned by rotation on to common axes labelled, P, M and V (composite measures of 'personality', 'mechanical ability' and 'verbal ability') and the data for all three groups were converted into scores on these three axes. Using these P, M, V scores regression and discriminatory functions were calculated for Group A, and applied to Groups B and C. The differences mentioned above between Group C and the other two groups on some of the variables were the main reason why the use of condensed P, M, V scores was considered appropriate in these comparative studies.

Regression and discriminant functions In order to explore the use of P, M, V scores as a means of interrelating samples for predictive purposes a multiple regression analysis of the Seaman officer sample of Group A was carried out, using D.TOT as criterion and P, M, V as predictors. The equation derived was:

$$(\text{D.TOT}) = \cdot 37\,(\text{M}) + \cdot 29\,(\text{V})$$

(multiple correlation of 0·40). This result is in keeping with the earlier results using raw data variables; it demonstrates the importance of cognitive scores for prediction of this composite measure of early training success. If we apply this equation to all observations in Groups A and C (both accepted and rejected candidates) the results obtained are encouraging in their similarity and in their confirmation of the success of the selection procedure in terms of short-term prediction. Further regression analyses explored the use of combinations of P, M, V scores, biographical data and early training results for prediction of the long-term success criterion (S.INDB). The sample used was again the Seaman officers of Group A but it was not possible to apply the predictors this time to later samples because of the absence of biographical data. Using P, M, V scores and biographical data the multiple correlation on S.INDB is 0·35; the inclusion of D.TOT as a predictor results in a multiple correlation of 0·43. These findings are much the same as those obtained in earlier analyses where raw data variables were used.

Using P, M, V scores alone discriminant functions were derived for the Seaman sample of Group A for prediction of membership of three categories: Promoted to commander/Not promoted but still serving/Not promoted, left service prematurely. In broad terms it was found that promotion is associated with high P and V scores and average M scores; premature leaving with low M scores, and long service without promotion with low P and V and high M scores. Applying the predictors to the parent observations in order to test prediction accuracy, a hit rate of 55 per cent was obtained. Thus a useful forecast on the basis of P, M, V scores alone can be obtained bearing in mind that a random forecast would result in approximately a 33 per cent hit rate. Cross-validation of the discriminant functions with the Seaman sample in group B gave a hit rate of 53 per cent suggesting that the result may be considered stable in the short-term. The functions were applied to the P, M, V scores of all candidates of Group C. The results, which are summarised in Table 3, appear to provide striking evidence of the success of current selection when measured in terms of forecast prospects of long-term career outcome in the Seaman branch, if it is assumed that the relevant parameters and relationships will remain stable for the next twenty years or so.

Similar discriminant functions were derived for the Supply officer sample of Group A. Here both promotion and premature leaving are associated with high P and

TABLE 3

FORECASTS OF CAREER OUTCOME USING GROUP A SEAMAN OFFICER DISCRIMINANT FUNCTIONS ON PMV SCORES OF GROUP C CANDIDATES

(Percentages)

	Forecast promoted	Forecast not promoted still serving	Forecast not promoted left prematurely
Accepted candidates	49	33	18
Rejected candidates	1	65	34

V scores, the former being related to low M and the latter to high M. A hit rate of 52 per cent was achieved when applying the predictors to the parent observations, which again is substantially greater than would be expected on a random forecast for three groups. Cross-validation with Supply officers in Group B yielded a hit rate of 57 per cent, again suggesting short-term stability. The results of applying the functions to the P, M, V scores of accepted candidates of Group C provide an interesting contrast to the results in Table 3. In this case only 12 per cent are forecast as 'promoted' and only 8 per cent as 'not promoted, still serving'. These analyses provide additional evidence that the qualities associated with long-term success differ from branch to branch and suggest that, if an attempt is made at selection to consider long-term potential, the use of a common selection criterion for all branches must inevitably be a compromise. The desirability of selecting on the basis of long-term potential in individual branches must of course be weighed against related requirements such as career structure and manpower planning and against the likelihood that a long-term predictor will remain stable over the period considered.

From these comparative studies of the original and later samples three conclusions are worth highlighting:

1 The examples described illustrate the feasibility of deriving regression and discriminant functions for each specialisation in terms of the synthetic P, M, V scores, and of using these functions for predictive purposes in other samples which can be shown to have similar data structure, provided relationships can be assumed to be stable. It should however be added that the incorporation of biographical and early training variables would enhance predictive accuracy.

2 The use of condensed selection test data (P, M, V scores) in predictor functions has the merit of identifying the predictive value of the data in terms of three readily recognisable dimensions rather than a variety of individual tests.

