Philippine Journal of Psychology
1979, Volume 12, No. 2, pp. 17-24

A VALIDATION OF HOLLAND'S OCCUPATION MODEL BY THE SMALLEST SPACE ANALYSIS

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This study re-validated the hexagonal model of occupations developed by John L. Holland through use of Smallest Space Analysis, a technique which graphically shows a geometric structure in a body of data. The fit between theory and observation was determined by examining the "internal" and "external" aspects of the model. The application of SSA confirms, in varying degrees, the internal and external consistency of Holland's model. Results and discussion further shed light on the study's contribution in providing an independent line of evidence different from, although consistent with, previous attempts to verify Holland's occupation scheme.

Much has been written on the nature of occupations, within and between cultures, in part due to their universal importance and to the ease with which they can be ordered, classified, and compared. For instance, despite the cultural variability of six industrial countries, Inkeles and Rossi (1956) demonstrated high similarities in occupational prestige as measured by surveys of popular opinion More notable perhaps is the growing body of research in the area of vocational preference. A representative case is that of Holland (1969, 1973) who has argued for a "closed" system of classifying occupations, according to their personality requirements at least. He posits a hexagonal model (Figure 1), an ideal type, by which the personality of most job seekers in a western culture may be categorized: Realistic [R], Investigative [I], Artistic [A], Social [S], Enterprising [E], and Conventional [C].

The realistic type is active and aggressive, one who has "preference for activities that entail the explicit, ordered, or systematic manipulation of objects, tools, machines, animals, and to an aversion of educational or therapeutic activities" (Holland, 1973:14). This person prefers occupations such as that of a mechanic, electrician, engineer, forester, and tool designer, among others.

The investigative type is task-oriented and somewhat asocial. He has "preference for activities that entail observational, symbolic, systematic, and creative investigation of physical, biological, and cultural phenomena that leads to the understanding and control of such phenomena" (Holland, 1973). He chooses occupations such as that of an astronomer, biologist, chemist, and zoologist.

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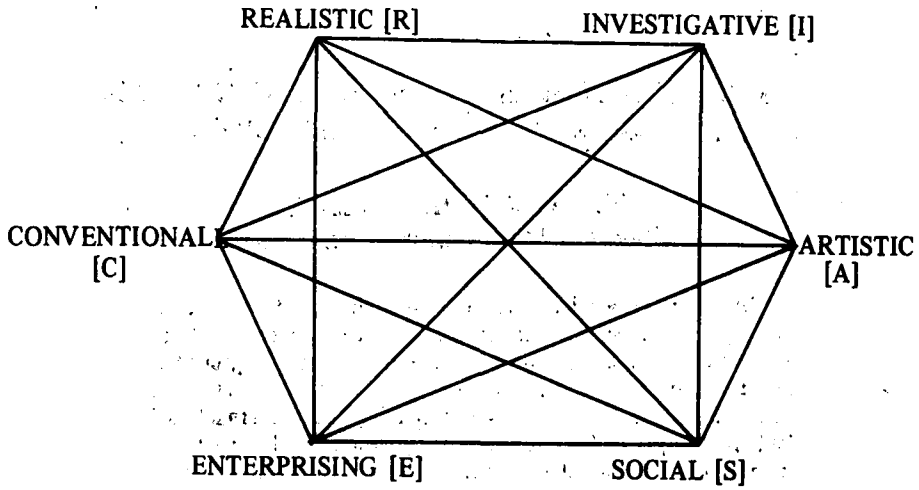

Fig. 1: *Holland's Hexagonal Configuration of Personality Types*

Note: Not exactly drawn according to scale. Original illustration, in tracing paper, is with the author.

The artistic type is concerned with the expression of his feelings and thoughts. He is also asocial, and avoids highly structured tasks or those which require physical skills. This person has "preference for ambiguous, free, unsystematized activities that entail the manipulation of physical, verbal, or human materials to create art forms or products" (Holland, 1973). His vocational interests include such occupations as that of a composer, writer, musician, and symphony conconductor.

The social type has "preference for activities that entail the manipulation of others to inform, train, develop, cure or enlighten; and an aversion to explicit, ordered, systematic activities involving materials, tools or machines" (Holland, 1973). Often he finds himself in a helping occupation such as that of a social worker and teacher, if not as a missionary or counselor.

The enterprising type enjoys selling and other risky or ambiguous activities that allow him to compete with others. He has "preference for activities that entail the manipulation of others for organizational goals or economic gain and an aversion to observational, symbolic, and systematic activities" (Holland, 1973). This individual likes to engage in occupations such as that of a salesman, executive manager, and political manager.

