

PREDICTING HOLLAND OCCUPATIONAL CODES BY MEANS OF PAQ JOB DIMENSION SCORES

R.P. VAN DER MERWE
J.A. LE ROUX
J.C. MEYER
H.G. VAN NIEKERK

*Department of Psychology
University of Stellenbosch*

ABSTRACT

A study was conducted on how to obtain Holland's codes for South African occupations practically and economically by deducing them from information on the nature of the occupation (as derived by means of the Position Analysis Questionnaire). A discriminant analysis revealed that on the basis of the PAQ information the occupations could be distinguished clearly according to the main orientations of their American codes. Regression equations were also developed to predict the mean Self-Directed Search scores of the occupations on the basis of their PAQ information.

OPSOMMING

Ondersoek is ingestel om Holland se kodes vir Suid-Afrikaanse beroepe op 'n praktiese en ekonomiese wyse te bekom deur hulle van inligting oor die aard van die beroep (soos verkry met behulp van die Position Analysis Questionnaire) af te lei. 'n Diskriminantontleding het getoon dat die beroepe op grond van die PAQ-inligting duidelik volgens die hoofberoepsgroepe van hulle Amerikaanse kodes onderskei kan word. Verder is regressievergelykings ontwikkel om beroepe se gemiddelde Self-Directed Search-tellings op grond van hulle PAQ-inligting te voorspel.

Many psychologists, personnel practitioners, counsellors and advisers daily have to deal with problems surrounding the linking of an individual's characteristics to the requirements set by specific jobs. The available personal and occupational information usually has to be integrated and interpreted by every investigator or user who is interested in the results. Such interpretations are tedious and time consuming and usually occur in a fairly subjective manner. The real problem with regard to vocational counselling and career planning, and this also applies in the case of the selection and placement of individuals, is therefore to collate meaningfully or to integrate the two sets of information when they are available (Smith, 1975; Sparrow, Patrick, Spurgeon & Barwell, 1982).

Holland (1966) developed a theory in an attempt to organize and interpret the available information on occupational behaviour. This approach has utility value as it offers a possible link between information about the individual and the world of work. According to Holland (1973) his theory of occupational choice is based on the premise that occupational interests are regarded as one of the aspects of personality. Consequently an indication of a person's occupational interests can also be regarded as a partial expression of his personality.

The essence of Holland's theory is his categorization of individuals into six particular personality types and the association of these types with six corresponding work environments (Holland, 1987). Holland states that, generally speaking, every person corresponds with one of the personality types, but is also influenced by a second or even a third type, all of which contribute to the person's ability to deal with his environment. The six main personality types of Holland are: Realistic (R); Investigative (I); Artistic (A); Social (S); Enterprising (E); and Conventional (C).

Holland's theory thus presents a method in which personal and occupational information can be utilised effectively by

linking a person's code to an occupation that has a corresponding code. Holland's Self-Directed Search (SDS) (1981, 1985) is therefore one of the very few occupational choice questionnaires that is based on a theoretical framework involving both the individual and the world of work. His theory enjoys growing status and esteem in the United States of America and his SDS is one of the most generally used psychometric instruments in occupational choice.

In order to determine the code of a particular occupation, various methods can be used. According to one of the methods, large groups of practitioners of the occupation in question complete the SDS after which the average code for that occupation is determined on the basis of the relevant results. Another popular method is to use job analysis data and to assign particular codes to the occupation on the basis of specific job contents. Experts can then be used to estimate the code of an occupation on the basis of the particular job contents. Instead of experts making an estimate of an occupation's code, the code can also be determined by developing a model on the basis of the obtained job analysis information.

When developing such a model, it is advisable that information on the jobs should be obtained in a scientific manner. The Position Analysis Questionnaire (PAQ) is well suited for this purpose. It is a structured questionnaire by means of which jobs are analysed and described as the work relating to them is carried out in practice. The questionnaire is an example of behaviour description classification that places the emphasis mainly on what the workers have to do in order to complete their work (McCormick, 1974; Palmer & McCormick, 1961). In terms of this approach not only can separate behavioural areas be identified in respect of a large variety of jobs, but each behavioural area can also be classified into smaller general work elements. With every work element assessed on a points scale, the PAQ system makes it possible to describe jobs in meaningful and quantifiable units of work information. Work data in this form meet the strict requirements set with a view to research, namely that it should be possible to quantify or categorize the relevant variables reliably (McCormick, Cunningham & Gordon, 1967; Smith, 1981).