3 The results suggest that the current Admiralty Interview Board selection procedure is successfully ranking candidates in terms of long-term prospects in the seaman specialisation, but confirms that there are marked differences in the qualities associated with success in different branches.

DISCUSSION AND CONCLUSIONS

On the basis of the analyses carried out in this follow-up study it is possible to draw certain conclusions which have implications for the identification of management potential in large organisations. These conclusions can best be discussed under three headings.

Abilities associated with success

While in the naval situation it is clear that success in training courses is associated

with intelligence as measured by a variety of written examinations and psychological tests, the relative loadings of verbal-educational and spatial-mechanical abilities vary from one training course to another and between different employment specialisations. Long-term success is also associated with intelligence, predominantly of the verbal type. Indeed, high mechanical ability appears to be a handicap to long-term success as measured by promotion, particularly for Engineer officers. In the engineering specialisation training and early career success is dependent on technical performance, which, in turn, is partly associated with mechanical ability. In later career verbal ability becomes more important.

There are several important implications from these conclusions. First, in view of the differences between branches, and between short-term and long-term, a selection procedure which attempts to rank candidates on a single scale of suitability for all forms of employment must inevitably be a compromise. Where such differences do occur, as shown by studies of ability structure and/or by systematic job analyses, there is a strong case for the use of differential scales, and for candidates to be assessed on each one (or as occurs in the Civil Service Selection Boards to be assessed on scales relating to different branches in which the candidate has expressed interest). Secondly, where it is found that changing roles within a given specialisation require different abilities at different stages of career development, this should be fully taken into account in career structures and career development schemes. In the case of Engineer officers in the Navy a marked change of role in mid-career indicates the potential value of education designed to develop the verbal abilities associated with managerial success, as distinct from the technical abilities which are relevant in early appointment. Thirdly there may be a case for offering short-term appointments to candidates whose abilities indicate that they are more likely to achieve success in early career than in the long-term.

The use of probationary service

The concept of probationary service recognises the fact that prediction of long-term performance may be difficult at the selection stage. The findings of this research showed that in the context of the Navy considerably better predictions of long-term success could be derived from results of first year naval training than from selection data. Where there is sufficient evidence to support such a relationship, and particularly where a common probationary period is feasible, then more effective selection and placement (or streaming) will undoubtedly result. It is worth noting that following the Fulton Report (Fulton 1968) the new entrant to the Home Civil Service joins as an administrative trainee, and is only placed in the fast stream (akin to the old administrative class) or the main stream (akin to the executive class) after a period of up to five years in the Service.

Judgmental or mechanical prediction

Another question to which this research is relevant is the problem of judgmental or clinical versus psychometric or mechanical prediction. It might be argued that judgmental prediction in the situation investigated could be improved without recourse to mechanical prediction. For instance in Part 1 of this paper it was reported that the correlations between interview board mark and V:ED and K:M (verbal-educational and spatial-mechanical abilities as measured by cognitive tests) were very low. If these relationships still hold, and if evidence exists to show that V:ED and/or K:M are

useful predictors of success, then selectors could give appropriate weight to relevant measures of cognitive abilities when assessing board marks. In practice an effective weighting was originally achieved by incorporation of the Civil Service Commission examination marks in aggregate selection scores, but these written examinations have now been abolished and there is evidence that more weight is now given to cognitive ability in assessment of board marks. This study has shown, however, that functions can be derived which would enable selectors to take full advantage of the predictive value of written examinations, cognitive tests, behavioural assessments and biographical data, provided the criterion/predictor relationships can be assumed stable over relevant periods.

Unfortunately this research does not provide indications of the relative contributions of the situational tests (individual command and group tasks, group discussions, short talks) to board mark and to subsequent performance. Knowledge of the predictive values of all sources of information on candidates, together with knowledge of the relative influences of this information on the decision making processes of the selectors, is of fundamental importance in improving the accuracy of judgmental prediction. However, it should be noted that this strategy for improving judgmental prediction is more likely to be successful where objective methods for obtaining information about candidates are in use. The American Telephone and Telegraph Management Progress Study which was begun in 1956, and is still continuing (Bray 1966), is an excellent example of how to apply this strategy. The extended interview technique is used for identification of management potential among employees, and the promising results being obtained show what can be done when detailed recording of selection criteria and carefully planned follow-up studies are in operation. The Civil Service Selection Board, a pioneer of the extended interview in this country, is also active (see Anstey 1971) in attempting to improve its judgmental prediction following the Fulton Report's expressed doubts about its objectivity (Fulton 1968) and the Davies Committee of Inquiry's recommendations concerning the greater use of objective testing and the need for the detailed type of follow-up research discussed above (Davies 1969).