Lastly, the conventional type seeks "activities that entail the explicit, ordered, systematic manipulation of data, such as keeping records, filing materials, reproducing materials, organizing written and numerical data according to a prescribed plan, operating business machines and data processing machines to attain organizational or economic goals; and an aversion to ambiguous, free, exploratory, or unsystematized activities" (Holland, 1973). He tends to select occupations such as that of a clerk, bookkeeper, and financial analyst.

Holland's geometric model, as portrayed, suggests one key proposition: that of consistency among the types. For example, realistic-investigative personalities have more in common than the conventional-artistic. Thus, the adjacent categories are the most consistent types, and the opposite categories the least consistent, since the physical distance among

the types are inversely proportional to the magnitude of their correlations.

However simple the model may be, the calculus imbedded in its distance-correlation correspondence is a complex one to prove. The literature abounds in attempts to validate the hexagonal structure. Not all of them can be catalogued here although some citations may be made. Holland and associates (1969; 1973) tested the model earlier, utilizing correlational analysis between and among the types. Williams (1972), through the use of discriminant analysis, validated it in relation to some independently developed measures of values. More recently, the works of Smart (1976) and Turner (1977) offered additional evidence of validity for the model. The most promising test is perhaps the one done by Nafziger and Helms (1974) which compared Holland's theoretical grouping with the results of an empirical grouping of occupations to see whether an agreement existed between them as hypothesized.

Although proven valid, something more needs to be done to fully demonstrate the isomorphism between Holland's theory and a body of data. The contention of this paper is simple and straightforward. The assumption of consistency, or agreement, needs to be shown in two facets: "internal" and "external." Internal consistency refers to the degree by which particular occupations are actually classified as such, according to their presumed group membership. One would expect, for instance, that the occupation "lawyer" (theoretically regarded as enterprising) should belong to the E-type of occupations.

External consistency, on the other hand, is the manner by which various occupations, as a group, form a hexagonal system. Thus, [R] occupations should lie midway between [C] and [I], but opposite [S]; [A] midway between [I] and [S], but opposite [C]; and so on, in the manner following the contours of the model.

Because the Holland model is essentially geometric and configurational, there is a need for a technique of analysis sensitive to and capable of portraying a geometrical structure in a set of occupational data, if one is to make an optimal assessment of its validity. The goal of this paper is along the groove of this logic, utilizing a more parsimonious, graphic technique of data reduction called Smallest Space Analysis.

METHOD

Data.– The data used are intercorrelations for some 45 occupations rated according to the Strong Vocational Interest Blank (SVIB) in 1927 and 1971 (Campbell, 1971). These occupations represent about half, 45 for 1971 and 46 for 1927, of the occupational titles originally analyzed by Campbell. The attrition arose from efforts to match similar occupational titles for both periods as close as possible. It was felt that the SVIB occupational scales, for which two correlational matrices are available, were sufficient for this analysis. More of this kind of data derived from independent sources, however, would certainly add strength to the results presented here.

Procedure.– For purposes of testing the "internal" consistency hypothesis of Holland's model, each of the occupational titles was assigned a three-letter code (Holland, 1973). For example, a lawyer is theoretically categorized as [EAS], that is, he is enterprising first, artistic second, and social last. Weights of 3, 2, and 1 were assigned to each occupation according to the degree of consistency between the theoretical grouping and the actual classification. That is, an empirically classified occupation was rated 3 points if its first letter code agreed with its theoretical grouping; otherwise, lesser points were assigned if only the second or third letter code matched with it. Then, the points were summated and expressed into a mean average score for all occupations falling under a particular classification or group.

Technique of Analysis.– The two matrices of correlation were separately submitted to the Smallest Space Analysis routine for symmetrical data, briefly termed SSA-1. (Analysis was performed at the University of Hawaii Computer Center.) Writers (Schlesinger & Guttman, 1969; Bloombaum, 1970) describe SSA-1 as a technique which maps out variables, in this case occupations, as points in a Euclidean space diagram, whose distances to one another are inversely proportional to their degree of correlations. According to this principle, two or more points which are positively intercorrelated will "hang" together in space; negatively intercorrelated points will spread out in polarized manner. The higher their positive correlations, the closer they will be in a space diagram. Violation of, or conformity to, the relationship between distance and correlation shows up in the "goodness" of data fit. The coefficient of alienation, as the fit is more technically called, will register values ranging from 0 (perfect fit) to 1. As a rule of thumb, the lower the coefficient, the more acceptable the fit.