As the nature of occupations and incumbents can differ from one country to the next, it means that when Holland's approach is used in South Africa, the question arises as to the

relevance of the American occupational codes to South African conditions. Determining codes for occupations in South Africa by obtaining SDS profiles of incumbents would be an onerous and expensive task. The use of experts to deduce the codes from job descriptions is convenient but there may be dangers with regard to subjectivity. The establishment of an objective method to assign Holland occupational codes to South African occupations can make a very useful contribution to the field of occupational counselling and career planning, and to the selection and placement of individuals – the reason being that the link between a person and an occupational field would be established more easily and can take place more scientifically.

METHOD

In the present investigation it was attempted to develop a model by means of which the Holland occupational codes, as obtained on the basis of the mean SDS scores of incumbents, can be predicted by using job description information as obtained by means of the PAQ.

Test group

Sixty occupations were identified on the basis of the Holland model and it was attempted to involve approximately ten incumbents per occupation. These incumbents were drawn from large organizations and companies. For the sake of homogeneity it was attempted to include preferably only white men in the sample. They had to have a minimum of two years practical experience in their particular field of work and an effort was made to keep the total range of ages within each occupation as limited as possible. Job satisfaction was also borne in mind and on the basis of results obtained by means of the Job Satisfaction Index (JSI) the final decision was taken as to whether a person could be included in the sample or not. The final sample group consisted of 576 subjects.

MEASURING INSTRUMENTS

Self-Directed Search (SDS)

The SDS is Holland's occupational choice questionnaire for gathering specific information on a person. It is comprehensive and evaluates a person's activities (what he likes to do), his competencies (i.e. the present competence of an individual based upon the experience he gained in the past), his self-assessing abilities (assesses himself with regard to his abilities and skills in comparison with other persons in the same age group), as well as his occupational likes and dislikes.

The questionnaire consists of 228 items and on the basis of the individual's responses a total score is calculated for each of the six personality dimensions. A combination of the individual's three highest personality dimensions, giving an indication of his experience and occupational preferences, is used to determine his three-letter (main class and two subclasses) SDS code (personal code). This SDS code is composed of any combination of three of Holland's six personality dimensions: R, I, A, S, E, C.

Position Analysis Questionnaire (PAQ)

The fact that the PAQ is objective and does not discriminate subjectively between jobs makes it, from a scientific point of view, a very suitable instrument. It can be used very successfully in a large number of situations in which, on the one hand, the characteristics of jobs are compared with one another, or, on the other hand, the characteristics of jobs are compared with aptitudes of persons. It can also be used to determine the aptitude requirements set by a particular job for its incumbent. Although the PAQ has many possible uses, only its job analysis aspects are often used as it is a good system for identifying the structure of human work, quantifying it and particularly for determining aptitude requirements for different jobs and groupings (Carter & Biersner, 1987; McCormick, DeNisi & Shaw, 1978; Van Rooyen, Verwey & Human, 1981).

The results of the 194 items of the PAQ are reflected in 32 specific (divisional) and 13 general (overall) work dimensions. This means that a score is obtained on each of these 45 dimensions for every job. By using these scores in certain regression equations, an indication can be obtained of the human abilities that are required for functioning in a specific job (McCormick, DeNisi & Shaw, 1978; McCormick, Mecham & Jeanneret, 1977a, 1977b, 1977c, 1977d). The expected human traits or characteristics such as interest, personality and aptitude are therefore deduced from the job description information. Average scores on the subtests of the General Aptitude Test Battery (GATB) can also be predicted.

Job Satisfaction Index (JSI)

Brayfield and Rothe (1951) used Thurstone and Likert's scaling method in the construction of their JSI. From an original 246 items they designed a final scale consisting of 18 items. Mauer (1976) administered the JSI to mine workers and subjected the 18 items to item analysis. On the basis of the results he shortened the scale to 16 items.

From published information it is evident that the JSI has satisfactory reliability and validity; moreover the questionnaire is short and administering it takes up little time. For these reasons it was regarded as a suitable instrument for determining the job satisfaction of the subjects to decide whether they could be involved in this investigation or not. A cut-off point of 48 was decided on, which was the sum of the mean values of the individual items. In terms of this some 10% of the persons did not meet the set requirements and were not included in the investigation group.

Statistical procedures

The final test group consisted of 576 subjects, each of whom completed the SDS and the JSI. In the case of the sixty chosen occupations a minimum of two, and in some cases even three, PAQ analyses were carried out for each occupation. Following the testing, scoring and processing of the data an average score for each of the sixty occupations on each of the six SDS fields was available – as calculated from the obtained SDS results of the 576 subjects. On the other hand, for each of the sixty occupations there was also a score on each of the 13 overall dimensions of the PAQ – as obtained from the results of the PAQ analyses that had been carried out.