The use of judgmental as opposed to mechanical prediction can be defended on two main grounds: first, the majority of organisations employ too few managers to enable the selection research required for mechanical prediction to be carried out; secondly, the complicated and sometimes unstable features of the manager-job interaction demand something more flexible than merely predicting an individual's future performance on the basis of statistical relationships gathered on groups of managers. In the context of the type of selection situation discussed in this paper the first argument is irrelevant; the strength of the second can only be assessed on the basis of comparative validation studies. The major reviews of such studies (Sawyer 1966; Korman 1968; Campbell 1970) are not always convincing in their generalisations, largely because comparisons are often being made between studies differing in important situational variables, in validation technique (concurrent or predictive), in the range and content of predictors, in success criteria, in the degree of criterion contamination, and so on.

The most recent comprehensive review of the evidence (Campbell *et al* 1970) concludes: 'The best strategy of all, it appears, is one which supplements data collected mechanically with the presumed broader range of data from the clinician's potentially faulty inferences by combining them into a predictive composite by a set of common rules or equations developed mechanically' (p.155). The current research would

support rather than detract from this conclusion, and it has amply demonstrated the power of multivariate techniques as methods of mechanically combining the predictors. In particular it has shown that the little known technique of discriminant analysis is well suited to situations where selection and placement considerations are desirable to make the most effective use of available manpower.

The extended interview technique has invariably been associated with judgmental prediction. There are historical reasons for this including the 'gestalt' philosophy underlying much of its thinking. The existence of computer facilities and of appropriate statistical techniques now makes the investigation and use of mechanical prediction more feasible in certain situations. In cases where this is possible, and where stability of parameters and relationships can reasonably be assumed, the provision of mechanical prediction scores indicating probabilities of success in each potential career is worthy of consideration. Such scores may either incorporate appropriately weighted interview marks or be provided as additional evidence to selectors. But whatever modifications are made to current applications of the extended interview, they should be assessed against criteria such as those defined by Davies (1969, p.2) for judging a selection system and viewed in the context of his 'other relevant factors', manpower planning and constraints and adequate follow-up.

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APPENDIX 1
LIST OF VARIABLES
(Selected items; full list in Gardner, 1971)

Biographical

CORPS	Any rank held above the lowest in JTC, ATC, etc.
SOCS	Officer of a school society or membership of more than three societies.
GAMES	Games official or school first team.
PREF	School prefect.
HMC.SC	Attending a school represented on the Headmasters Conference.
F.OCC	An index of socio-economic background defined in terms of father's occupation.
FAT.RN	Father a regular officer in RN.
ON.CH	Only child.
A.AIB	Age in years at date of interview by Admiralty Interview Board

Senior Psychologist's Tests. (Details are given in Vernon and Parry, 1949)

GT35	Score on a verbal reasoning test
SP96	Score on a verbal comprehension test
SP21	Score on a clerical aptitude test
SP117E	Score on an electrical information test
SP117M	Score on a mechanical knowledge test
SP97	Score on a memory for designs test
SP160	Score on a mechanical comprehension test
V:ED	A composite verbal-educational score equal to GT35 + 5×SP96
K:M	A composite spatial-mechanical score equal to SP97 + SP117E + SP117M + SP160

Civil Service Commission Examinations

ENGL	Marks for English paper
GENL	Marks for General paper
MATH	Marks for Mathematics paper
PHYS	Marks for Physics paper
T.EXAM	The aggregate mark for English, General and Mathematics and two optional papers.

Board Marks

PRES	Mark awarded by President of Board, an Admiral
DP	Mark awarded by Deputy President, a Captain RN
CS	Mark awarded by a Civil Service representative
EO	Mark awarded by an RN engineering officer of commander's rank
SO	Mark awarded by an RN supply officer of commander's rank
PSYCHO	Mark awarded by board psychologist
TO	Mark awarded by board testing officer
B.MARK	Mark awarded by board members collectively, after discussion
B.SD	The r.m.s. deviation of board members marks about their mean
B.AGG	The aggregate selection score, B.MARK plus T.EXAM

Training Results

ENGG	Mark awarded for engineering in cadet training cruiser, HMS Devonshire
OLQ	Mark awarded for officer-like qualities in cadet training cruiser, HMS Devonshire
D.TOT	Aggregate mark for all subjects in cadet training cruiser, HMS Devonshire
T.LCDR	Duration of service between joining RN and promotion to Lieutenant Commander; a measure of overall success in training

Career Criteria

S.INDA	A measure of speed of promotion to Commander
S.INDB	A measure of usefulness to the service

Derived Variables

P	A derived measure of personality
M	A derived measure of mechanical ability
V	A derived measure of verbal ability