Other than the assumption of monotonicity just described, SSA-1 imposes no explicit requirement on the nature of the data (which a particular correlation does). Neither does it specify the number of dimensions through which the data may be adequately portrayed. SSA-1, as its name implies, finds the minimum number of dimensions (smallest space) enough to depict the data with a meaningful and interpretable structure. A one-dimensional solution simply lines up the occupations as series of points along a single axis. A two-dimensional solution shows them on a plane as having the structure consisting of two axes perpendicular to each other. More complicated and, hence, less visualizable is a three-dimensional configuration which adds a third axis to a square, making it now a cube. There is no hard and fast rule defining the acceptable number of dimensions, but the more parsimonious configuration (line or square) with a sufficiently low coefficient of alienation is preferred.

Since the Holland model is hexagonal, a two-dimensional SSA-1 would seem adequate as its test of validity. If the empirical grouping of occupations emerges consistent with the theoretical classification, and if the spatial structure corresponds to the hexagonal model as theorized, then the model is said to possess validity. It must be stated that in SSA the configuration of points is invariant to rotation; no matter where the axes are drawn, the total structure remains unchanged. This property makes the technique even more suitable in the present validation exercise, not to mention SSA's obvious simplicity. Reading its results does not call for deep statistical background or special knowledge of quantitative analysis on the part of readers. Such knowledge, however, is an added leverage to quick understanding of the data.

RESULTS

Application of SSA-1 showed that two dimensions would yield a tolerably good data fit, the coefficients of alienation being 0.18 for the 1927 data and 0.10 for the 1971 data. (Coefficients of alienation for one dimension are 0.39 for 1927 and 0.35 for 1971; for three dimensions, the coefficients are 0.08 and 0.06, respectively.) The configuration of points, therefore, can be adequately represented in a plane, whose distances have been faithfully preserved relative to the magnitude of their intercorrelations.

To facilitate reading and interpretation of results, dashed lines were drawn around those occupations which theoretically belong together, thereby partitioning the space into appropriate regions. Each group or type was then labeled [R], [I], [A], [S], [E], and [C], following the model. Fitting the theoretical classification with the empirical grouping forms a hexagon, congruent with the hypothesized structural arrangements of the various occupations. And second, each

occupation was rated on a scale of 1 to 3, as discussed previously, and the average score taken for each group to find out how well the two kinds of classification – one is empirical and the other, theoretical – closely agree with each other.

The 1972 SVIB occupations, mapped out in space, appear as a circular pattern in almost quite the same way as does the hexagonal scheme (Figure 2). Their spatial structure indicates an exact ordering of the hypothesized occupational types, with the slight exception of the conventional and enterprising groups which are so contiguous to each other that they render interpretation extremely difficult. Although not as neat as the ideal hexagon, the result generally lends support to the validity of the Holland model.