In the present study it was firstly attempted to evaluate the applicability of Holland occupational codes to South African occupations. The similarities were checked visually and t-tests were also used. Subsequently it was attempted to determine whether the occupations could be classified on the basis of their PAQ dimension scores in the six previously determined main occupational groups of Holland. For this purpose a discriminant analysis was carried out on the basis of the observed job dimension scores for every occupation. *Lastly* the linear relationship between the two sets of data were investigated by means of Pearson correlation coefficients and multiple regression equations to determine whether the PAQ dimension scores could be used to predict scores on the SDS personality dimensions.

RESULTS

Firstly it was ascertained to what extent the empirically determined occupational codes of the sixty South African occupations concerned corresponded with the Holland occupational codes that had originally been allocated in the United States of America.

When the sequence of the three letters in an occupational code was ignored, the original American Holland occupational codes and the South African empirically determined occupational codes were the same with regard to one letter in 60 (100%) of the cases; with regard to two letters in 52 (86.7%) of the cases; and with regard to all three letters in 24 (40%) of the cases.

When the sequence of the three letters in an occupational code was taken into consideration, the original American Holland occupational codes and the South African empirically determined occupational codes corresponded with regard to their first letters in 34 (56,7%) of the cases; with regard to their first two letters in 11 (18,3%) of the cases; and with regard to all three of their letters in 7 (11,7%) of cases. Better results were therefore obtained by ignoring the sequence of the letters in an occupational code than by taking them into account.

Subsequently it was determined whether the incumbents could be classified on the basis of their mean empirically observed SDS scores in the thirty previously determined suboccupational groups (two letter codes according to the Holland model). As no purely AC, AR or CA occupations could be found in the case of the present sample, only 27 of the actual 30 suboccupational groups were represented in this case.

When the sequence of the letters in a two-letter code was ignored the original American suboccupational codes were the same with regard to one letter in 26 (96,3%) of the cases and with regard to both letters in 9 (33,3%) of the cases.

When the sequence of the two letters in a suboccupational code was taken into consideration, the original American suboccupational codes and the South African empirically determined suboccupational codes corresponded in respect of their first letters in 18 (66,7%) of the cases and in respect of both their letters in 6 (22,2%) of the cases. Better results were therefore obtained by ignoring the sequence of the letters in a suboccupational code than by taking them into account.

It was also determined whether the incumbents could be classified on the basis of their empirically observed SDS scores in the six previously determined main occupational groups of Holland (R, I, A, S, E, C). With regard to each main occupational group significant differences were found, by means of t-tests, between the calculated means of the incumbents of jobs who had been classified into that occupational group and the incumbents who had not been classified into that specific occupational group. Particularly good results were therefore obtained by attempting to distinguish the six occupational groups on the basis of the incumbents' empirically observed SDS scores. These results appear in Table 1.

Subsequently it was determined by means of discriminant analysis whether the occupations could be classified on the basis of every occupation's obtained PAQ dimension scores in the six previously determined main occupational groups (R, I, A, S, E, C).

In order to bring the number of variables (13) into a better ratio to the number of observations (10) for each main occupational group, with a view to carrying out a discriminant analysis, it was decided to leave out job dimensions that had the lowest discriminatory value between occupational groups. Analysis of variance (ANOVA) was subsequently carried out

to obtain information on the discrimination value of each of the 13 job dimensions. On the basis of these results it was decided to make use of the seven job dimensions that could at least at the 10% level identify significant differences between the six main occupational groups in further processings.

The data should meet certain requirements before a multivariate discriminant analysis can be carried out (Betz, 1987; Du Toit & Stumpf, 1982). The requirements in question are the following:

- The data set should be derived from a multivariate normal population;
- with equal subgroup covariance matrices; and
- the subgroups should be a collections of independent data sets.

With regard to the present data set it is accepted that it originates in a multivariate normal population although the subgroups contain fewer than thirty observations – as is always the case for the central limit theorem. The subgroups are also independent as presupposed by premise (iii), as every observation is limited to one particular group only. In order to check the equality of the covariance matrices, a chi-square test was carried out. This yielded a value of 242,73 with 140 degrees of freedom ($p < 0,01$). As the chi-square value is significant, a linear discriminant analysis was not desirable (Thabachnick & Fidell, 1983) and consequently a quadratic discriminant analysis was carried out that made use of separate covariance matrices. The results of the classification made on the basis of this analysis are shown in Table 2.