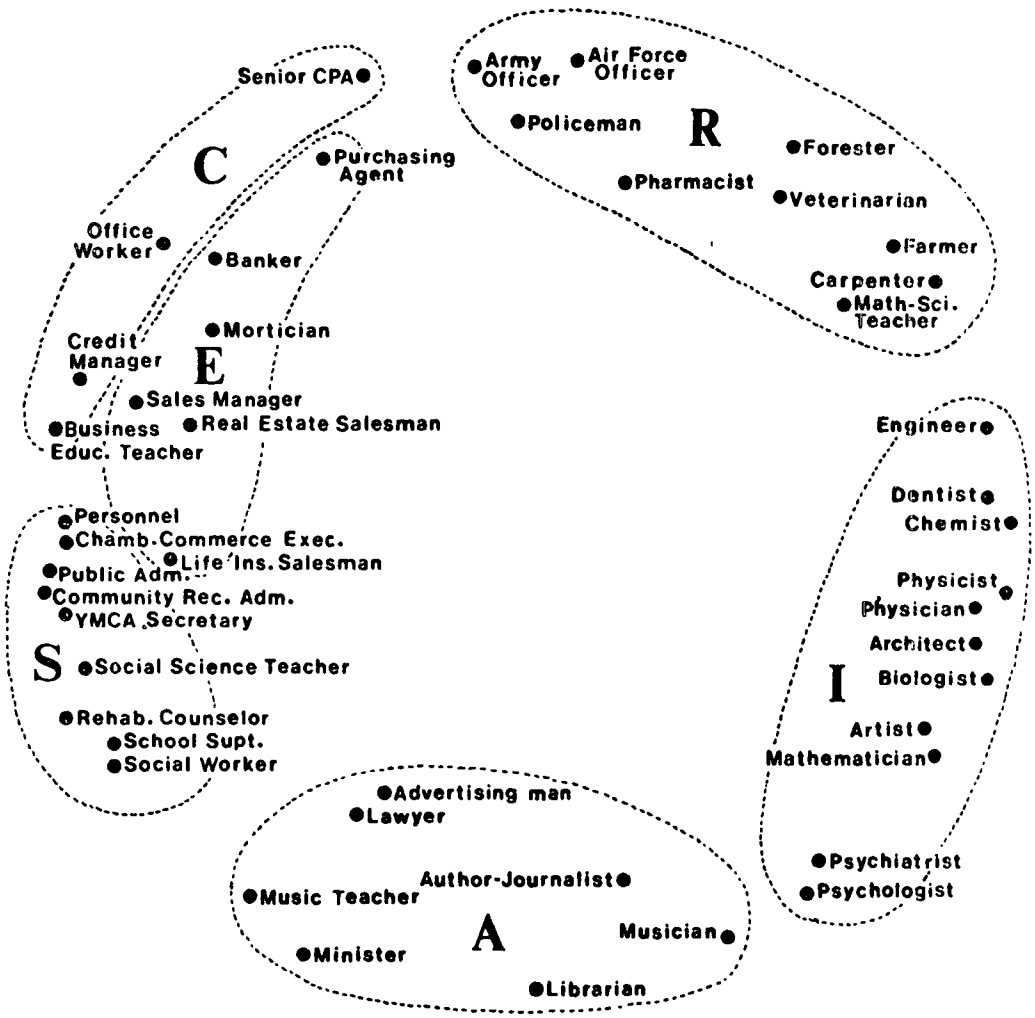

Fig. 2: TWO-SPACE DIAGRAM OF 1927 SVIB OCCUPATIONS, CLASSIFIED INTO HOLLAND'S SIX PERSONALITY TYPES (COEFFICIENT OF ALIENATION = 0.18; N = 46 OCCUPATIONS)

Examining closely the individual membership of each type, one discerns a substantially good agreement between the empirical and theoretical classifications. By far, only one occupation (pharmacist) has fallen completely out of place. None of its three-letter code [IES] matched with [E] occupations where it is found. Another occupation (math-science teacher), also found in this category, is somewhat misplaced. Only its last letter code [ISR] agrees with this occupational group. Seven other occupations for 1927 are slightly misfit, with their second letter code showing concordance with their actual groupings. These are artist [AIR], architect [AIR], minister [SAI], and mortician [SEC?]. Overall, deviations of this sort attenuated the average score of [R] to 2.11 (maximum is 3.0), as compared to I = 2.81, A = 2.57, S = 2.88, E = 2.83, and C = 3.0.

The data structure for 1971 occupations also generally substantiates the hexagonal hypothesis (Figure 3). Much like the 1927 data, it exhibits spatial commonality with respect to the conventional and enterprising types. This finding strengthens the suspicion that the [E] and [C] types are hardly distinguishable from each other in an empirical sense. In the language of factor analysis, these two groups of occupations may belong to the same underlying factor or component.

Shifting now the attention to the individual occupations within types, again only one occupation (still pharmacist) turned up to be totally misplaced as it did in the 1927 data. Another seemingly "deviant" occupation (purchasing agent) got its last letter code [ESC] agreeing with the [C] group where it is actually situated. Eight other occupations are slightly misfit, but it is gratifying to note that their second letter codes are consistent with their empirical classifications. These are veterinarian [IRS], air force officer [IRC], army officer [IRC], architect [AIR], librarian [SAI], lawyer [EAS], public administrator [ESC], and funeral director [SEC]. The average scores of the types are as follows: R = 2.25, I = 2.9, A = 2.71, S = 2.9, E = 2.8, and C = 2.5. In summary, these figures provide an independent line of evidence corroborating the validity of Holland's occupational scheme.

DISCUSSION

This study began with the premise that the Holland's hexagonal model of occupations stands further validation through use of another technique, SSA-1, which depicts a geometric structure in the data. The method of data reduction chosen is particularly germane, for it offers a parsimonious and straightforward analysis of whether occupations, in fact, behave according to prediction of the hexagonal hypothesis. The application of SSA-1 focused separately, and simultaneously, on two important aspects of the consistency proposition generated from Holland's model. First, the model's external consistency, that is, whether the empirical grouping of occupations would align with the hexagonal arrangements of occupations as theorized was exploited. And secondly, with the method, the internal consistency of the model was tested shining the degree of agreement between individual occupations in terms of their conceptual and actual group memberships.