TABLE 2
DISCRIMINANT ANALYSIS CLASSIFICATION
OF THE SIXTY OCCUPATIONS

Original main occupational group classification	Classification on the basis of PAQ data						Total
	R	I	A	S	E	C	
Realistic	9	0	1	0	0	0	10
Investigative	0	9	1	0	0	0	10
Artistic	1	0	7	1	0	1	10
Social	0	0	0	9	0	1	10
Enterprising	0	0	0	0	10	0	10
Conventional	0	0	0	0	0	10	10
Total	10	9	9	10	10	12	60

The results in Table 2 show clearly that the poorest classification occurred in the case of the Artistic group, in which only seven of the ten posts (70%) had been placed correctly according to their job dimension scores. Particularly good results were therefore obtained by classifying occupations on the basis of their PAQ dimension scores according to Holland occupational codes and the conclusion can be reached that this is data in respect of six clearly different occupational groups.

TABLE 1
RESULTS OF T TESTS FOR EACH MAIN OCCUPATIONAL GROUP

Occupational group	n	Relevant occupational group		n	Non-applicable occupational group		t	Degrees of freedom
		\bar{X}_1	sd		\bar{X}_2	sd		
R	99	30,40	7,20	477	16,79	10,30	15,77*	574
I	98	26,37	11,04	478	19,02	9,21	6,17*	574
A	90	27,69	8,56	486	14,83	8,99	12,56*	574
S	98	30,98	7,78	478	25,54	7,86	6,26*	574
E	89	26,60	10,24	487	21,55	8,93	4,79*	574
C	102	27,70	6,75	474	19,63	7,99	9,48*	574

* $p < 0,01$

In order to develop a model for predicting the Holland occupational codes by means of job description information, the linear relationship between the obtained PAQ dimension scores of an occupation and the means of each of the six SDS personality dimensions for that occupation had to be checked. In order to investigate the relationship between the obtained PAQ dimension scores and the means of each of the six SDS personality dimensions of an occupation, Pearson correlation coefficients were calculated. A stepwise multiple regression analysis was conducted with the mean scores on each of the six SDS personality dimensions as dependent variables and the 13 overall PAQ dimension scores as independent variables so that the variables that played the most useful role in the prediction could be determined. This was done by using the F-test to investigate the significance of the increase in variance from the first to the last step of the model (Pedhazur, 1982).

If an increase in variance between the first and last step of the model is found which is significant at least at the 5% level of confidence, one continues by comparing the following equation (Step 2) with the last step. This procedure is repeated for the subsequent steps until that specific step (regression equation) is found whose variance does not differ significantly from the last equation. By following this approach a specific regression equation is therefore identified as the cut-off point for each of the six SDS personality dimensions (see Table 3). The specific regression equations as obtained at every particular cut-off point ($y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$) are reported in Table 4.

TABLE 3
CUT-OFF POINTS IDENTIFIED FOR THE
PREDICTION OF THE SIX SDS FIELDS

SDS field	R ² (13 dimensions)	Chosen equation Step	R ²	F
Realistic	0,7075	5	0,5749	14,61*
Investigative	0,4656	3	0,3724	11,08*
Artistic	0,4867	4	0,4032	9,29*
Social	0,4602	5	0,3897	6,90*
Enterprising	0,6317	5	0,5503	13,22*
Conventional	0,5709	5	0,5322	12,29*

* $p < 0,001$

TABLE 4
REGRESSION EQUATION FOR EVERY SDS FIELD

PAQ dimension	beta-coefficients of SDS occupational groups					
	R	I	A	S	E	C
1		3,225	5,611			-2,480
2	3,663	2,020				-2,382
3				-2,902	-3,800	
4		3,234				
5	-5,845		5,326	2,678		
6				-0,991	-1,272	1,845
7						
8	4,705					
9				1,905	1,551	
10	1,895				3,226	2,638
11			2,175		2,065	1,248
12						
13	-3,064		4,875	2,579		

Constants:
2119,151 1988,803 1744,290 2643,424 2130,215 2070,174

By using the empirically obtained PAQ dimensions of each occupation and these calculated regression equations in respect of every occupational group, predicted SDS scores for each of the sixty occupations were calculated and the SDS code concerned was determined on the basis of the three highest scores. Subsequently the similarities that occurred between

the empirically determined occupational codes and the codes that were obtained by means of the regression equations were investigated.

Table 5 shows a summary of the similarities that occur between these two sets of data when the sequence of the three letters in an occupational code is ignored.