Results yielded an optimal measure of validity for the Holland hexagonal model, and revealed new information apart from those already known in the literature. The analysis calls attention to deviant occupations, particularly pharmacist, and to some extent, math-science teacher and purchasing agent. The following questions are raised by these findings: Are their memberships in the groups to which they were found spurious, or are their theoretical classifications faulty? Could not these occupations be reclassified in order to bridge the gap between theory and reality?

Another interesting fruit gained from this study is the knowledge that the conventional and enterprising types, no matter how elegant these concepts may be, are in fact difficult to isolate from each other. The possibility lurks that they are subtypes of an overarching occupational group. While the number of occupations analyzed for the [E] and [C] types are too few to warrant conclusive statements, the total evidence uncovered in this investigation is nonetheless attesting enough to enhance the utility of the Holland model.

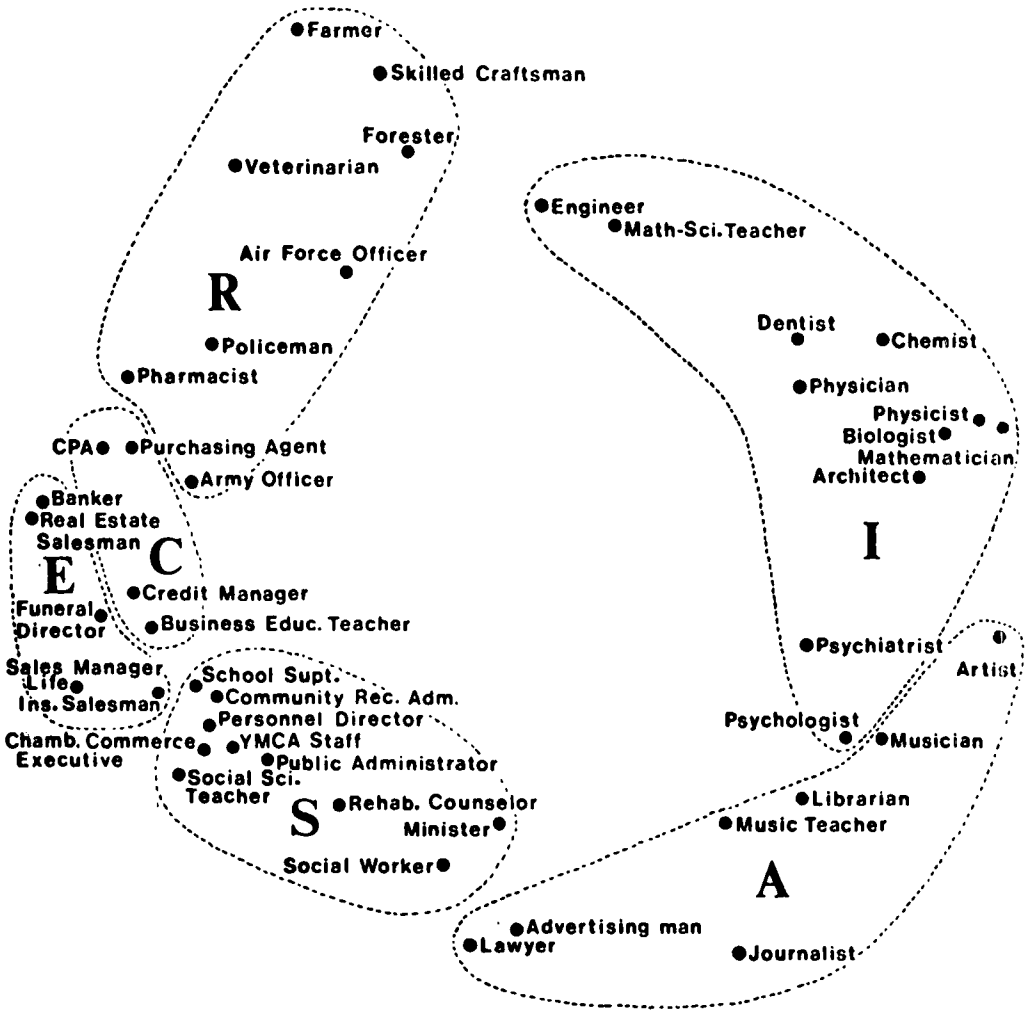

Fig. 3: TWO-SPACE DIAGRAM OF 1971 SVIB OCCUPATIONS, CLASSIFIED INTO HOLLAND'S SIX PERSONALITY TYPES (COEFFICIENT OF ALIENATION = 0.10; N = 45 OCCUPATIONS)

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