TABLE 5
SIMILARITIES BETWEEN EMPIRICALLY DETERMINED
AND PREDICTED OCCUPATIONAL CODES (SEQUENCE
OF THE THREE LETTERS IGNORED)

Occupational group	The same three letters	Two letters the same	One letter the same	n
R	3	7	0	10
I	4	4	2	10
A	4	4	2	10
S	6	4	0	10
E	5	5	0	10
C	6	3	1	10
Totals	28	26	6	60

When the sequence of the three letters in an occupational code was ignored, the South African empirically determined occupational codes and the occupational codes that were obtained by means of the regression equations were the same with regard to one letter in 60 (100%) of the cases; with regard to two letters in 54 (90%) of the cases; and with regard to all three letters in 28 (46,7%) of the cases.

Table 6 shows a summary of the similarities that occur between these two sets of data when the sequence of the three letters in occupational codes was taken into consideration and consequently had to be the same.

TABLE 6
SIMILARITIES BETWEEN EMPIRICALLY DETERMINED
AND PREDICTED OCCUPATIONAL CODES (SEQUENCE
OF THE THREE LETTERS THE SAME)

Occupational group	First letter the same	First two letters the same	All three letters the same
R	7	6	2
I	3	1	1
A	3	3	3
S	8	3	2
E	3	3	2
C	6	5	3
Totals	30	21	13

When the sequence of the three letters in an occupational code was taken into consideration, the South African empirically determined occupational codes and the occupational codes that were obtained by means of the regression equations corresponded with regard to their first letters in 30 (50%) of the cases; with regard to their first two letters in 21 (35%) of the cases; and with regard to all three of their letters in 13 (21,7%) of the cases. Better results were therefore obtained by ignoring the sequence of the letters in an occupational code.

DISCUSSION

The differences between the empirically determined occupational codes and the original American Holland occupational codes of the sixty occupations can be ascribed to various causes. It should be remembered that the American Holland occupational codes do not necessarily apply unchanged to South African occupations. Empirically the South African code for an occupation can therefore differ from the overseas code. In addition the number of persons per occupation who were involved in this study was small (about ten) and this too,

could have influenced the occupations' mean SDS scores, on which the empirical occupational code is based. The conclusion can therefore be reached that care should be taken with the use of American Holland occupational codes in the South African context as it would seem that unchanged they are not necessarily applicable to South African conditions.

By using suboccupation groups (two-letter codes), better results were obtained than in the case of the first-mentioned results where the individual occupational codes were compared with one another. In the case of the suboccupation groups the differences that occur between the two sets of data can be ascribed to mainly the same reasons as in the case of individual occupations. However, it appears that according to the present results the different suboccupation groups can to some extent be classified on the basis of the mean empirically observed SDS scores of the incumbents. Consequently these findings tend to support the Holland model and its applicability to South African occupations. Care should nevertheless be taken with the use of American Holland occupational codes in the South African context as it would seem that unchanged they do not necessarily apply to South African conditions.

Subsequently it was ascertained that the incumbents in the six previously determined main occupational groups (according to the Holland model) can be classified on the basis of their empirically observed SDS scores and that this was data on six clearly different occupational groups. These findings lend positive support for the Holland model and its applicability to South African occupations.

The sixty occupations involved in this investigation could to a great extent be classified into the six previously determined main occupational groups of Holland if only each occupation's obtained PAQ dimension scores were used. By therefore using job analysis information instead of occupational or personal information, the six different occupational groups of Holland could still be classified and the conclusion can be reached that this is data on six clearly different occupational groups. These findings lend further positive support to the Holland model and its applicability to South African occupations. They also illustrate how useful the PAQ is in making a clear distinction between different occupational groups. Although incumbents in the six previously determined main occupational groups (according to the Holland model) could be classified on the basis of their empirically observed SDS scores, it does appear from the results of this investigation that care should be taken with the use of American Holland occupational codes in the South African context as it would seem that, unchanged, they do not necessarily apply to South African conditions.

By means of regression equations (as developed from the empirically determined SDS codes) and the obtained PAQ dimension scores, SDS codes were developed that generally compare very well with the empirically determined SDS codes. Subsequently a relationship exists between the obtained PAQ dimension scores of an occupation and the means of each of the six SDS personality dimensions for that occupation. PAQ personality dimensions can therefore be used to draw conclusions on the desired personality dimensions in the case of a specific occupation.

From the above it can be concluded that job dimension scores may be used to predict personality dimensions and this link between information about the world of work and the individual has far-reaching implications in practice. The utility value in the case of personnel selection and placement, career planning and occupational guidance is that the link between a person and an occupational field can be made more easily and also more scientifically.

The regression equations that were compiled, should be extended in the course of time when details concerning a greater number of jobs and incumbents become available. However, the present results are so positive that they can be regarded

as useful for the praxis. Such comparisons undoubtedly have wide application possibilities in various fields and can greatly increase the scientific nature of vocational counselling and personnel selection.

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